

DEVELOPING AN EDUCATIONAL RESOURCE FOR INCREASING LONG-  
TERM RETENTION OF CEREBELLAR CIRCUITRY AND PATHWAYS  
IMPLEMENTING THE PRINCIPLES OF ENDURING  
UNDERSTANDING

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## DEDICATION

Thank you to my family and friends whose consistent support and positive encouragement helped strengthen the project and hasten its completion.

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by

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Abstract

This thesis focuses on implementing the educational model of enduring understanding as it applies to the visual arts and neuroscience. The thesis was designed around developing an interactive web-based flash program intended to aid in medical students' retention of cerebellar circuitry at specific instances in their medical education. It focused on the visual and textual

organization laid out within the principles of enduring understanding. By using the first two facets of enduring understanding, explanation and interpretation, the program was designed to teach medical students about the cerebellum's structure and function. Both facets provided a framework for the organization of the text and design of the illustrations, two and three-dimensional animations and questions sections. Testing was performed on medical students at varying levels in their medical education for gaps in knowledge and usefulness. These groups included first, second, and fourth year medical students, as well as residents. Further research will test the programs effect on students' efficiency and aptitude. Such testing will demand medical students' involvement over four years of schooling to determine the programs full efficacy.

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## LIST OF DEFINITIONS

No definitions

## **CHAPTER ONE**

### **Introduction**

#### **RESEARCH QUESTION**

Can an interactive program be designed to specifically aid medical students' retention and recall of cerebellar circuitry at specific points in their medical education?

#### **GOALS & OBJECTIVES**

The project goal was to produce an interactive web-based flash program to aid in medical students' retention of cerebellar circuitry at specific instances in their medical education. The program would be usable in sequential steps during a student's medical education: during the first year neuroscience course, as a helpful guide during their boards, and finally as an aid during residency. The main objective is to provide students with clear, easily understandable, base visuals functional in a variety of levels of informational content. Likewise, it should describe cerebellar circuitry and pathways with comprehensive user-controlled interactive diagrams. Also, it should contain a more logical diagram and 3D model of cerebellar circuitry for study and clarity of dimensionality than are currently available.

## **AUDIENCE**

The program is intended for medical students at varying levels during their medical education. The target audience can be broken into three specific groups. The first target group is medical students taking medical neuroscience for the first time during their first or second year of medical school. Such a group of students would have either a basic or limited understanding of neuroanatomy and physiology. The second target group is students reviewing the information for their boards during the summer after their second year of medical school. This group would need a program designed for study but also to serve as a refresher to major information vital to their upcoming exams. The third target group is medical residents beginning in neuroscience and neuropathology residencies and requires a program which concisely expresses the information necessary to make clinical correlations to specific pathology and disease.

## **BACKGROUND**

The rigors of medical school can prove a challenge to even the most equipped students. In today's top medical programs, students are expected not only to know more information than in the past, but know it quicker, and in greater detail. Students are required to make large scale clinical inferences about course material to succeed. Presented with such obstacles many students are overwhelmed. In



one medical school study, it was found that“...students have too few cognitive resources to optimally retrieve information from long term memory, which may seriously hamper learning” (van Hell et al 835).

Given these challenges, some schools are trying a new approach to learning referred to as enduring learning. Guised under multiple names from “enduring learning” to “unit based correlative visual frameworks,” the concept remains the same — identification of key concepts and consistent visualization is crucial. One such school adding the concept of enduring learning to its curriculum is the Mayo Clinic. In the Mayo Clinic M. D. curriculum objectives, enduring learning and an understanding of core competencies are listed as one of their primary purposes (Mayo 1).

Presently multiple programs are in circulation which provide students with basic neuroanatomical information, but many of these programs fail to provide information for continued learning, or lack core concepts. None yet exist which implement the concept of enduring learning style into the structure of their program.

Prior to the development of the program, the core objectives had to be identified. The core concept of the cerebellum was determined based on the current medical

neuroscience course syllabus objectives. These objectives were adequately structured to handle the needs of the enduring-learning style. Upon completion of the program the medical student will be able to:

1. Name the major internal and external cerebellar cortical structures including: hemispheres, tonsils, flocculus, nodulus, and vermis, as well as midsagittal and parasagittal structures.
2. Properly identify the cerebellar peduncles and their specific afferent and efferent projections.
3. Identify the three layers of the cerebellar cortex, name which cells lie in each area, and describe how these cell types interact.
4. Identify specific cerebellar cortex cells.
5. Describe which cell types carry information to and from the cerebellum.
6. Identify the three major functional divisions of the cerebellum and be able to describe their afferent and efferent pathways.
7. Determine functional deficiencies determined by abnormalities to the structures previously described.

## **SIGNIFICANCE**

This project is concerned with the amount of information forgotten and lost by medical students during their years of education. We hope to provide a supplement to the current syllabus that would aid in increasing students retention of information on the cerebellum and decrease cognitive load.

There are many resources available to students to assist in learning about the cerebellum, from three-dimensional models of the brain to cortical dissection slides. None of the programs combined the information from multiple levels of education to create one cohesive understanding of the cerebellum. This program offers a consolidated visual focus incorporating many different available resources as well as concise information to aid in recall and recovery during study.

The current images and interactive programs available to the student, either through the library or online provide information on basic neuroanatomy and slides with minimal activity and no further application. Some of these programs provided quiz sections. Unfortunately though, these quiz questions tested only basic anatomical structures. We hope to crease a program which would provide

information related to core principles on the cerebellum and its functions and provide students with the foundation necessary to produce basic neuro-anatomical correlations no matter the chosen specialty later in their education. The program should provide the adequate amount of material to be useful to both early studies and future clinical application.

One other area missing from any of current programs was a section on the dimensionality of the cerebellar cortex cells. The intent of the program is to create such an expression by relating the three-dimensionality of specific cell types and their functionality to the Purkinje cell outputs and their relation to deep cerebellar nuclei.

#### Early Limitations

One of the limitations foreseen early in the project was the scope. Further study would have to be conducted later by the neuroanatomy program as to the effectiveness of the interactive program on one group over a period of four years. This would test the significance enduring understanding's effectiveness to medical education. The intention of this project was to create a model useable in testing, and to evaluate its efficacy on each individual group.

## **PROJECT PRESENTATION**

The final presentation method is an interactive web-based program designed to provide multiple methods of engaging the medical student during study. The interactive program includes illustrations, diagrams, movie clips, 3D animations and stills, and interactive questions. The textual information from the syllabus and accompanying textbook for the neuroanatomy class provided the backbone for the images and content which was included in two different spaces within the program. The main bar provided the most important information to a general understanding of the neuroanatomical concepts. Information included in the bottom bar was designated as advanced information and often included concepts beyond the knowledge necessary to gain a general perspective of the subject. The media was then compiled in Adobe Flash CS3 for final output as an .flv file. Here the content was given designated sections to guide the user and content tabs to provide easier reviewing.

## **PAPER ORGANIZATION**

The content of the paper is organized based on chronology in the developmental and creation process. The first chapter is an introduction, including the goals and objectives, the intended audience, significance, limitations to the scope, and the paper's organization. The second chapter is a review of the existing literature

pertaining to enduring learning and cerebellar circuitry providing information on the interactive and visual resources currently available in neuroscience pertaining to the cerebellum. The third chapter addresses the methodology used to design, create, and implement the program including the software used. The fourth chapter is an analysis of data from evaluations and testing done on the program's effectiveness. The fifth and final chapter concludes the paper and includes recommendations for further study.

**CHAPTER TWO**  
**Review of the Literature**  
**ENDURING UNDERSTANDING**

**Introduction and Interactive Programs in Medical Education**

The progress of educating and teaching in medical school can be painfully slow. Some critics question whether it is even changing at all from year to year. Hewitt states, “It is probably fair to say that most people do not see the field of education advancing at the same rate, or in the same disciplined fashion, as the field of medicine “(Hewitt 161). Yet some believe learning can be more efficient and enjoyable in future classrooms, but technology and computers access needs to play a central role (Hewitt 161).

The area of computer assisted learning has been heavily debated for years. In 2001, Greenhalgh noticed this emerging form of teaching through an enhanced learning style. She stated the use of computer assisted learning,

“...is inevitable. Individual lecturers and departments are already beginning to introduce a wide range of computer based applications, sometimes in a haphazard way. Planned and

coordinated development is better than indiscriminate expansion”

(Greenhalgh 40-41).

Computer assisted learning helps to provide multiple methods of presentation of material. Within a computer interactive the teacher can blend video clips, games, quiz questions, clinical correlations with informational content and provide a diversity of learning styles (Lujan and DiCarlo 14-5).

Another reason for medical educational difficulties is a lack of defined learning styles and an understanding of the content necessary for proper application.

Since medical students represent such a broad spectrum of ages, cultures, experience levels and ethnicities it is hard to limit an education to one method.

Lujan and DiCarlo define a learning style as “ the complex manner in which, and conditions under which, learners most efficiently and most effectively perceive, process, store, and recall what they are attempting to learn” (13). Knowing this allows teachers to become more cognizant of medical students’ needs and hopefully find effective ways to implement such styles, to teach concepts more effectively and promote better learning (Lujan and DiCarlo 14-5).



## **Enduring Understanding Principals**

One suggested learning style to change medical education comes from Amy Haddad, who believes teaching using the principles of enduring understanding can help medical students to not only possess knowledge appropriate to novel text but also to have the ability to reflect on their knowledge and put it into practice in the appropriate setting (Haddad 73).

“Like people in other design professions, such as architecture, engineering, or graphic arts, designers in education must be mindful of their audiences. Professionals in these fields are strongly client-centered. The effectiveness of their designs corresponds to whether they have accomplished explicit goals for specific end-users. Clearly, students are our primary clients, given that the effectiveness of curriculum, assessment, and instructional designs is ultimately determined by their achievement of desired learning. We can think of our design, then, as software. Our courseware is designed to make learning more effective, just as computer software is intended to make its users more productive”(Wiggins and McTighe 13).

Such statements provide the basis of enduring understanding. The concept was developed by Grant Wiggins and Jay McTighe in 1998 in the publication

Understanding by Design. Enduring understanding is defined as “the specific inferences, based on big ideas that have lasting value beyond the classroom” (Wiggins and McTighe 342). The core principles of enduring understanding are: defining the concepts and ideas, determine the main objectives of the course, decide what is worth remembering, establish transferrable knowledge across multiple skill areas, and choose essential ideas to the discipline at hand.

To better elaborate the principals toward which to determine what enduring concepts are, we break them into a few key objectives. First, enduring understandings are core concepts requiring overarching comprehension. They give meaning to concepts and importance to the facts at hand. They are usually concepts often misunderstood and requiring “uncoverage” yet are transferrable to other areas and topics. These principles would also provide a foundation for basic skills within which other information can be built upon and require a solidified foundation for optimal learning. For these principles to exist there must be six facets of understanding involved which offer a blueprint for uncovering the necessary objectives to a lasting teaching style: explanation, interpretation, application, perspective, empathy, and self knowledge. (Wiggins and McTighe 44-62)

The first facet, explanation requires “sophisticated and apt theories and illustrations, which provide knowledgeable and justified accounts of events, actions and ideas” (Wiggins and McTighe 85). Thusly, understanding requires not just knowledge of specific facts but a true ability to make inferences about a concept without specific rules or theories. Illustrations accompanying these texts, therefore, should be equipped to handle not just specific concepts within an area, but an application to the concept as a whole, allowing for broader applications. An evaluation of the current set of images available to students will be evaluated in the fourth chapter of this paper.

The second facet, interpretation is defined as “interpretations, narratives, and translations that provide meaning” (Wiggins and McTighe 88). The challenge presented to interpretation is to bring text to life, by having explanations and visuals to crystallize relationships with logically defensible concepts of a subject. Interpretations require solidified knowledge and a recall of the concept the student can be confident in (Wiggins and McTighe 90). Medical students therefore need the confidence not only to know a subject, but also to interpret its uses. The difficulty for the medical educator is to provide a student with these tools. Barker and Olson found in medical school such confidences to be crucial to medical education and that decreased scores can occur when a student lacks orientation and application (Barker and Olson 5).

The third facet, application, requires “the ability to use knowledge effectively in situations and diverse realistic contexts” (Wiggins and McTighe 92). Here, the student needs to be able to apply knowledge to a specific context. In this case effective use of skills would be application in a clinical setting. In the current structure of medical education, students have difficulty applying knowledge and half of them don’t have the necessary knowledge readily available in a clinical setting (van Hell 831).

The fourth facet, perspective, improves the student’s ability to have critical and insightful points of view on a subject (Wiggins and McTighe 94). Many medical educators can find difficulty having a student grow beyond repeatable knowledge to making examinations greater than the criteria they are being taught. Teachers need to foster the self-education process and supply instruments of clinical knowledge which can support analysis of a situation and reflection on current methods (Benini 14).

The fifth facet in enduring understanding is empathy. Empathy requires a person to understand another’s emotions and worldviews. Application of such knowledge allows for insight and a better understanding of the fourth facet, perspective (Wiggins and McTighe 98). Growth within empathy allows for

application in a clinical setting, another factor to what is lacking in earlier descriptions by van Hell.

The sixth facet is developing self-knowledge. Medical students need the ability to determine what they know and what they need to learn. Often within any educational setting the most common method to test such things is through assessment. Assessment allows the students to test their own knowledge and question their results. More often than not, though, teachers provide little quizzing before students are expected to perform on tests of large sectional knowledge (Wiggins and McTighe 98).

Using the principles of the six facets of knowledge we can then break down the best designs into those which are both engaging and effective. Engaging designs allow diverse learners to be energized, fascinated and provoked. Effective designs help learners to become more competent and productive, and provide engaging intellectual content which increases retention and speeds productivity (Wiggins and McTighe 195).

## THE BASICS OF THE CEREBELLUM

Neuroscience abounds with textual resources on the anatomy and functionality of the cerebellum. Two major educational resources on the cerebellum are Purves Neuroscience, and Kandel, Schwartz and Jessel's Principles of Neural Science. In this next section, I identify the important information to be provided within the interactive program, and describe the current information on the cerebellar anatomy, cerebellar cellular construction and its functional divisions.

### **Cerebellar Anatomy**

The cerebellum is one of the most studied regions of the brain. Its placement and positioning in the brain gives it clinical significance and functionality in initiation, coordination, learning, the execution of movements and posture. It is located posterior and dorsal to the cerebrum and overlies the brainstem being separated medially from it by the fourth ventricle. It is also covered superiorly by the tentorium cerebelli. The primary function of the cerebellum is to regulate motor error between intended and actual movement and send signals to either correct for or reduce such errors (Adelman 321).

The cerebellum can be divided into three anatomically distinct regions respective medial to lateral: the vermis, the intermediate and lateral portions of each hemisphere. The main blood supply for the cerebellum is received through the vertebral-basilar arterial system, which is a posterior projection of the circle of Willis (Kandel Schwartz and Jessell 834).

On the surface of the cerebellum are some functionally separate and clinically important subdivisions. Major external cerebellar structures include: the flocculi and nodulus, the brainstem, the cerebellar peduncles, the cerebellar tonsils, the folia, and the vermis.

The flocculi are a set of tufts of cerebellar parenchyma on either side of the brainstem. Along with the nodulus, these structures comprise the flocculonodular lobe which is closely associated with the vestibulocerebellum and is a relay for inputs from the vestibular nuclei (Purves 477-78).

The brainstem comprises the midbrain, pons, and medulla oblongata and is connected to the cerebellum via the cerebellar peduncles. There are three separate cerebellar pathways into the cerebellum via the brainstem, the superior middle and inferior cerebellar peduncles, which connect the cerebellum to the other parts of the central nervous system. The superior cerebellar peduncles, also known as the brachium conjunctivum, are almost entirely made up of efferent fibers leaving

the cerebellum. The middle cerebellar peduncles or brachium pontis contain only afferent axons coming from the neurons of the contralateral basal pons. The inferior cerebellar peduncles originate in the medulla oblongata and contain mostly afferent projections with small amounts of efferent projections (Purves 477-78).

The cerebellar tonsils or amygdaline nucleus lies on the inferior-medial aspect of each hemisphere near the midbrain. They are clinically relevant as they are centrally located near the fourth ventricle and growth or abnormality can cause blockage of CSF in the brainstem. The folia are external structures characterized by narrow parallel ridges looking like pages of a book or “leaves” and give the cerebellum its extensive surface area. The vermis is located on the midline of the cerebellum and is a worm like structure that separates the hemispheres. It contributes to proprioception and is concerned with regulating eye and proximal muscle movements (Purves 476-77).

Internally, the cerebellum can be separated into four paired deep nuclei: dentate nuclei, emboliform nuclei, globose nuclei and fastigial nuclei. The dentate nucleus is the largest of the four in humans and receives most of its projections from the cerebrocerebellum and therefore effects motor planning. The emboliform nucleus is paired with the globose nuclei and is called the interposed



nuclei. The interposed nucleus receives connections from the spinocerebellum and effects motor execution by connecting to the brainstem and motor cortex. The fastigial nucleus also receives input from the spinocerebellum and thusly effects motor execution. The fastigial nucleus is often difficult to view grossly (Purves 480-1).

### **Cerebellar Cortex Anatomy**

The cerebellum “constitutes only 10% of the brain but contains more than half of its neurons” (Kandel Schwartz and Jessel 832). The reason for its great collection of neurons is its broad surface area and thus widespread cortex. When viewed in cross-section, the cerebellar cortex can be separated into three distinct regions- the molecular layer, the Purkinje-cell layer, and the granular layer (Bear 558-59).

The outermost layer of the cerebellar cortex is the molecular layer. It contains the cell bodies of stellate and basket cells, which inhibit Purkinje cells. Stellate cells, called such for their star-like appearance, are a type of local interneuron which receives their input from parallel fibers. The other type of local interneuron in the molecular layer is the basket cell. It modulates a string of Purkinje cell bodies

as it wraps its axonal projections around the Purkinje cell bodies in a basket-like fashion. The only excitatory projections within this layer are granule cell axons called parallel fibers. These parallel fibers run parallel to the fanned distribution of Purkinje cell dendrites along the long axis of the folia (Adelman 321-25).

Beneath the molecular layer is the Purkinje cell layer. The only cell bodies contained within this layer are the Purkinje cells. Purkinje cells are the only source of outgoing signals from the cerebellar cortex. Their enormous dendritic trees are flattened into a single plane, running perpendicular to the long axis of the folium. This orientation allows for integration of large amounts of granular cell (via parallel fiber) signals (Brodal 310-11).

The deepest layer of the cerebellar cortex is the granular cell layer. Within this layer are the cell bodies of the Golgi cell, and granular cells. Golgi cells receive their inputs from within the molecular layer. The Golgi cell dendrites receive excitatory influences from parallel fibers which receive their signaling from granular cell bodies. The Golgi cell provides a feedback loop to the granular cell by extending axons back to granular cells and producing an inhibitory influence on granular cell signaling (Manto 8).

Inside the molecular layer are two other extensions from the deep cerebellar nuclei: climbing fibers and mossy fibers. Together they provide all of the afferent signaling entering the cerebellar cortex. Mossy fibers mediate graded information about movement's localization and proprioception due to their numbers in the lower granular cell layer. Mossy fibers also provide excitatory influence to the granular cells. Climbing fibers on the other hand provide information about movement errors directly to the Purkinje cells through a series of complex spikes. These direct connections are provided by the climbing fibers ability to climb the Purkinje cell and wrap around their dendrites like vines. It is believed these signals to the Purkinje cell will alter the long term interaction of Purkinje cells with mossy fibers indirect actions (Brodal 312).

### **Functional Divisions and Pathway Projections**

The circuitry of the cerebellum can be divided into two categories: afferent and efferent connections. Afferent connections involve the fibers entering the cerebellum via the peduncles and terminate in both the cerebellar nuclei and cerebellar cortex. Efferent connections involve the Purkinje cell axons leaving the cerebellar cortex and provide connections to portions of the motor cortex and descending pathways. The afferent and efferent projections of the cerebellum

can further be divided into the three functionally separated portions of the cerebellum: the spinocerebellum, the cerebrocerebellum and the vestibulocerebellum (Adelman 324-26).

The oldest developmental division of the cerebellum is the vestibulocerebellum or flocculonodular lobe. “It is the most primitive part of the cerebellum, appearing first in fishes...” (Kandel Schwartz and Jessell 834). It receives information from the vestibular semicircular canals, which provides a motional sense relating body and head position to gravity. The major vestibulocerebellar afferents come from the vestibular labyrinth and the vestibular nuclei by way of the inferior cerebellar peduncles. The major vestibulocerebellar efferents project back to the lateral, medial, and superior vestibular nuclei through same peduncle (Kandel Schwartz and Jessell 834).

The spinocerebellum is the next major division and can be subdivided into two major parts: the vermal portion (containing the fastigial nuclei) and the paravermal portion (including the emboliform and globose nuclei). The spinocerebellum provides information relating eye movements to centers of focus during head rotations. Afferent connections entering the cerebellum via mossy fibers provide fractured somatotopic information to the vermal and paravermal portions of the cerebellar cortex. The major spinocerebellar afferents collect in

the contralateral ventral (anterior) spinocerebellar tract and ipsilateral dorsal spinocerebellar or cuneocerebellar tracts and make their way to the spinocerebellum via the inferior and superior cerebellar peduncles. The major spinocerebellar efferent connections can be separated into the paravermal and vermal projections. Projections leaving from the paravermal lobe exit through the superior cerebellar peduncle and project to the contralateral cerebellum via the thalamus, and the ipsilateral rubrospinal tract. Efferents which leave through the vermal lobe travel through the inferior cerebellar peduncle and descend the ipsilateral vestibulospinal tract or the ipsilateral descending medial longitudinal fasciculus (Kandel Schwartz and Jessell 841-42).

The final and phylogenetically youngest division of the cerebellum is the cerebrocerebellum or neocerebellum. It was originally believed to be implicated in motor function but recently studies using fMRIs have shown it also has perceptual and cognitive functions involved in planning movement and evaluating sensory stimuli for action planning. Cerebrocerebellum afferents project from the contralateral inferior olive and the contralateral pontine nucleus and go through the middle and inferior cerebellar peduncles (Kandel Schwartz and Jessell 846).

## **Cerebellar Peduncles**

The cerebellum is connected to the rest of the central nervous system via the cerebellar afferents of the brainstem. These connections convey information from the cerebral cortex, brainstem and peripheral nervous system to the cerebellum via one of three peduncles: the inferior cerebellar peduncles, middle cerebellar peduncles or superior cerebellar peduncles (Hendelman 148).

The first of these, the inferior cerebellar peduncle directs information from the medulla and brainstem to the cerebellum. The pathway connects information of the ipsilateral posterior (dorsal) spino-cerebellar pathway, the ipsilateral cuneo-cerebellar pathway and the olivo-cerebellar pathway to the cerebellar cortex. It also contains some afferent and efferent projections to vestibular nuclei (Hendelman 148).

The middle cerebellar peduncle is influenced by multiple portions of the cerebral cortex the cortico-pontine pathways. All of the middle cerebellar peduncles axons are afferent and are coming from neurons of the contralateral basal pons within the internal capsule via the pontine nuclei. They provide information relating to motor commands and intended motor movements (Hendelman 148).

The last of the cerebellar peduncles is the superior cerebellar peduncle. The superior cerebellar peduncle is the source of the major efferent pathways of the cerebellum. The afferents of the ventral (anterior) spino-cerebellar tract enters through the superior cerebellar peduncle (Hendelman 148-49).

## **CURRENT RESOURCES AND RELATED MATERIALS**

### **Images**

There is an immensity of images on the cerebellum within medical literature. Some common resources on the subject are Purves' Neuroscience, Netter's Atlas of Human Neuroscience, Netter's Neurology, and Kandel Schwartz and Jessel's Principles of Neural Science. The difficulty of these books is that often the images are designed to be used at multiples levels and are drawn to meet the needs of the text not the major concepts of the subject. None of the available resources use the principles of enduring understanding to assemble their information and therefore their images were often clinically or anatomically oriented for application in very specific contexts.

## **Interactive Programs**

Readily available interactive programs on the cerebellum were difficult to find. Many of the programs provided information on the basic gross anatomy of the brain but were unable to give further information on cerebellar output and functioning. The programs were often neuroanatomical in nature and gave both three-dimensional visuals as well as cadaver dissections to describe the different portions of cerebellar anatomy. As a whole the programs that would be available online to medical students were both difficult to find and often outdated. Some programs were available for purchase but required either renewable subscriptions or purchase of collective CDs on neuroanatomy.

One interactive program available online was the Digital Anatomists Project ([www9.biostr.washington.edu/da.htm](http://www9.biostr.washington.edu/da.htm)). It provided two and three-dimensional models, as well as cadaver sections, MRI scans and computer reconstructions of the cerebellum. The program was developed in 1997 and is very difficult to navigate. Likewise the images provided little text to help the user navigate and didn't address needs outside of a gross anatomical understanding of the brain. The program itself consisted of images within an .html document and provided forward and backward buttons which navigated you through sets of three dimensional and cadaver images.



Another available program on the cerebellum was Salamon's Neuroanatomy and Neurovasculature Web-Atlas Resource

([www.radnet.ucla.edu/sections/DINR/Part4C1.htm](http://www.radnet.ucla.edu/sections/DINR/Part4C1.htm)). This program was also set up in an .html document with interaction limited to forward and backward navigation. The program held few references and was limited to MRI images and cadaver images. This constrained the program to gross anatomical understanding and provided no cellular understanding of the cerebellum.

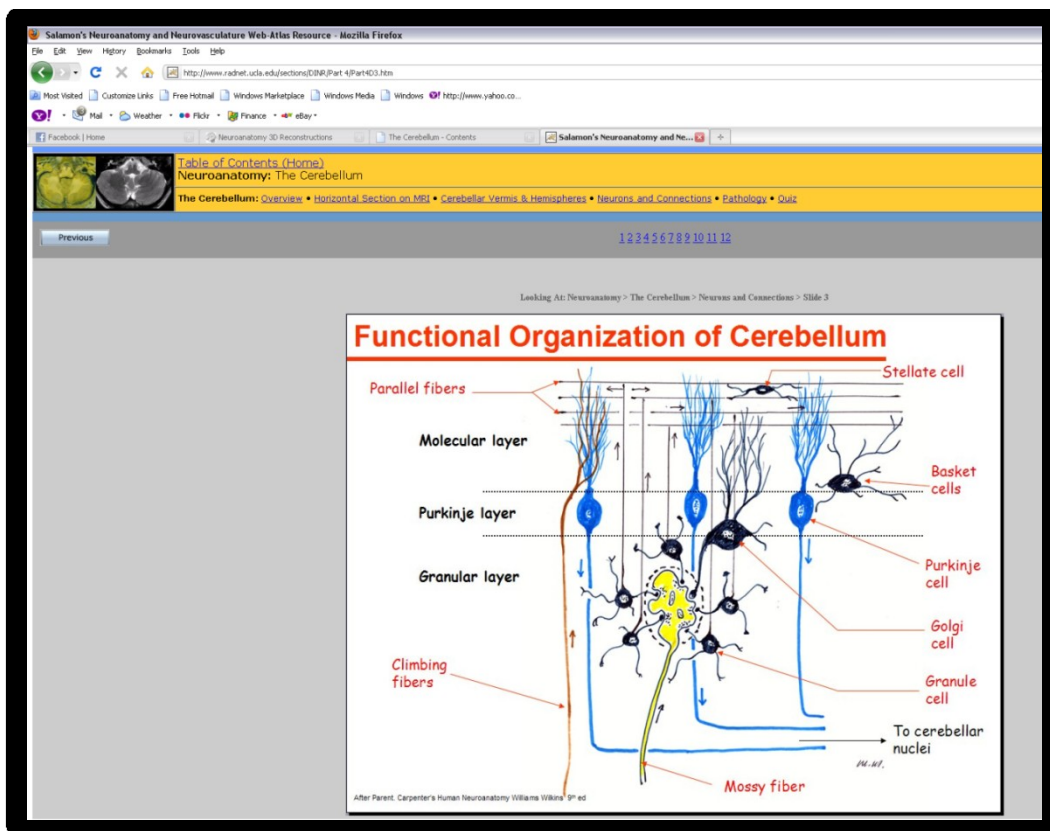
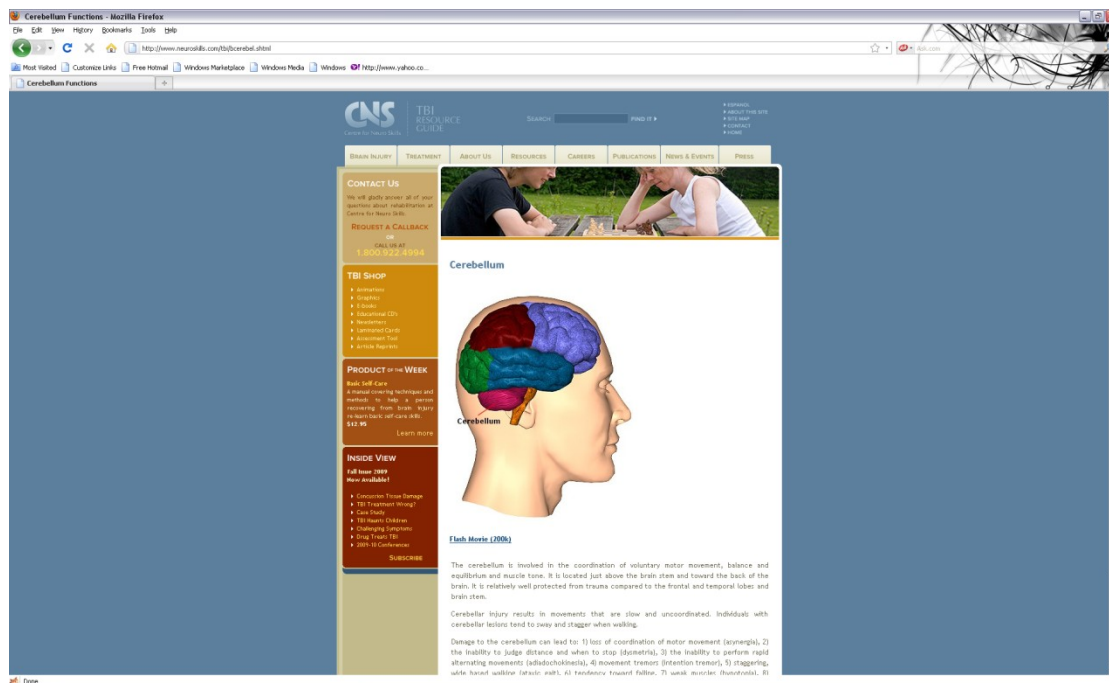


Figure 2.1 Salamon's Neuroanatomy and Neurovasculature Web-Atlas Resource

The Centre for Neuro Skills (<http://www.neuroskills.com/tbi/bcerebel.shtml>) is another source of interactive and flash video clips available on the internet. It provides some three-dimensional renderings of the brain and cerebellum but also only goes into the cerebellum location and orientation and does not provide the user with adequate images to help understand the concepts of cerebellar anatomy and cellular structures. It also provides no information on the functional divisions of the cerebellum or any images to accompany it.



*Figure 2.2 The Centre for Neuro Skills*

Another interactive program provided by the Karolinska Institutet is The Central Nervous System- Visual Perspectives (<http://3d-brain.ki.se/index.html>). It also provides a program relating the basic gross anatomical structures of the cerebellum but lacks any information on the other important aspects of the brain including the cellular structures or the functional divisions and its relation to the rest of the brain.

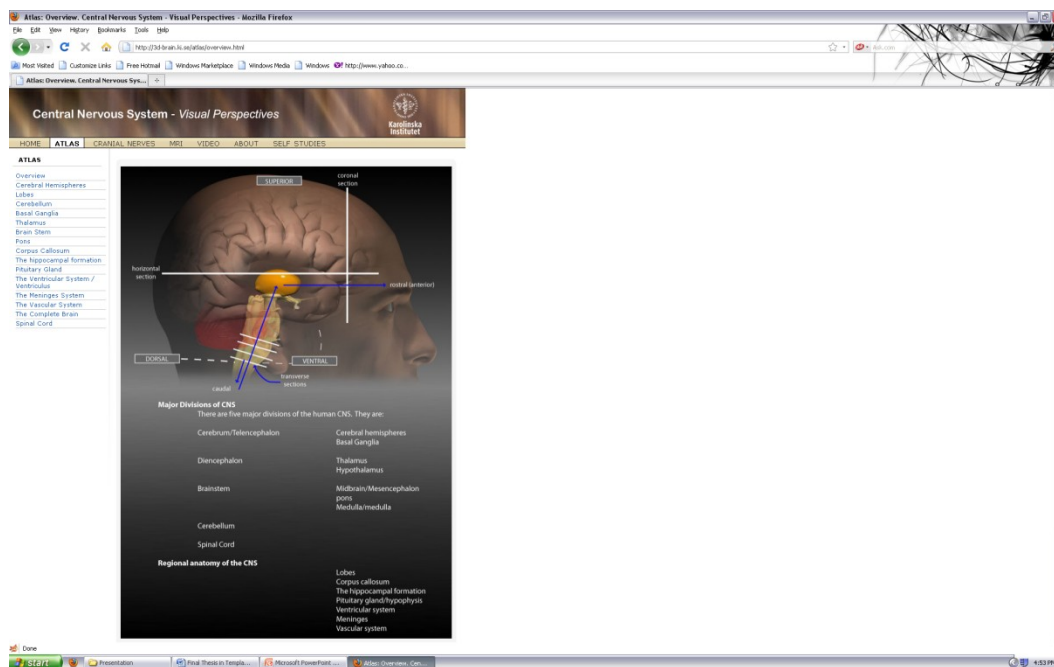


Figure 2.3 The Central Nervous System- Visual Perspectives

Based on the images and resources provided, we determined that there was a visible need for a resource similar to what was envisioned for this thesis. The reviewed programs did not include information outside of basic neuroanatomy. It did not include information on three-dimensional cellular orientations and other key principles discussed above.

Another important factor was none of the programs proved to have used the principles of enduring understanding in their creation. At this time returned to discussions to determine an outline and script.

## **CHAPTER THREE**

### **Methodology**

#### **PROJECT CONCEPTION**

The project was envisioned as a need for modification of the current resources available to students in the medical neuroscience course at UT Southwestern. The lecture series was under revision by the instructor, Dennis Burns, M.D., who desired better clarification and illustration of the images accompanying the syllabus. The first meetings were used to determine specific areas within the content with increased confusion and difficulty. After discussion, two lectures were identified on the cerebellum, including a basic chapter on neuroanatomy and a chapter on its influences to motor activity. The primary function of the project was to produce imagery which could be used to teach all levels of medical education. The current images needed to be simplified enough to teach the primary classes ( first-year medical students, physician assistants, and physical therapists) as well as be sustainable enough to help teach difficult and detailed imagery to the advanced students (residents and interns). In the initial meetings, specific goals were established to aid students on the arduous concepts. The teacher identified areas that students often misunderstood and that needed clarified illustrations. During these initial meetings the primary set of objectives were establish as follows:

Initial Goals:

1. To improve the illustration of the cortical projection pathways, articulating the three-dimensional nature of the cells, the excitation and inhibition pathways and the cell functions.
2. To produce a better model of the functional divisions of the cerebellum with simplified visuals and understandable pathways.
3. To aid in understanding the gross anatomy and provide an alternative to the dissection labs and syllabus.

## **OUTLINING**

Once the primary objectives were determined, a rough outline was established. It listed the main topics for the illustrations, as follows:

1. Introduction to the Cerebellum
  - A. Superior Cerebellar View
  - B. Ventral (Anterior) Cerebellar View
  - C. Inferior Cerebellar View
  - D. Cerebellar Peduncles

- E. Parasagittal View
- F. Midsagittal View
- 2. Cerebellar Cortex
  - A. Cerebellar Slides
  - B. Cortical Cell Types
  - C. Cortical Cell Dimensionality
  - D. Cortical Cell Inhibitory and Excitatory Pathways
- 3. Functional Divisions
  - A. Vestibulocerebellum
  - B. Spinocerebellum
  - C. Cerebrocerebellum

## **RESEARCH**

After the initial concept was established, background research was completed on neuroanatomy and effective methods to presenting clearer illustrations and animations. Initial research lead to considering modern technology and web-based interactivity to help students gain hands-on experiences with the confusing visuals included in the syllabus and recommended texts. A few methods of implementation were discussed at this point including: QTV-R, a Smartphone or

iPhone application, or a social network application (such as Facebook or MySpace). In an informal survey of fifteen students from varying medical professional programs, few showed an interest in any of the previously discussed methods of execution. Many stated the applications on their phone would be too small and too difficult to read or understand, and preferred their social networking applications remain as such. These initial discussions lead to establishing the final output for the program as a web-based application included on the Ut Southwestern Web Curriculum website. A second round of discussions was then held with students on necessary materials within the online interactive program to be a resource they would be willing to use. Three concerns were established:

1. It must to offer information in a more understandable and concise method than the syllabus itself.
2. It must methods which are more engaging than simply reading the syllabus, increasing learning time.
3. It must supplement the text and visuals already included in the syllabus and must provide coherent visuals between resources.



## **FINAL FORMAT**

I resolved the final format would be an Adobe Flash .swf file. This interactive program is intended to be included as a flash component on the university website. As a final method of output for the university it would be included in its packaged form on a CD for uploading to the server and tested as an .html file.

## **VISUALS AND TEACHING METHOD**

At this point, it became clear the program required an established teaching method to offer its information concisely and effectively to the full scope medical education. Discussion was held on teaching methods centered on such a ranging scope. Enduring learning was proposed as one such method to solving the essential question of sustainability across varying levels of knowledge and implementing a set of core visuals useful to such diverse sets of students. The method was studied in detail in elementary settings, but had little research in higher learning. From these findings, it was found best to limit the project to simply evaluating the functional capabilities and not on the full scope of the

concept. Further research would need to be conducted on the benefits and concerns of enduring understanding on a group of students over the course of four years and their uses for the program within the different levels of neuroscience testing. These tests would be used to determine if the teaching style was effective, as seen in the lower levels of education and similar to those methods being implemented at Mayo in their medical school curriculum.

### **TARGE AUDIENCE GOALS AND OBJECTIVES**

Once enduring learning was established as the utilized teaching method, the next major step was to choose the goals and objectives the students needed to achieve during their study of the two cerebellar chapters. These objectives would serve as a guide to the program and as a goal to test the successes and failures of the program's effectiveness in the preliminary testing.

At any level, the student would need:

1. To be able to name the major internal and external cerebellar cortical structures including: hemispheres, tonsils, flocculus, nodulus, and vermis, as well as midsaggital and parasaggital structures.

2. To be able to properly identify the cerebellar peduncles and their specific afferent and efferent projections.
3. To be able to identify the three layers of the cerebellar cortex, which cells lie in each area, and how these cell types interact.
4. To be able to identify specific cerebellar cortex cells.
5. To know which cell types carry information to and from the cerebellum
6. To the three major functional divisions of the cerebellum and be able to describe their afferent and efferent pathways.
7. To be able to determine functional deficiencies determined by abnormalities to the structures previously described

Here, the pre-test and post-test would serve to investigate the programs ability to illustrate and convey such specific objectives. It would be used to test the knowledge of their understanding of the core concepts and help correct problems with the interactivity and design. Evaluations would be given alongside these to determine the student's observation of the product usefulness. Larger scale testing is necessary during the next four years to test whether the program was sustainable throughout medical student's academic careers. Such testing was decidedly outside of the scope of the thesis, but is to begin with the next class session in the spring

## **CONTENT ORGANIZATION**

### **Final Content Proposal**

A final draft was then completed of the different topics to be included in the program. It was at this point we began discussing the different programs likely to be utilized during the process to convey each of the different concepts. A basic outline was completed of the topics to be discussed.

During this phase there was discussion on whether a questions section would be necessary. If questions were included, they would need to be relevant to all groups and not contain specifics questions only answerable by the higher or lower levels of medical education.

In the preliminary stages, discussion lead to adding a clinical correlations section but within the final stages of the project was reconsidered. It decided that only the residents and higher level medical students would benefit from these questions. Students learning the information for the first time would not be included.

In the final outline of the program the clinical correlations were changed to review questions, where questions pertinent to all levels could be tested. The final model outline is as follows:

1. Gross Anatomy (3D rotatable animation)
  - A. Superior Cerebellar View
  - B. Ventral (Anterior) Cerebellar View
  - C. Inferior Cerebellar View
  - D. Cerebellar Peduncles
  - E. Parasagittal View
  - F. Midsagittal View
2. Cortical Anatomy (multiple)
  - A. Slides (Gross dissection slides)
  - B. Image of Cortical Cell Types (2D flat art)
  - C. Multiple Views of 3D Cortical Slice (3D Model)
  - D. Cortical Excitation/Inhibition Pathways (2D Animations)
3. Functional Divisions (all 2D Animations)
  - A. Vestibulocerebellum
    1. Afferent Pathways
    2. Efferent Pathways
  - B. Spinocerebellum
    1. Afferent Pathways

- 2. Efferent Pathways
- C. Cerebrocerebellum
  - 1. Afferent Pathways
  - 2. Efferent Pathways
- 4. Review Questions (Interactive Questions)
  - A. Questions within Gross Anatomy
  - B. Questions within Cortical Anatomy
  - C. Questions within Projection Pathways

### **Storyboards and Script**

During storyboarding, two items were produced: a site map and the program storyboards with script. The sitemap was used to determine the navigation and access the program would require (see Appendix A). It also relayed the imagery and programming discussed for each of the areas. The sitemap was used to help create the menus and submenus for the program and establish the number of secondary and tertiary menus necessary to properly navigate the main hub program.

Next, the program storyboards were created. These storyboards included initial concepts for the visuals, as well as the approved text to be included in the program (see Appendix A).

The text went through many revisions by Dr. Dennis Burns as the program was built. The initial text was derived from the syllabus and the supplementary texts associated with the class. It was determined that the program would include only information available to the student through their syllabus and supplemental materials. The main purpose was to contain the same information while presenting it in a more concise user-friendly mode.

Continuing the principles of enduring understanding into the content was achieved by using the objectives discussed in the goals and objectives section. By including images which could be used to teach the different levels of learning we hope to be able to increase the student's ability to interpret and to help provide better explanation. For the purposes of this project the first and second facets are the only ones in which medical illustration and designs apply. Helping to build a solid foundation through strong visuals will hopefully create a better base for students to grow their medical understanding.

The initial script for the program was created with these objectives in mind and helped to provide a natural supplement to the information within the course syllabus. By including information from each of the texts and combining this information with the other levels of education, we were able to provide a supplement which could be used to help each level study while provide cohesive images for the group as a whole.

As the programs concept became clearer, revisions created more comprehensive explanations of the information within each slide, as well as better textual transitions from slide to slide. The storyboards were then placed with their corresponding text.

The program navigation and script was reviewed by Dr. Dennis Burns, one of the professors for the medical neuroanatomy courses taught at UT Southwestern Medical School as well as the other members of the committee to check for content flow.



## **Design**

### *Layout Design and Style Sheets*

Once the storyboards were approved, the programs style and concept was determined. Within this phase, style sheets were created to determine the color palettes for the program, and to begin decisions on the programs navigation. As the program was going to require multiple levels of navigation, it became necessary to determine a placement which would not dominate the programs allotted visual space, yet still have appropriately sized fonts for easy reading. The abundance of textual information included in the program needed multiple levels of navigation to function adequately. A primary style sheet was then created for review by the committee (see Figure 3.1 and 3.2). After discussion on the activities of the rollovers and the navigation within the program the style for the program was approved. The specifications for the program were also determined. The main program was designed for a 1024 by 768 resolution. The loaders were placed into the main program at a size of 1024 by 645.

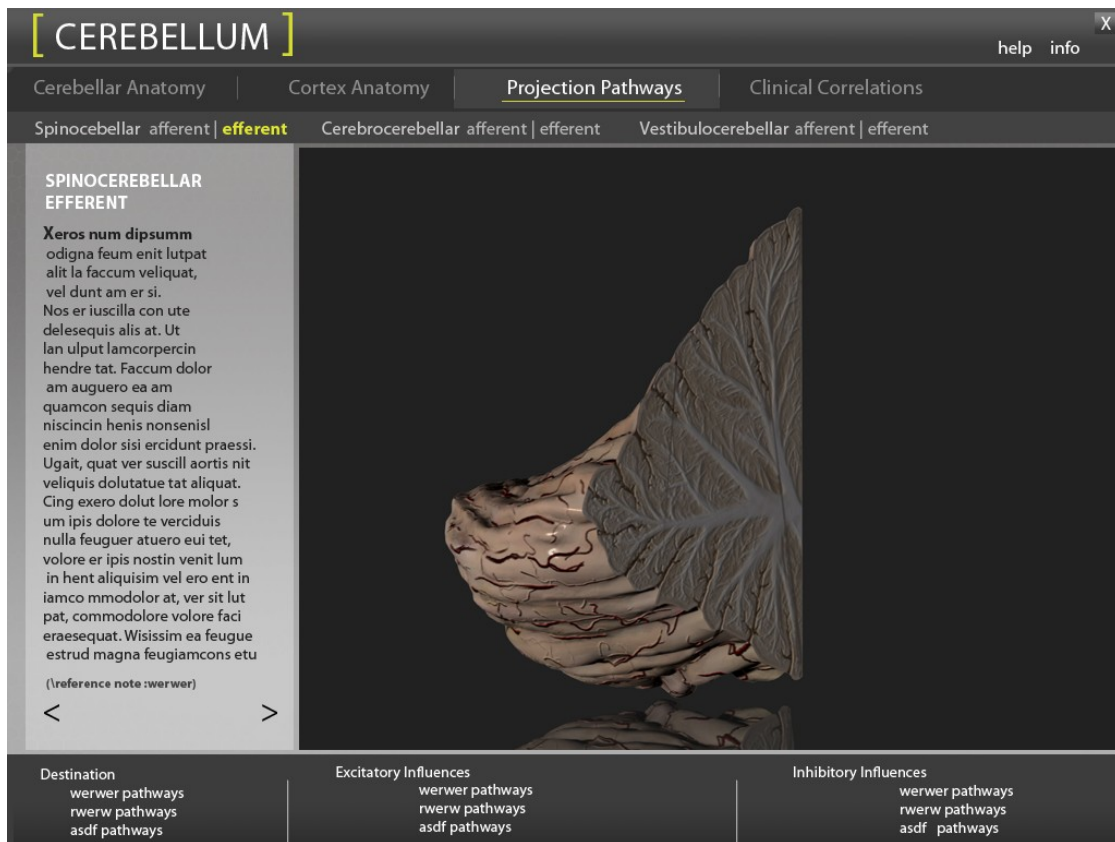


Figure 3.1 Gross Anatomy Style sheet

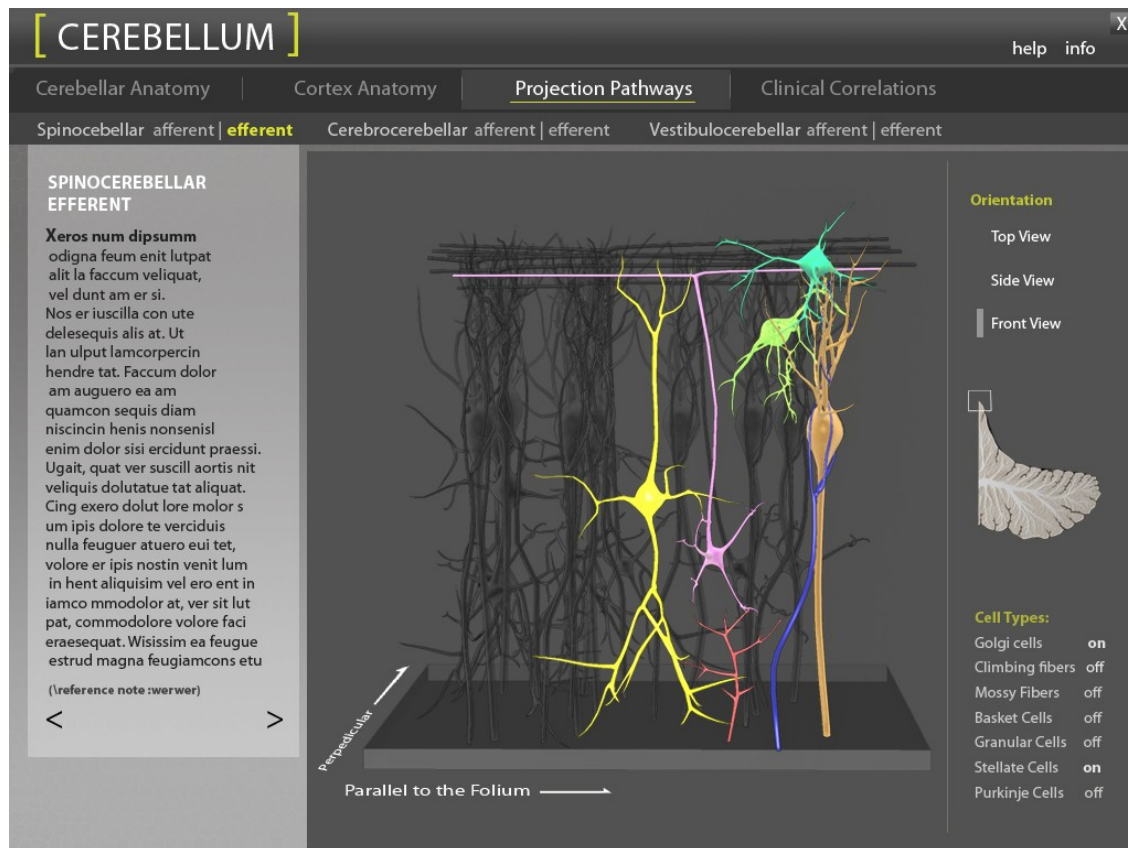


Figure 3.2 3D Model Style sheet

### Color Selection

Since the program requires a diverse spectrum of colors for description of cell types and distinction in the different pathways videos, the main program was developed in a palette of different shades of grey and white (see Figure 3.3). Such colors were used to minimize confusion and ease the users experience with the content of the program. Much of the program emphasis could then be placed on the typography and not on the colors used.

The illustrations were given a rich palette of colors to help distinguish the unusual items within each section. Colors were kept consistent within each of the three majors sections to alleviate confusion on each colors meaning. Similar colors were only used twice when included in a different section, to help keep the purpose consistent and clear.



*Figure 3.3 Colors Palette*

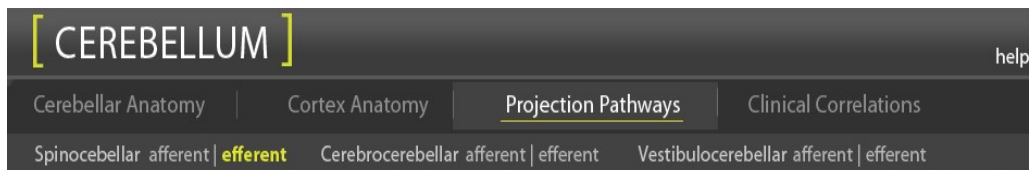
### *Visual Organization and Typography*

The program used black and white versions of Myriad Pro (Bold and Italic) and Myriad Pro Condensed in varying font sizes: 10pt, 12pt, 14pt, 16pt, 18pt and 30 pt. The main program title was 30pt font to help offset it from the main body of text. The main text was included headers in an uppercase white 18pt font. All subsequent text in the program was then a 14pt font. Labels were given a 12pt font with a .75pt leader line. Text found in the secondary bar at the bottom of the

program was distinguished by giving it a 10pt font and underlines or bold when necessary. The choices in font type help guide the viewer through information which was most pertinent at lower levels and for review to information which was more detailed and for higher levels of medical education.

### *Menus and Submenus*

The program contained a main menu; a secondary menu and a set of four sub-menus (see Figure 3-4). During the storyboarding phase it was determined that the menus needed to take up as little of the visual space as possible due to the amount of detailed text, labels, and visuals necessary on every page. The full program menu was allotted a space of 1024 pixels by 123 pixels. Menus were then given a height of 54 pixels for the main menus, 42 pixels for the secondary menu, and 27 pixels for each of the related submenus, consecutively. The full menu was set up to be allowing only for the submenus to roll down upon user selection of specific areas. Minimized menus allowed for larger illustrations and graphics.



*Figure 3.4 Menus Style*

### *Interactivity*

The interactivity for each of the components was determined by the needs of each slide. A set of rollover buttons with similar functionalities were created to help the user to distinguish whether an item was a label, or a movie clip. A three dimensional model was created as part of the gross anatomy section and included limited rotation to help student gain perspective on the cerebellum's dimensionality. Similarly, a model of the three dimensional cell types was created to relay information on cell axon directions and flow of information within the system.

## **SOFTWARE USED IN PRODUCTION**

A number of different software programs were utilized to create the [Cerebellum] program. Illustrations for the program were created using Adobe Photoshop ®, Adobe Illustrator ®, Autodesk Maya 2009 ®, and Pixologic Zbrush 3.1®. The interface design was developed using Adobe Photoshop ®and finally produced in Adobe Flash ®. The three dimensional models were created using Autodesk Maya 2009® and Pixologic Zbrush 3.1 ®. Both two dimensional and three dimensional video clips were created within Adobe After Effects ®and transitions were developed in Adobe Premiere Pro ®. The final program including both the main user interface and the loaders were created within Adobe Flash ®.

## **PRODUCTION**

Once the design concepts and functionality were approved by the thesis committee, production of the interactive program began. The initial style sheets were brought from Adobe Photoshop ® into Adobe Flash ® as a JPG file. At this point, a default interface was created which would serve as the backbone for the entire program. This default program included basic rollovers to be included

in all of the slides: main text and main header, one rollover button, a secondary information bar with text, and a background box.

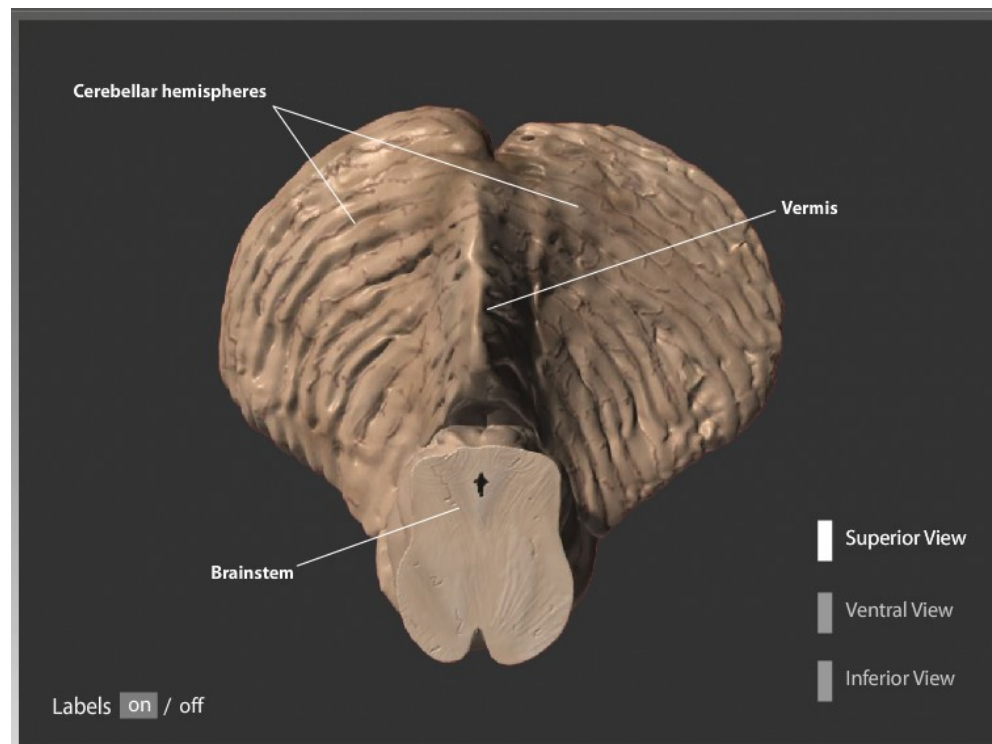
To ease the size of the program for the internet it was decided to split the program into functional loaders and have one main hub program to load each of the four subsections into. This organization would help to lower the overall size of the program and decrease the amount of time necessary to load while downloading via the internet. An initial loader screen was developed from defaults within the Adobe Flash ® database.



*Figure 3.5 3D Model*

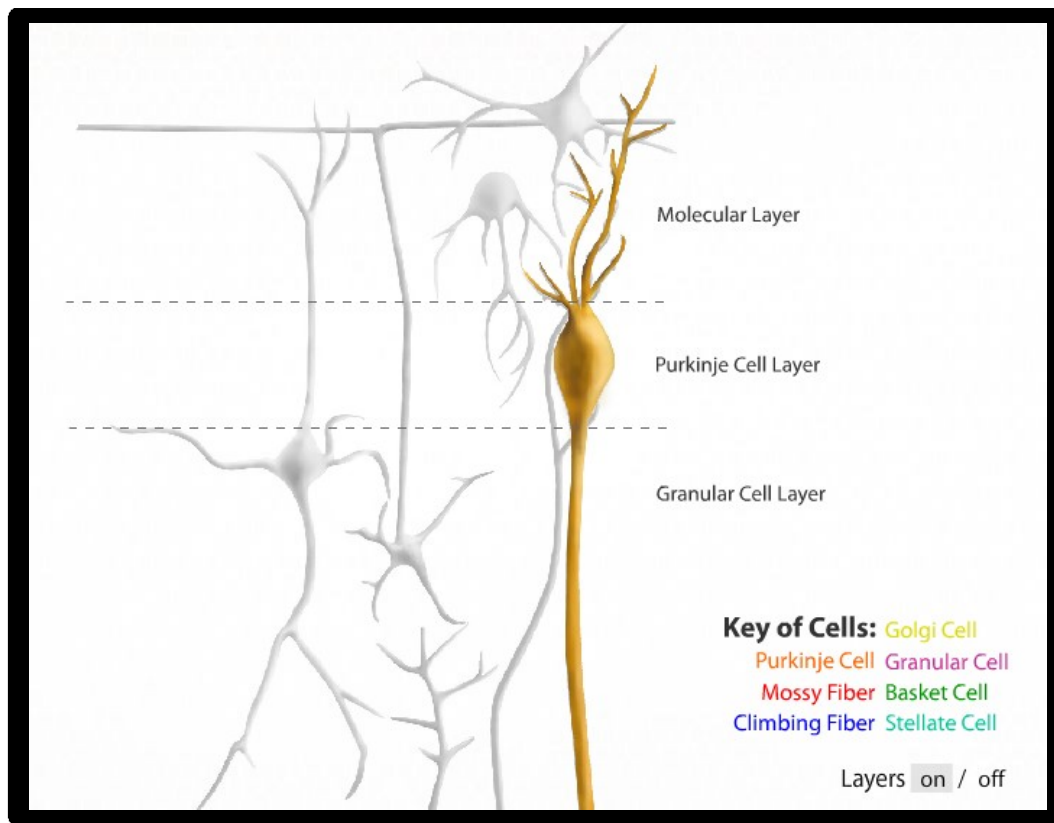


At this point, a base model was created in Autodesk Maya 2009 ® for the gross cerebellar anatomy section. By using both slides provided by Dr. Burns and by attending gross dissection of the cerebellum, the external anatomy was sculpted. Within Maya ® a base cerebellum was created and exported to Pixologic Zbrush ® for detailing coloring and texturing. Two layers were then brought back into Maya, one with detail of the color of the cerebellum and one of the textures of the cerebellum. Ramp shades were applied in Autodesk Maya ® to create an even more continuous look to the cerebellum. These layers applied tones and created an overall matte appearance.



*Figure 3.6 3D Model in Flash*

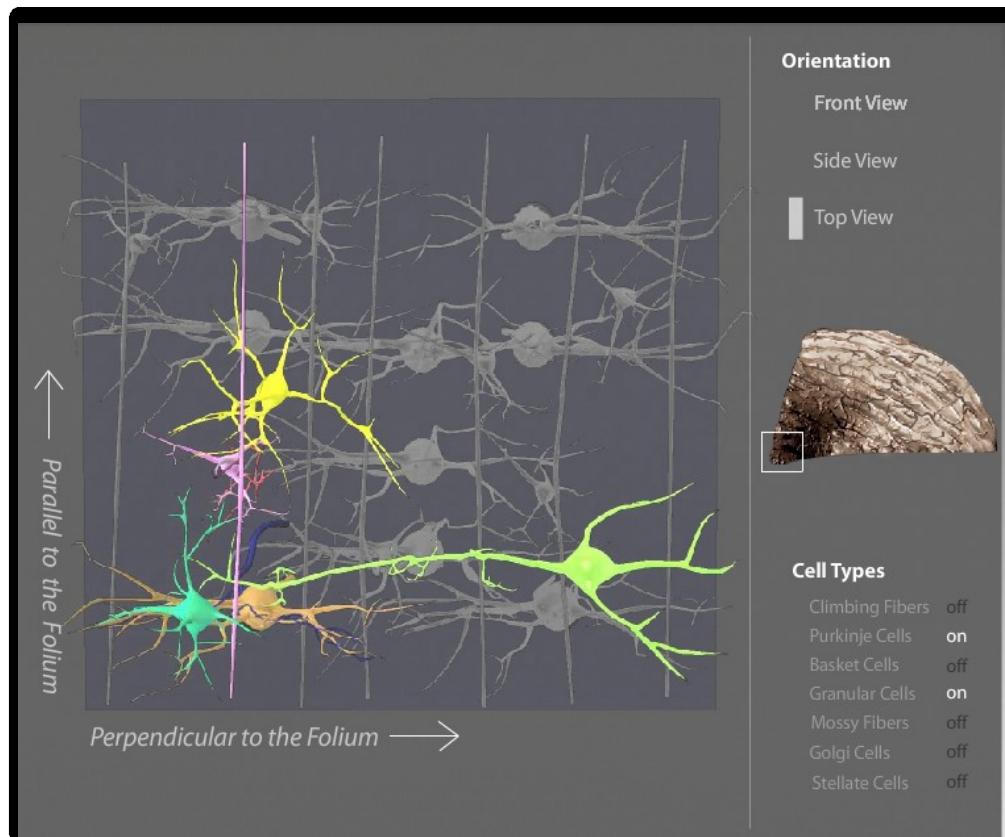
Once the base cerebellum was produced, it was subdivided to create the faces of the midsagittal and parasagittal planes. Both of the cut faces were exported and detailed using Adobe Photoshop ®. One gross cerebellar model was created before the others to provide an example of the necessary flow for creating the 6 other models. This model was used in the cerebellar cortical layers section in expressing the three dimensional cuts made in the model of the cerebellar cortex.



*Figure 3.7 2D Drawing of Image*

Autodesk Maya 2009 ® was also used to create the cerebellar cortical cell types and the three dimensional model. The process of producing these was reversed. First, the main model was made for the three dimensional visualization of the cortex cell types. After the model was created and reviewed by Dr. Dennis Burns sketches were created in Adobe Illustrator ®. These pieces of line art were rendered in detail in Adobe Photoshop ® to be closely related to the three

dimensional model. These images were placed into their preceding sections and rollover labels, final coloring, and related animations were laid over them.



*Figure 3.8 Final 3D Model of Cells in Flash*

The functional division's segment was completed in three separate steps. The still image of the brainstem and cortex slices was originally revised from images previously included in the syllabus. Once revisions were completed and approved by both the committee and the content advisor the image was brought into Adobe Flash ® and placed in the images section for each of the programs slides. Once in

place labels were placed on top of the images only including the relevant labels to that specific functional division. This varied from the syllabus images which included all related labels which often became burdensome and confusing. A series of pathways were then created and masked to create movie clips of the motion pathways each of the signals would take in their course through the afferent and efferent pathways.

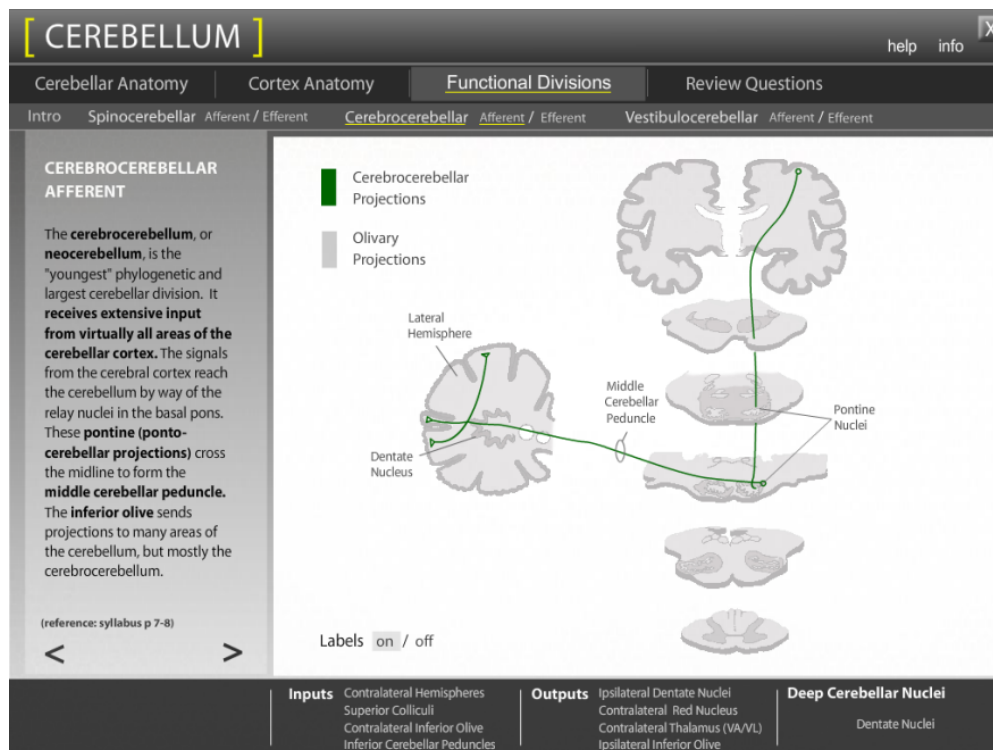


Figure 3.9 Projection Pathways in Flash

Finally, the questions section was created. This was used only to reemphasize the information already included in the program. It was not intended to elaborate on any of the information or provide further detail but simply serve as a study aid to students who desired to quiz themselves over the knowledge included inside the program. Here a series of questions was created by the content advisor Dr. Dennis Burns which would properly relate and quiz the information included in the three previous sections. For easier navigation, it was broken into questions related to each of the three previous sections.

Once the program was completed it was saved as a final set of Adobe Flash FLA files and exported as SWF files. The program included a note in the packaging as to which SWF file to open first as well as the necessary debugger to open the program on newer versions of Windows. It was then compiled into an .html file to be given to the medical education program to be included on the online curriculum for neuroanatomy.

## **REVIEW & REVISIONS**

During and after production the program went through many levels of review and revision with both the content advisor and committee members. Since the program was intended to have multiple levels of usage, it was reviewed to make

sure the concepts were clear to all levels of medical students. The textual content of the program was revised many times to make sure it both related to the imagery and was simplified and organized into areas easily distinguishable by the student. Implementing the first two facets of enduring understanding in the program was one of the main goals to helping provide a structure to the layout and content of the program. Once again examining these first two facets helped drive what content would require additional revisions. Modifications to the text were finished and an additional introduction was added to the gross anatomy section to provide a better continuity to the program and increase its usage as a standalone component.

## **CHAPTER FOUR**

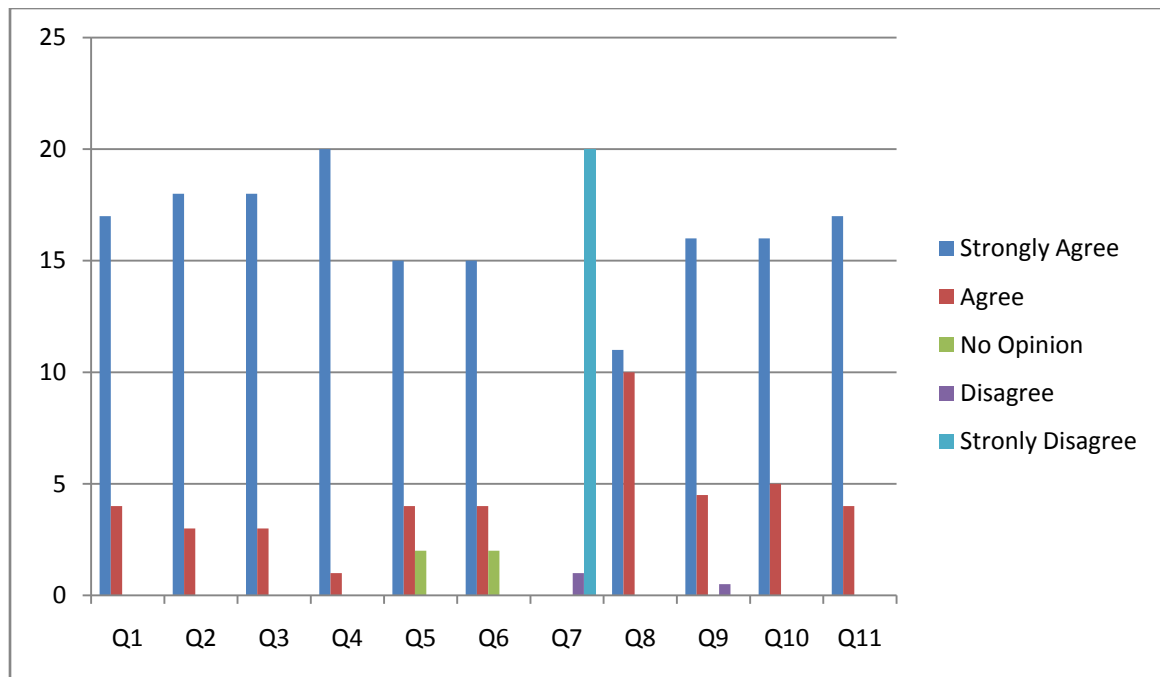
### **Results**

### **EVALUATIONS**

Once the program was approved by the committee, it was evaluated by students of different levels within their medical education. Each student was given an unrestricted time to look through the program and to complete the questions. They were given a pre-test, post-test and a questionnaire and a sheet of blank paper for additional comments. Before beginning the packet or using the program, each student was given instructions as to how to enter the program, a note as to its contents, and an orientation to the packet they were handed. The sample group comprised of 8 biomedical communication graduate students, 2 first year medical students, 1 second year medical student, 2 fourth year medical students, and 2 residents.

Twenty one pre-test, post-test and program evaluations were handed to the group. From those packets, twenty one evaluations were handed in, and fifteen pretests and post tests were taken. Some students relayed that they were unable to give the time necessary to follow through the pre-test and post-test portions of the packet but would gladly evaluate the program.





*Table 4.1 Evaluation Results*

## Program Questionnaire

*[Cerebellum]*

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	1	2	3	4	5
3.) The content of the program is organized well for both study and review.	1	2	3	4	5
4.) The layout and design were appealing.	1	2	3	4	5
5.) The interactive program provided the information necessary to perform well on the testing.	1	2	3	4	5
6.) The pathway movie clips are the best way to present this material .	1	2	3	4	5
7.) Your understanding of the cerebellum and its functions has increased with the use of this program .	1	2	3	4	5
8.) The rotating cerebellum videos help me orient to its spatial location.	1	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	2	3	4	5
10.) I would like to use this program again to review the content again in the future .	1	2	3	4	5
11.) The content of this program would be useful for review at other times in my medical career .	1	2	3	4	5

Additional Comments and/or Suggestions:

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*Figure 4.1 Evaluation Sheet*

Students were given an evaluation in their packet which included a set of eleven questions based on a Likert scale. On each questionnaire there was also a portion to include additional comments, which were carried over in many cases onto the included piece of blank paper. The results of the evaluations can be seen in Table 4.1 above.

The students' evaluations for the programs were as follows:

1. The interactive program was easy to navigate: 17 students strongly agreed, 4 students agreed.
2. The images and supporting media are important in a thorough understanding of the subject. 18 students strongly agreed, 3 agreed.
3. The content of the program is well organized for both study and review. 18 strongly agreed, 3 agreed.
4. The layout and design were appealing. 20 strongly agreed, 1 agreed.
5. The interactive program provided the necessary information to perform well on testing. 15 strongly agreed, 4 agreed, 2 had no opinion.
6. The pathway movie clips are the best way to present this material. 15 students strongly agreed, 4 agreed, 2 had no opinion.

7. Your understanding of the cerebellum and its functions has decreased with the use of this program. 20 strongly disagreed, 1 disagreed.
8. The rotating cerebellum videos helped me orient to its spatial location. 11 strongly agreed, 10 agreed.
9. The review questions and answers provided clear and concise explanations to their questions. 16 strongly agreed, .5 agreed, .5 disagreed.
10. The content of this program would be useful for review at other times in my medical career. 16 strongly agreed, 5 agreed.
11. I would like to use this program to review the topic in the future. 17 strongly agreed, 4 agreed

Notable evaluation comments included:

- “I like that each section has a different ‘animation/rollover’, yet is still cohesive.”
- “Not too much text, but gives enough information that is important to know for the course.”
- “The questions are extremely helpful.”
- “ There is a lot of information in the program, I probably wouldn’t use it all at once, but more likely when I wanted to review a particular concept”

- “I love these! Especially the ones that draw out the efferent and afferent tracts. The signal pathway clips are cool too!”- in response to evaluation question 6
- “I definitely clicked these several times!”- In response to evaluation question 8.
- “I really like the interactive nature of the 3D model- Visualizing the cells in multiple views really helped me understand the special relationship of the cells.
- “Very helpful. The large quantity of material does seem daunting, and a lot to handle, but viewed in small doses. I think it would be extremely useful. I didn’t retain a lot of information, but if I was using this as a study aid, I think it would build upon the other materials.”
- “I would use it!”
- “Overall, I truly believe this is a great tool to gain a very rounded understanding of the material. I could see myself using this on my own outside of class to help my study for the course. The organization of the program is a strong point. It’s a lot of information and you organized it well....”

In response to question nine, the respondent found some of the answers to the questions to be lengthy and confusing. This may have been due to the

individual's lack of exposure to the content of the program or to an inadequate amount of time given to review the material.

Further comments were also made on typographical mistakes as well as any confusing navigation. These comments and thoughts were taken into consideration during a final phase of revisions for the program before completion

## PRE AND POST TESTING

### Overall Scores

<i>Test #</i>	<i>Classification</i>	<i>Pre-Program Test</i>	<i>%</i>	<i>Post-Test</i>	<i>%</i>
1	1 <sup>st</sup> yr Med Ill	5/20	25	7/20	35
2	1 <sup>st</sup> yr Med Ill	5/20	25	7/20	35
3	1 <sup>st</sup> yr Med Ill	3/20	15	12/20	60
4	1 <sup>st</sup> yr Med Ill	7/20	35	11/20	55
5	2 <sup>nd</sup> yr Med Ill	9/20	45	14/20	70
6	2 <sup>nd</sup> yr Med Ill	5/20	25	9/20	45
7	2 <sup>nd</sup> yr Med Ill	4/20	20	8/20	40
8	2 <sup>nd</sup> yr Med Ill	7/20	35	7/20	35
9	1 <sup>st</sup> Yr Med Student	4/20	20	3/20	15
10	1 <sup>st</sup> Yr Med Student	1/20	5	9/20	45
11	Resident	8/20	40	16/20	80
12	Resident	4/20	20	19/20	95
13	4 <sup>th</sup> Yr Med Student	7/20	35	19/20	95
14	2 <sup>nd</sup> Yr Med Student	6/20	30	16/20	80
15	4 <sup>th</sup> Yr Med Student	6/20	30	18/20	90
			27		58.3

*Table 4.2 Pre-test and Post-test Score Percentages*

Pre and post testing was also performed to test the effectiveness of the program in helping students to learn the information. No testing was performed to determine how quickly students learned or if there was an increase in understanding based on use of the program. Further testing will need to be conducted later on any learning which may have occurred from using the program and in the implementation of enduring learning principles. The intention of the pre and post-testing was to determine any gaps in knowledge which may have been unforeseen in the creation of the program. These gaps would have been filled in with other slides if need occurred or if confusing information prevailed. Revisions would be done to help create a better understanding of the misunderstood concept. Table 4.2 shows the final results as well as information on the student group into which it pertains. The results were interesting, though statistically they would not be significant enough until further testing was performed.



Test	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
1	x/1	x/1	x/1	1/1	x/x	x/1	x/x	1/1	x/x	x/x	x/x	x/1	x/x	1/x	x/x	x/x	1/x	1/x	x/x	x/x
2	x/1	x/x	x/x	x/x	x/1	x/x	x/x	1/x	x/x	x/1	x/1	x/1	x/x	1/x	1/1	1/x	x/1	x/1	x/x	1/x
3	1/1	x/1	x/1	x/1	x/1	x/1	x/x	1/1	x/1	x/x	x/x	x/x	x/x	x/x	x/1	x/x	x/1	x/x	1/x	x/1
4	x/1	1/1	x/1	x/1	x/1	x/1	x/x	1/x	1/x	x/x	x/x	1/1	1/x	x/x	x/1	1/x	x/1	1/x	x/x	x/1
5	1/1	x/1	1/1	x/1	x/1	1/1	x/x	1/1	x/1	x/1	1/1	1/x	x/x	1/1	x/x	1/1	x/x	1/1	x/x	1/1
6	x/1	1/1	x/1	x/x	x/1	x/x	1/x	1/x	x/x	x/x	x/x	x/x	x/x	1/1	1/1	x/1	1/1	x/1	x/x	1/1
7	x/1	1/x	x/1	x/1	x/x	1/1	x/x	x/x	x/x	x/1	1/1	1/x	x/1	x/x	x/1	x/x	x/x	x/1	x/x	x/x
8	1/x	x/x	x/x	x/x	x/x	x/x	x/1	1/x	1/1	x/1	x/1	x/1	1/x	1/1	x/x	x/x	x/1	x/x	1/1	1/1
9	x/x	1/1	x/1	x/x	x/x	x/x	x/x	1/x	x/x	x/x	x/x	x/x	x/1	x/x	x/x	x/x	1/x	1/1	x/x	x/x
10	x/1	x/1	x/1	x/1	x/x	x/x	1/x	1/x	x/1	x/1	x/1	x/x	x/x	x/x	x/1	x/1	x/x	x/1	x/x	x/x
11	x/1	1/1	x/1	x/1	1/1	x/1	x/1	x/x	x/x	x/1	1/1	x/x	x/1	1/1	1/1	1/1	x/1	1/1	1/1	x/x
12	x/1	x/1	x/1	x/1	x/1	x/1	x/1	1/1	x/1	1/1	x/1	x/1	x/1	x/1	1/x	x/1	x/1	x/1	x/1	1/1
13	x/1	1/1	1/1	1/1	1/1	x/1	x/1	1/1	x/1	x/1	x/1	x/1	1/1	x/1	x/1	x/1	x/1	x/1	1/1	1/1
14	x/1	1/1	x/1	1/1	x/x	x/x	1/1	x/x	x/1	x/1	1/1	x/1	x/1	x/1	x/1	1/1	x/1	1/1	x/1	x/x
15	x/1	1/1	x/1	x/1	x/1	1/1	x/1	x/1	x/1	x/1	x/1	1/1	x/1	1/1	x/1	x/1	x/x	x/x	1/1	1/1
Total Results	3/13	8/12	2/13	3/11	2/9	3/9	3/6	11/6	2/8	1/10	4/10	4/8	3/7	7/8	4/10	5/8	3/9	6/10	5/6	7/8
Without Illustrators	0/6	5/7	1/7	2/6	2/4	1/4	2/5	4/3	0/5	1/6	2/6	1/4	1/6	2/5	2/5	2/6	1/4	3/6	3/5	3/3

Key: x- incorrect

1-correct

Results: pretest/post-Test

Table 4.3 Pre-test and Post-test Result

The table above (Table 4.3) provides a breakdown of the questions which were correct and incorrect on each students pre and post quiz. The information was used to determine gaps in knowledge with the students. After reviewing the results only two questions may show a need for revision. Question 7 asked

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior Olive
- B. Thalamus
- C. Basal Ganglia
- D. Cerebral Cortex

The questions received only 6 of the 15 respondents getting it correct during the post test. Likewise, four medical students got the question correct in the pre-test and incorrect on the post-test. The information was provided twice during the program, once during information within the functional divisions and again during the review questions.

The second question which may show need for revisions was question number 20. On this question only 3 of the respondents got the question correct, in the pre and post-test. The question read as follows:

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and “clumsiness”. Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected. Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere.
- B. An infarct involving the left lateral medulla oblongata.
- C. An infarct involving the right middle cerebellar peduncle.
- D. A tumor involving the superior cerebellar vermis.

The information in the question was never specifically given in the text and in retrospect would require an outside understanding of neuroscience and the other chapters of the syllabus in order to generate the response to this question. Adequate information as to context of the question was not given within the program.

From these results it was determined that no clear revision were necessary to the program text at this time. Both questions presented concerns within the evaluations and not within the program itself. Further testing would be required to determine if the program provided increased knowledge and speed of learning. Corrections to the text and imagery may be determined necessary at that time.

## **CHAPTER FIVE**

### **Conclusions and Recommendations**

#### **CONCLUSIONS**

The interactive program was designed out of a need to revise the current set of supplementary resources available to medical students in the neuroscience class. The current set of materials given to the student were related to gross anatomy and any readily available sources on the web provided inadequate information on the content included in the lectures. The diversity of students provided difficulty in finding appropriate resources as well, and it was determined a method of teaching would need to be implemented to be able to address the full spectrum of students involved. After reviewing the materials there was a need found for a program to gather the information within the lectures and provide further illustration on its topics.

Students were questioned on what type of program they would be most likely to use, and it was determined to use a web-based interactive module. The program included information categorized into four different sections of information: gross anatomy, cortex anatomy, functional divisions and a review questions section. Further interactivity was included with introductions, help sections, and an information page. The final product was an interactive web-based Adobe Flash

Player ® file to be loaded on the web curriculum by the neuroscience program and used as a supplement to the syllabus and texts.

Once the final product was created and approved it was evaluated by a pool of students within medical education including medical illustrators, medical students, and residents. Little dissatisfaction was shown toward the program. Also a series of pre and post tests were given to the students. There was little variation on the number of correct responses to questions on the post test. It was determined from this that the program did not need further content revisions. It was then concluded from the evaluations, and pre and post testing the program provided adequate content on the cerebellum and its functions.

### **RECOMMENDATIONS FOR FURTHER STUDY**

The interactive module is intended to be a set of programs completed for the neuroscience department. Further programs could be created for the other sections of the syllabus or for some of the other confusing lectures within the syllabus. Subsequent programs could be created with the same framework of teaching method and structure in mind and become part of a package available to students as a supplement to their syllabus and texts.

The hope for the program is to create these lectures within a structured time of three years to be included within the lectures series at that time. Each year three to five programs would be created to be completed by the spring of 2012. Testing could then be done on the program as a whole to determine any effectiveness it may have with medical neuroanatomy learning.

Further study would also need to be done on the effectiveness of the teaching method within a single group of students. Little research could be found on enduring understanding as it pertained to medical education and is a further area of interest for research. The study would take four years to complete, and would require standardized testing of the individuals across all four years of medical school. Such testing was determined outside of the scope for this thesis but is of further interest. A schedule of testing will be laid down to be used with the help of medical testing and the UT neuroscience society, which would determine these results. Students would be ranked based on student number for ambiguity and tested throughout their medical career. With the help of the SIGN group, testing could be completed over a four year period and include students who have plans to enter neurosurgery or neuropathology residencies.

Students within the four year program could then be tested by the medical testing department at the levels within their medical education where classroom testing is

involved. These three levels would help provide a better idea of the larger scale significance and provide a greater knowledge of the uses of the program

Further consideration may also lead to addressing different learning types. By using programs sounds to aid in the visual cues, as well as included gaming within any other interactivity students would be given a better range of interactivity. Such options may provide a larger diversity of options for students to use in their supplementary materials.



## **APPENDIX A**

### **Storyboards**

Anatomy of the Cerebellum

w/ submenu

- (3D) Side View
- (3D) Top View
- (3D) Bottom View
- (3D) Cerebellar Peduncles
- (3D) Mid-sagittal Plane
- (3D) Para-sagittal Plane

Cerebellar Cortex

w/submenu

- (photo/flat) Cellular Layers
- (photo/flat) Cortex Cell Types (subcomponent 1)
- (3D) Model of Cell Set (subcomponent 2)
- (2D) Cerebellar In/Outputs (subcomponent 3)

Main Menu Page

w/ main menu and submenus

Projection Pathways

w/submenu

- Animation of Pathways: (subcomponent 4)
- Vestibulocerebellar Afferents
- Vestibulocerebellar Efferents
- Spinocerebellar Afferents
- Spinocerebellar Efferents
- Cerebrocerebellar Afferents
- Cerebrocerebellar Efferents

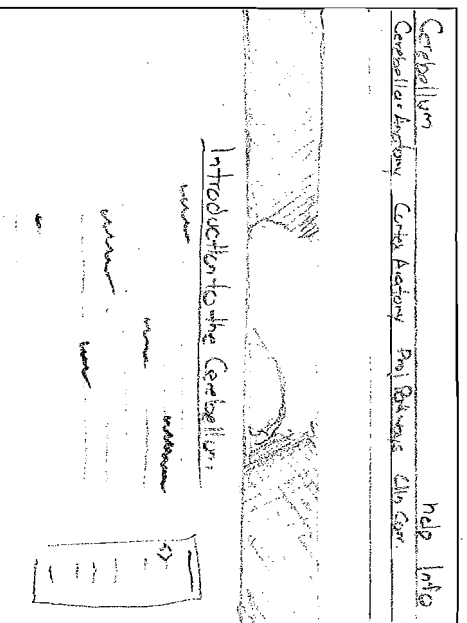
Clinical Correlations

w/submenu

- Truncal Ataxia
- Nystagmus
- Intention Tremors, Dysmetria, Hypotonia, Dysidiadochokinesia
- Motor abnormalities in the large truncal muscles.

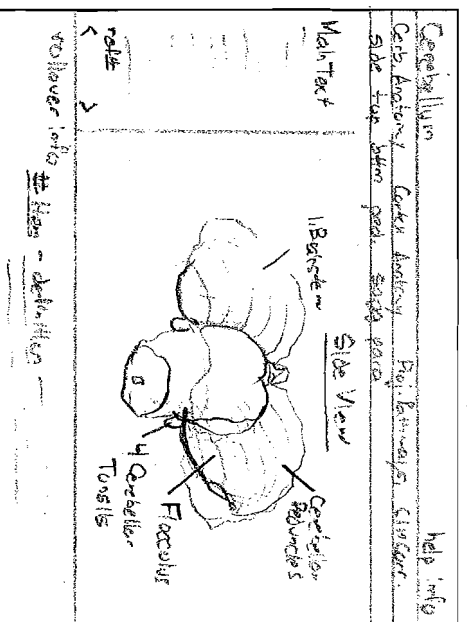
## Slide 1

## Slide X - Chapter 1 Anatomy of the Cerebellum



## Introduction Slide

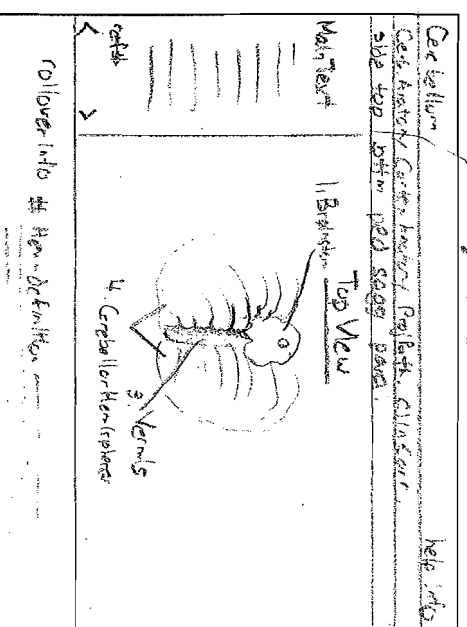
3D model of brain which when clicked again orients to specific anatomy as the view specified by the item requires



## Side View

**Main Text:** The cerebellum or "little brain" is the structure occupying most of the volume of the posterior cranial fossa. It represents an important component of the motor system with functions including: maintenance of balance and equilibrium, coordination of eye movements, coordinating ongoing motor activity in the extremities.

**Rollovers:** 1. **Brainstem**- comprises midbrain, pons and medulla oblongata 2. **Cerebellar peduncle**- attaches to the cerebellum via the brainstem and contain axons leaving and entering the cerebellum 3. **Flocculi**- two tufts of cerebellar parenchyma visible on anterior (ventral) surface of cerebellum. 4. **Cerebellar tonsils**- lie in the inferior-medial aspect of each hemisphere next to the brainstem. 5. **Folia**- external surface is characterized by multiple narrow-parallel ridges called cerebellar folia, like "leaves" or pages of a book, allowing for an enormous amount of surface area to the cerebellar cortex.



## Top View

**Main Text:** The cerebellum rests on the floor of the posterior cranial fossa and is covered superiorly by a dural reflection known as the tentorium cerebelli. The cerebellum receives its blood supply from branches of the vertebral-basilar arterial system. A number of the fissures ("grooves") of the cerebellum have specific names and have been used to subdivide the cerebellum into a number of rather complex regimes. In this presentation we will take a simpler functional approach, dividing the cerebellar cortex into three medial to lateral subdivisions.

**Rollovers:** 1. **Brainstem**- the medulla is the most caudal part of the brainstem 2. **Cerebellar Hemispheres**- subdivisions of the distinct regions of the cerebellum 3. **Cerebellar Vermis**- a midline "worm-like" component of the cerebellum. 4. **Cerebellar Hemispheres**- two large hemispheres lie on either side of the Vermis.



## Slide 43

<p>Corbellum</p> <p>Anterior</p> <p>size too with 2nd stage Pupa</p> <p>Male Text</p> <p>Cell #</p> <p>&lt;</p> <p>&gt;</p>	<p>help 4th</p> <p>3. Cestric Peduncles</p> <p>Bottom View</p> <p>2. Ventrals</p> <p>1. Bristles</p> <p>4. Hemipores</p>
---	--

# Slide 5

<p>Cerebellum</p> <p>Cerebellar Cortex</p> <p>Side Temporal Groove</p> <p>Posterior</p> <p>Superior</p> <p>inferior</p> <p>middle</p>	<p>Anterior</p> <p>Posterior</p> <p>Superior</p> <p>inferior</p> <p>middle</p>
---	--

## Slide 6

<p>COllower, wk6</p> <p>the skin - split off from</p>	<p>124 #</p> <p>&lt; &gt;</p>	<p>Capogulum</p> <p>cells: nodules, outer, fibrous, 3-4 cell thick, like cord</p> <p>skin top like a 200-300 cell cord</p> <p>Main Text</p> <p>1. Nerve</p> <p>2. Nodules</p> <p>MIS 300g H2O 1.01g</p>  	<p>beta info</p>
---	-------------------------------	---	------------------

Bottom View

Main Text: As the cerebellum is rotated to give us a view of its inferior surface, some of the landmarks unrecognizable previously are now visible along with the midline vermis and the hemispheres which are still visible.

	Afferent →	← Efferent
<b>Inferior</b>	Dorsal Spino Cuneo Vestibular Sys Contralateral	Flocculus, nucleus, fastigial nuclei to vestib sys
<b>Middle</b>	Inf. Olive	
<b>Superior</b>	Contra Axons/ basal pontine Ant Spino	none Dent/Int, VAVL

## Cerebellar Peduncles

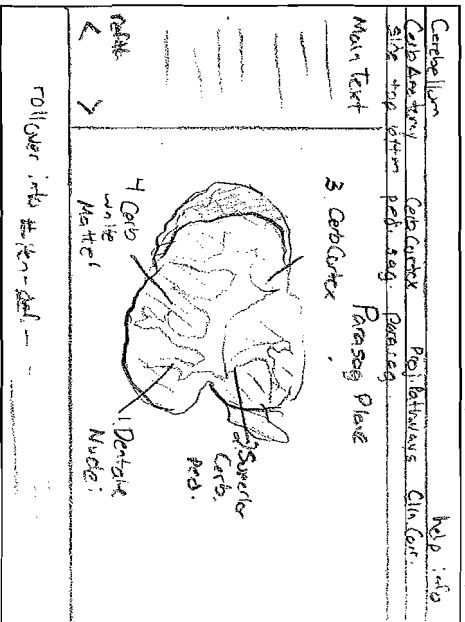
Main Text: Cerebellar Peduncles attach the cerebellum to the brainstem and contains axons entering and leaving the cerebellum. **Superior-** contains major efferent pathways and few entering. **Middle-** it contains only afferent axons. **Inferior-** originates in medulla oblongata. It has predominant afferent projections with a smaller number of efferent.

**Midsagittal Plane**

**Main Text:** On the cut surface the cerebellar folia are composed of a thin layer of gray matter (cortex) supported by branching white matter cores. The white matter is comparatively scanty within the vermis but much more abundant within the hemispheres of the cerebellum.

**Rollovers:** 1. **Vermis**-divisions of the cerebellum by white matter. 2. **Nodulus**- is one of nine subdivisions of the cerebellum. We will discuss this further when we consider the "vestibulocerebellum", which is one of three functional divisions of the cerebellum.

Slide 7

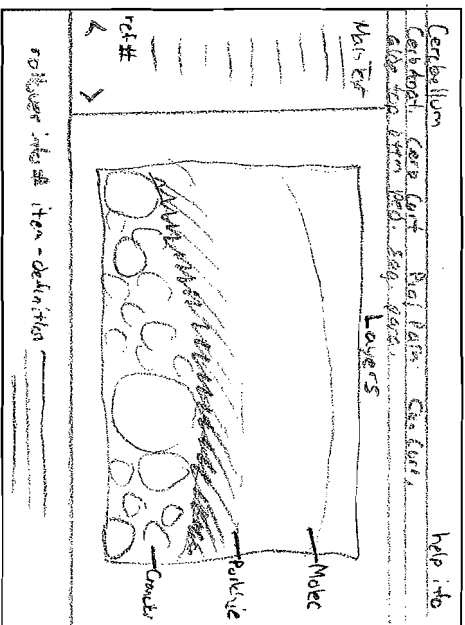


Parasagittal Plane

Main Text: The cerebellum contains four paired deep nuclei: Dentate, Emboliform, Globose and Fastigial ("don't eat gross food") laterally to medially. The largest is the dentate nuclei.

- Roll-overs: 1. **Dentate nucleus**- largest and most laterally situated of the deep cerebellar nuclei. 2. **Superior Cerebellar Peduncle**- emanates from the hilar region of the dentate. 3. **Cerebellar Cortex**- is functionally divided into three sections and directs inputs to deep cerebellar nuclei 4. **Cerebellar White Matter**-myelinated cerebellar axons also known as "arbor vitae".

Slide 8- Chapter 2 Cerebellar Cortex

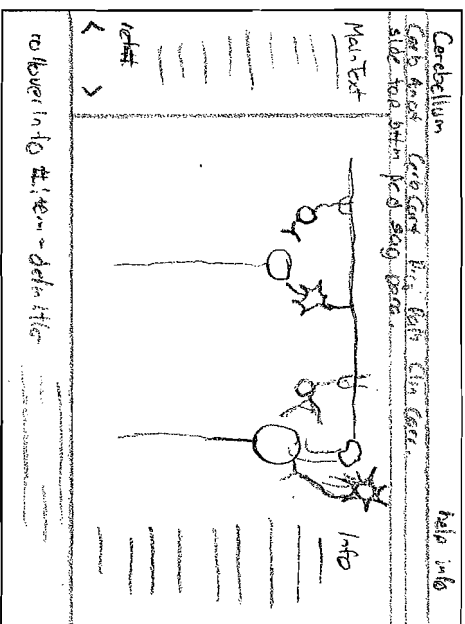


Layers of the Cortex

Main Text: Although the cerebellum has distinct functional divisions, from a microscopic standpoint, the appearance is remarkably uniform from area to area. Externally it contains a relatively hypocellular zone- the molecular layer. Below this is the prominent layer or large pyramidal neurons- Purkinje cells. Deepest is the densely cellular granular layer.

- Roll-overs: 1. **Granular Cell Layer**-sometimes called the internal granular layer, is the deepest layer of the cerebellar cortex. Important Structures: Granular cells, golgi cells, cerebellar glomeruli. 2. **Purkinje cell layer**- prominent purkinje cells are the "grand central station" of the cerebellar cortex, which are the ultimate target of all projections to the cerebellum and the only source of output from it. 3. **Molecular Layer** is the most external layer containing stellate cells and basket cells which inhibit purkinje cell activity. It also contains numerous cell processes that will be illustrated later- Purkinje cell dendrites, granule cell axons and others.

Slide 9



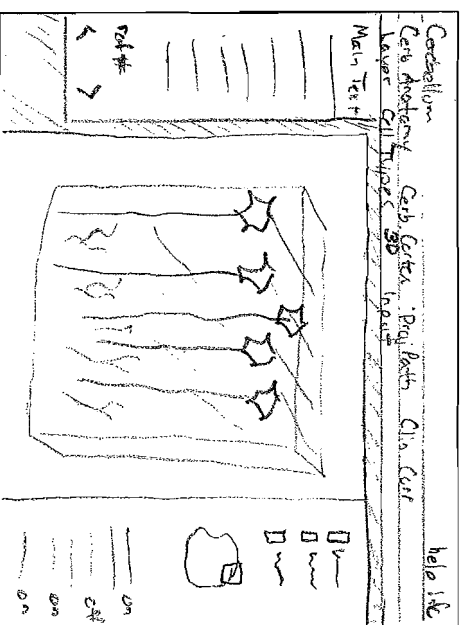
Cell Types.

Detailed in (subcomponent 1)

Main Text: using this higher resolution image of the cerebellum, we can now take a closer look at the specific cells and cell processes that populate the cerebellar cortex, their connections and their functions.

- Roll-overs: descriptions for each cell type based off syllabus: 1. Parallel fibers, 2. stellate cells, 3. basket cells, 4. molecular cells, 5. purkinje cells, 6. granular cells, 7. climbing fibers, 8. mossy fibers, 9. deep cerebellar nuclei. Texts found in Appendices 1.

Slide 10

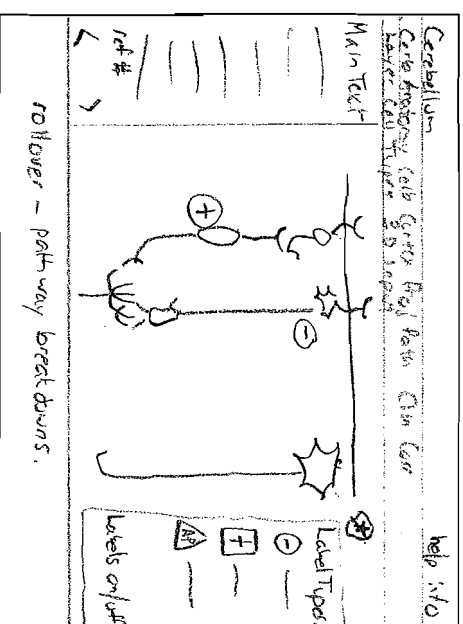


3D Rotatable Model

Detailed in (subcomponent 2)

Main Text: This 3D image provides us with a 3D look at the various cell types discussed in the previous panel. Note the fan like distribution of the Purkinje cells, the processes which are oriented perpendicular to the long axis of the cerebellar folium. Because of this arrangement a parallel fiber is able to synapse with the dendrites of multiple Purkinje cells. Also the Purkinje cells is situated to receive multiple excitatory inputs from multiple granule cells

Slide 11



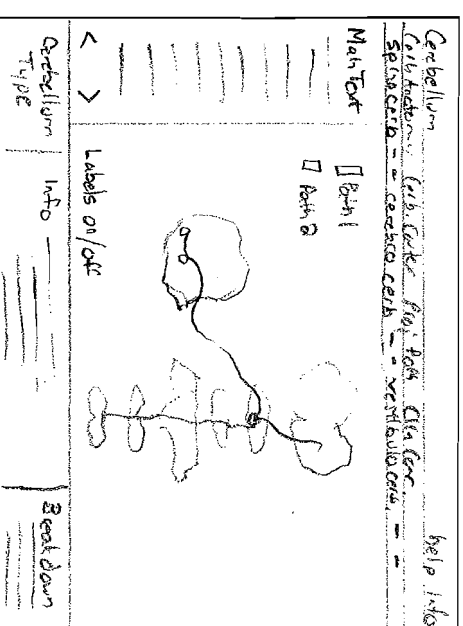
Cortex Excitatory and Inhibitory Pathways

Detailed in (subcomponent 3)

Main Text: This sequence allows us to trace the different action potentials from the cerebellar cortex. Lets take a closer look at the signals coming in to the cortex through mossy fibers, climbing fibers, etc.

Rollovers 1. Mossy fibers are exciting granular cells. They have many interesting effects. One of these is the excitation of Golgi cells, which in turn inhibits the activity of the granule cell creating a feedback loop and shutoff sequence. 2. In addition to exciting Golgi cells it also sends excitation influences to Purkinje cells and excitatory signals to basket cells and stellate cells which in turn inhibit the Purkinje cell. It creates a reciprocal effect of excitation and inhibition. 3. The excitation via climbing fibers is much more straight forward as they send signals straight up the axons and excite the target cells.

Slide 12-18 Chapter 3 Cerebellar Pathways



Projection Pathways

Detailed in (subcomponent 4)

Broken into 6 identical slide layouts with movie clips specific to each efferent or afferent pathway. They will be user guided animations to better help visualize destination. Includes option of maskable overlay of entire pathway for related circuit.

Rollovers: similar squares. 1 stating the destination of the pathway, 2 telling the inputs to the pathway, 3 telling the outputs of the pathway.

## Appendices 1

Golgi Cells- receives excitatory projections from granule cells via parallel fibers and sends inhibitory fibers back to granular cells at the level of the cerebellar glomerulus (make a cerebellar glom. Definition somewhere on the page with accompanying dotted line to explain).

Granule Cells- receives excitatory projections from mossy fibers in the cerebellar glomerulus, inhibitory projections from Golgi cells in the cerebellar glomerulus. Sends excitatory projections via parallel fibers to Golgi cells, stellate cells and basket cells.

Mossy Fibers- account for the majority of axons coming into the cerebellum. Excitatory projections to granular cells. Come from a wide range of neurons in the spinal cord, brainstem and cerebral hemispheres.

Climbing Fibers- the other source of excitatory influence in the cerebellar cortex. Mossy fibers come exclusively from the contra lateral inferior olive and encircle Purkinje cell processes much like tendrils of Ivy climbing up the branches of a tree.

Basket Cell- is an inhibitory cell that provides a "basket-like" axonal connection to the cell body of the Purkinje cell.

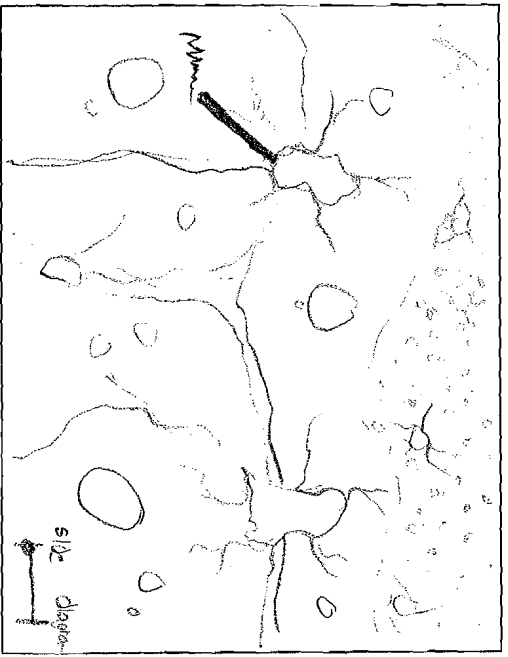
Stellate Cell- are excited by granule cells via parallel fibers. They send star like inhibitory processes to Purkinje cell dendrites.

Purkinje Cells- are the "grand central station" to the cerebellar cortex and serve/provide the only source of signaling leaving the cerebellar cortex. It receives excitatory signaling from climbing fibers and mossy fibers(via) granular cells. They receive direct inhibition from stellate and basket and indirect inhibitory influence from Golgi cells which in turn send inhibitory projections to deep cerebellar nuclei and vestibular nuclei.

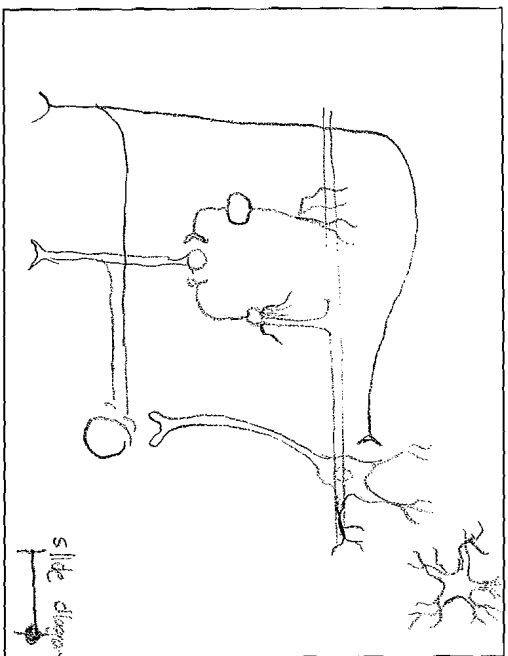
# WERKMEISTER

date: 11/20/09

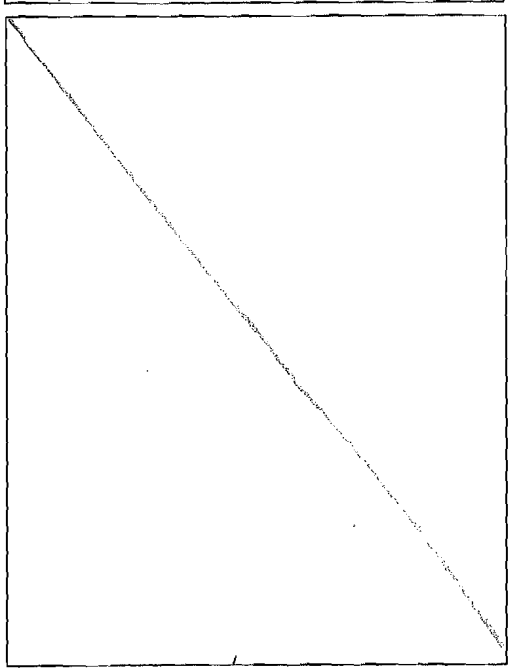
scene 1



scene 2



scene



nts includes following that would include the specific

type of cell within a specific slide diagram

pertaining to each specific cell type

1 Parallel Fibers

2 Stellate cells

3 Basket cells

4 Molecular cells

5 Purkinje cells

6 Granular cells - most numerous cells appear in routine section of cerebellar cortex

7 Climbing Fibers

8 Cerebellar Glomeruli

9 Mossy Fibers

10 Deep Cerebellar Nuclei

11 Golgi Cells - larger of the two less numerous - a granular cell body with a long apical dendrite extending into the molecular layer (1870) 532-3130

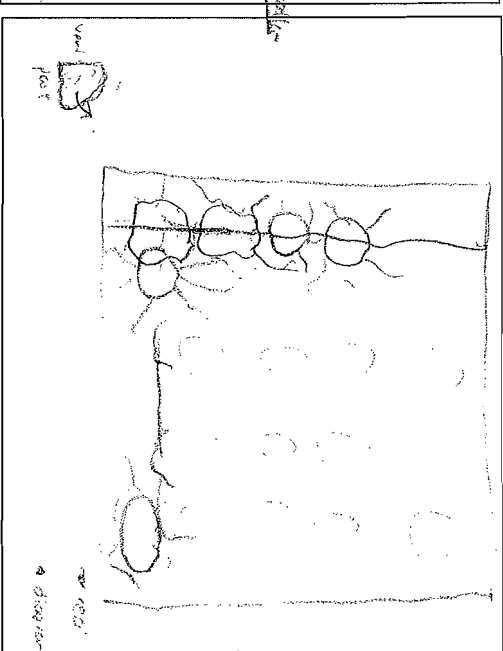
Visual Simplification of slide position



date: 12/20/00

project name

scene 3 w/ corresponding diagram



top view

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$$r$$

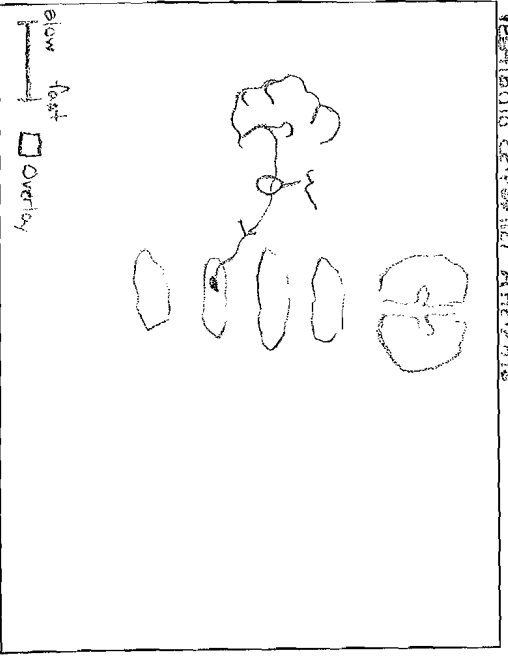
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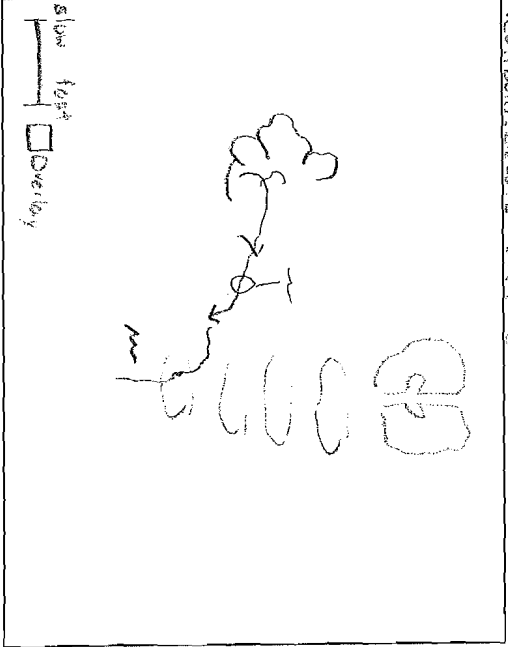
# WERKMEISTER

date: 1/20/09

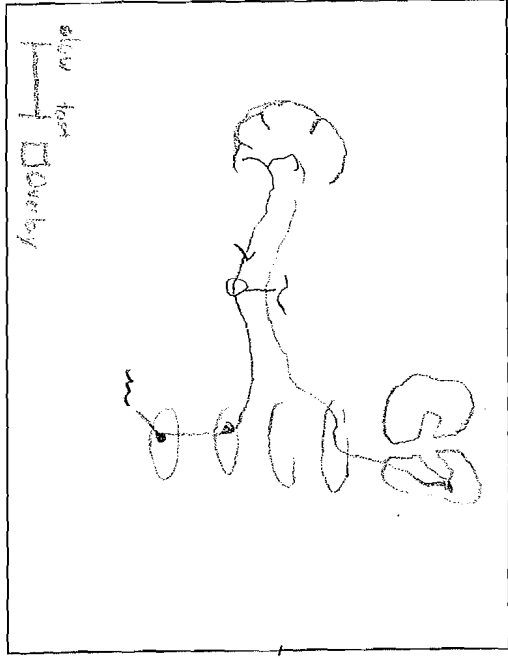
scene 1  
 Vestibulo cerebellar Affrents



scene 2A  
 Vestibulo cerebellar Efferents



scene 2B



nts  
 for each component the audience is  
 given a pathway w/ optional overlaying  
 all pertinent pathways for them  
 specific afferent/efferent system  
 (motion movies)

nts  
 when multiple paths exist within a specific  
 system the user is prompted to choose a  
 direction; gives the direction chosen the  
 viewer may see the course of the signal &  
 also choose to see the path overlays.

## **APPENDIX B**

### **Evaluations**

# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	①	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	①	2	3	4	5
3.) The content of the program is well organized for both study and review.	①	2	3	4	5
4.) The layout and design were appealing.	①	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	①	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	①	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	⑤
8.) The rotating cerebellum videos helped me orient to its spatial location.	①	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	①	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	①	2	3	4	5
11.) I would like to use this program to review the topic in the future .	①	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	1	2	3	4	5
3.) The content of the program is well organized for both study and review.	1	2	3	4	5
4.) The layout and design were appealing.	1	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	1	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	5
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	1	2	3	4	5
11.) I would like to use this program to review the topic in the future .	1	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	①	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	①	2	3	4	5
3.) The content of the program is well organized for both study and review.	①	2	3	4	5
4.) The layout and design were appealing.	①	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	①	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	①	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	⑤
8.) The rotating cerebellum videos helped me orient to its spatial location.	①	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	①	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	①	2	3	4	5
11.) I would like to use this program to review the topic in the future .	①	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	(1)	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	(1)	2	3	4	5
3.) The content of the program is well organized for both study and review.	(1)	2	3	4	5
4.) The layout and design were appealing.	(1)	2	3	4	5
5.) The interactive program provided the necessary information to perform well on testing.	(1)	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	(1)	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program.	1	2	3	4	(5)
8.) The rotating cerebellum videos helped me orient to its spatial location.	(1)	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	(1)	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career.	(1)	2	3	4	5
11.) I would like to use this program to review the topic in the future.	(1)	2	3	4	5

Additional Comments and/or Suggestions:

I really like the interactive nature of the 3D model - Visualizing the cells in multiple views really helped me understand the spatial relationship of the cells (now basket cells & climbing fibers make sense - "I really liked seeing how the climbing fibers wrapped around the purkinje cells). I like the syllabus references.

Main Suggestion = for anatomical diagrams can you outline each of the structures? or color them when the label is rolled on as is done with the histology pictures. This would help a beginner a lot. ☺

# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	(2)	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	(1)	2	3	4	5
3.) The content of the program is well organized for both study and review.	1	(2)	3	4	5
4.) The layout and design were appealing.	(1)	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	(2)	3	4	5
6.) The pathway movie clips are the best way to present this material.	1	(2)	<del>3</del>	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	(4)	5
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	(2)	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	(2)	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	1	(2)	3	4	5
11.) I would like to use this program to review the topic in the future .	1	(2)	3	4	5

Additional Comments and/or Suggestions:

would've liked a little refresher of what some of the pathways control.

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	①	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	①	2	3	4	5
3.) The content of the program is well organized for both study and review.	①	2	3	4	5
4.) The layout and design were appealing.	①	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	①	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	①	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	④	5
8.) The rotating cerebellum videos helped me orient to its spatial location.	①	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	②	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	①	2	3	4	5
11.) I would like to use this program to review the topic in the future .	①	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	4	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	1	2	3	4	5
3.) The content of the program is well organized for both study and review.	1	2	3	4	5
4.) The layout and design were appealing.	1	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	1	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	5
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	1	2	3	4	5
11.) I would like to use this program to review the topic in the future .	1	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	①	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	①	2	3	4	5
3.) The content of the program is well organized for both study and review.	①	2	3	4	5
4.) The layout and design were appealing.	①	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	①	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	1	②	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	⑤
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	②	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	①	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	①	2	3	4	5
11.) I would like to use this program to review the topic in the future .	①	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	1	2	3	4	5
3.) The content of the program is well organized for both study and review.	1	2	3	4	5
4.) The layout and design were appealing.	1	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	1	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	5
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	1	2	3	4	5
11.) I would like to use this program to review the topic in the future .	1	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate. ↳ for some reason, I want to be able to go back to the 1st page	①	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	①	2	3	4	5
3.) The content of the program is well organized for both study and review. ↳ I wish it was divided by the 3 tests	1	②	3	4	5
4.) The layout and design were appealing. ↳ very nice colors - soothing.	①	2	3	4	5
5.) The interactive program provided the necessary information to perform well on testing. ↳ I would use it!	①	2	3	4	5
6.) The pathway movie clips are the best way to present this material. ↳ movie clips rock	①	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program.	1	2	3	4	⑤
8.) The rotating cerebellum videos helped me orient to its spatial location. ↳ start w/ a ventral or lateral view	1	②	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions. ↳ I might even go through them but I did the program	①	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career. ↳ very concise & to the point	①	2	3	4	5
11.) I would like to use this program to review the topic in the future.	①	2	3	4	5

Additional Comments and/or Suggestions:

Very helpful. The large quantity of material does seem daunting and a lot to handle, but viewed in small doses I think it would be extremely useful. I didn't retain a lot of information, but if I was using this as a study aid, I think it would build on other materials.

# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	1	2	3	4	5
3.) The content of the program is well organized for both study and review.	1	2	3	4	5
4.) The layout and design were appealing.	1	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	1	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	5
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	1	2	3	4	5
11.) I would like to use this program to review the topic in the future .	1	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	1	2	3	4	5
3.) The content of the program is well organized for both study and review.	1	2	3	4	5
4.) The layout and design were appealing.	1	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	1	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	5
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	1	2	3	4	5
11.) I would like to use this program to review the topic in the future .	1	2	3	4	5

Additional Comments and/or Suggestions:

- Intro pg - bolded white type in 4 was same as key indicated roll overs... but weren't roll overs. Looked good though.
- Cerebellar Anatomy - Midsagittal plane page: The animation plays suddenly and is quick - I almost missed it b/c I was reading the side panel. Maybe slow it down.
- From Cerebellar Peduncles to Midsagittal view, the jump in size of the cerebellum bothers me.
- In Cortex Anatomy - Cerebellar Cortex cell types - it only colors the cells when the cell is rolled over - I want to

In Cerebellar Anatomy

# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	(2)	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	(1)	2	3	4	5
3.) The content of the program is well organized for both study and review.	(1)	2	3	4	5
4.) The layout and design were appealing.	(1)	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	2	(3)	4	5
6.) The pathway movie clips are the best way to present this material.	1	2	(3)	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	(5)
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	(2)	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	(2)	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	(1)	2	3	4	5
11.) I would like to use this program to review the topic in the future .	(1)	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	1	2	3	4	5
3.) The content of the program is well organized for both study and review. <i>Very organized</i>	1	2	3	4	5
4.) The layout and design were appealing. <i>great! Visually easy</i>	1	2	3	4	5
5.) The interactive program provided the necessary information to perform well on testing. <i>yes, for the most part, could be more concise or some text</i>	1	2	3	4	5
6.) The pathway movie clips are the best way to present this material. <i>simple animation not overdone</i>	1	2	3	4	5
7.) Your understanding of the cerebellum and its functions has <u>decreased</u> with the use of this program. <i>No, I don't see how using this program would decrease my knowledge!</i>	1	2	3	4	5
8.) The rotating cerebellum videos helped me orient to its spatial location. <i>yes, but a little limiting</i>	1	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career. <i>yes + no, too wordy on Q #1 + 6 - too much visual text!</i>	1	2	3	4	5
11.) I would like to use this program to review the topic in the future.	1	2	3	4	5

Additional Comments and/or Suggestions:

Overall, I truly believe this is a great tool to gain a well rounded understanding of the material. I could see myself using this on my own outside of class to benefit my study for the course.

- The organization of the program is a strong point - It's alot of information + you organized it well that it is not visually complex or confusing - very user friendly, easy navigation, great animations + roll over info is beneficially.

- Perhaps too wordy in some areas, but overall, text is OK

# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	①	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	①	2	3	4	5
3.) The content of the program is well organized for both study and review.	①	2	3	4	5
4.) The layout and design were appealing.	①	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	①	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	①	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	⑤
8.) The rotating cerebellum videos helped me orient to its spatial location.	①	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	①	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	①	2	3	4	5
11.) I would like to use this program to review the topic in the future .	①	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	1	2	3	4	5
3.) The content of the program is well organized for both study and review.	1	2	3	4	5
4.) The layout and design were appealing.	1	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	1	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	5
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	1	2	3	4	5
11.) I would like to use this program to review the topic in the future .	1	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	1	2	3	4	5
3.) The content of the program is well organized for both study and review.	1	2	3	4	5
4.) The layout and design were appealing.	1	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	1	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	5
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	1	2	3	4	5
11.) I would like to use this program to review the topic in the future .	1	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	(1)	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	(1)	2	3	4	5
3.) The content of the program is well organized for both study and review.	(1)	2	3	4	5
4.) The layout and design were appealing.	(1)	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	2	(3)	4	5
6.) The pathway movie clips are the best way to present this material.	1	(2)	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	(5)
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	(2)	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	(1)	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	1	(2)	3	4	5
11.) I would like to use this program to review the topic in the future .	(1)	2	3	4	5

except the mid sagittal rotation was too fast

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	1	2	3	4	5
3.) The content of the program is well organized for both study and review.	1	2	3	4	5
4.) The layout and design were appealing.	1	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	1	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	5
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	1	2	3	4	5
11.) I would like to use this program to review the topic in the future .	1	2	3	4	5

Additional Comments and/or Suggestions:

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# Program Questionnaire

[Cerebellum]

Instructions: Please circle the answer on the right that best matches your level of agreement.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1.) The interactive program was easy to navigate.	1	2	3	4	5
2.) The images and supporting media are important in a thorough understanding of the subject.	1	2	3	4	5
3.) The content of the program is well organized for both study and review.	1	2	3	4	5
4.) The layout and design were appealing.	1	2	3	4	5
5.) The interactive program provided the necessary information to preform well on testing.	1	2	3	4	5
6.) The pathway movie clips are the best way to present this material.	1	2	3	4	5
7.) Your understanding of the cerebellum and its functions has decreased with the use of this program .	1	2	3	4	5
8.) The rotating cerebellum videos helped me orient to its spatial location.	1	2	3	4	5
9.) The review questions and answers provided clear and concise explanations to their questions.	1	2	3	4	5
10.) The content of this program would be useful for review at other times in my medical career .	1	2	3	4	5
11.) I would like to use this program to review the topic in the future .	1	2	3	4	5

Additional Comments and/or Suggestions:

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**APPENDIX C**  
**Comments**



## Introduction to cerebellum homepage

= The program is subdivided into 3 major categories...."

- I don't think this needs to be in bold face text.  
- Maybe?

"important tools" box on homepage is great

- How do I navigate back to homepage??

Rotating animations are awesome - but would be nice to rotate in all 360°

< > — maybe these buttons  
could be larger in size? (only slightly)  
- I think they often get  
lost in text in some screens

Overall I think the information is organized

- I enjoy that each section has  
different "animation/rollout", yet still  
cohesive

- Not too much text, but gives enough information  
that is important to know for the course  
- some screens might be too wordy - maybe  
could be more concise.

\* a lot to look at  
- but, it is organized  
making it not so  
visually complex - great

- Not a huge fan of the "help" section

- I think maybe it could be organized better -- seems  
scattered

- Too many lines maybe?

- the lines might all be at  
random angles - organize them in equal angles

through out the  
page

I like the idea of the "review questions" page but to make  
it more interactive - perhaps a multiple choice quiz?

Question 1 + Question 6 - too wordy

Midsagittal plane.

"The nodulus is highlighted —"  
highlighted?

- If the submenu (such as Intro, spinocerebellar ...) has color when we are in submenu, it will be great. Because sometimes, it is confusing where I am in, even there are title on left.  
So, just like menu, what about having underlined or   
underlined colored submenu?
- The submenu of Review questions are different with the yellow title, and makes me confused.
- maybe highlight on questions, just a little.  
That will make people know where they are.
- Maybe if there are some link ~~to~~ back to lecture from the answer of review question, it will be great.  
The review and lecture are really helpful, by the way.

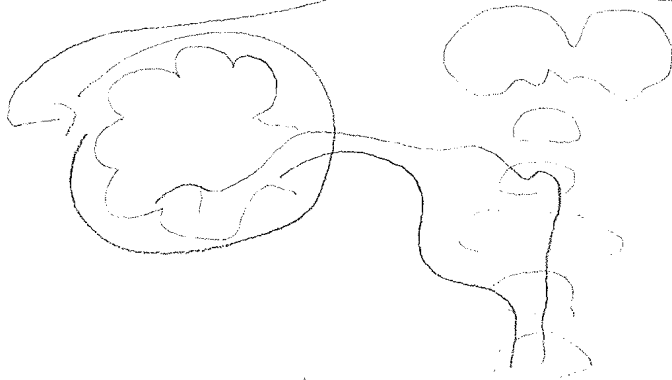
---

I'm not sure it was intended.

but I feel the answer of review is more specific than the lecture.

## Functional Divisions

- in the spinocerebellar Affected, I don't know from the illustration where the signal is ending. perhaps a label? (is that suppose to be the spinocerebellum?)



- when the signals terminate, I would like a label telling me what the specific location is.
- it would reinforce the information & make things more clear for people like me who may just skim over the text

## Review Questions

- I get confused about which questions I am an. Could the questions be highlighted?
- Cerebellar Anatomy = Introduction to gross Anatomy?
  - titles should be the same
- the questions are extremely helpful → it might be nice to be able to jump to a section I needed to review

## General

- I would like to see a whole brain image including the cerebellum before I started the program.
- there is a lot of information in this program → I probably wouldn't use it all at once, but more likely when I wanted to review a particular concept

1. Sup view of cerebellum (text)

✓ "once open" → Δ to "once it is removed..."

"Also, a # of ... ③ but we will take a functional approach...  
into three subdivisions from medial to lateral."

2. Ventral view

✓ ... cerebellar tonsil. The flocculus is also visible from this more anterior view.

3. Internal view

✓ ... ~~"along"~~

"still helping"... entire sentence is awkward

4. Midsag. plane

"highlighted" → check spelling on yours

✓ Last sentence → "The nodulus is highlighted in this image b/c it will be important later to your understanding of the functional divisions."

5. Cortex Anatomy → Cortical Layers → Slide 2

✓ Black/Yellow (➤) offer for Rollman

6. ✓ Signal pathways

→ I sort of wish that the AP's images still had color coding or labeling of the cell types or the ability to roll over and cause color to pop up

7. Spinocerebellar Efferent

✓ → "projections from the white the..."  
→ huh?

## - Welcome Menu -

- maybe say: "Its intent is to help equip ..." (instead of past tense)

## - Cerebellar Anatomy -

- Superior view: line 7-8: "Once opening."
- Ventral view: "The cerebellum, or "little brain" represents..  
break up sentence: "... as well as the cerebellar tonsils. Also visible from this more anterior view is the flocculus."
- Inferior view:

Is the word "along" supposed to be there? or is it "visible along AND including..."

- Cerebellar peduncles: "The" should not be bold

parasagittal Plane: missing quote mark after mnemonic

\* overall: this section has larger text - I could see the difference when I moved on. I like the larger text for viewing on screen. Also, because there is reversed-out text, it is easier to read when larger. ~~✱~~ (would making it bold help?)

oh wait, I just got that they were h100% rollovers! ↗

- Cortex Anatomy - I liked the bold black font more than white - this is the only section w/ white text
- cortical Layers - not sure, but maybe a colon instead of hyphen?  
"hypocellular zone: the molecular layer"  
"pyramidal neurons, Purkinje cells, in the..."

this renames this

## • cerebellar cortex cell types -

- not too thrilled about color key in corner.

key of cells

Purkinje Cell	Granular cell
Mossy Fiber	Basket cell
Climbing Fiber	Stellate cell
Golgi Cell	

title at top?

↳ I think this column should align left, flush right

Is there any way to create another rollover type of effect? you kind of have to guess which cell is which - any way to make the names of the cells in the color key rollovers? That way if you want to know about Purkinje cells, you can highlight the word instead of searching for shape.

- On the superior view of cerebellum, the text is a little confusing. I think it should say 'Once the tentorium cerebelli is open'
- Cerebellar peduncles slide - "The superior cerebellar peduncle contains major effluent pathways and few entering"

I love that the rollovers indicate confused have ~~that~~ all afferent/efferent connections

- the rotation to the midsagittal plane is kind of fast  
highlight → highlight
- Cerebellar glomerulus rollover area is looking I think? ~~new~~
- 3D layer of cortex anatomy is GREAT, makes so much sense, especially seeing the cross sectional area of the brain from which each view is taken
- Signal pathways slide - I kind of want to know which cell is which, maybe label them somehow?
- Functional divisions slide = terrific - I like the concise info, from the rollovers, '...'
- Ventral/Foramen projectors slides made a lot of info come together. The labels are nice and not overwhelming. Cerebrocerebellar projectors don't have labels though! I clicked 'on' and nothing happened. Also maybe label the cross sections here like (superior cross section or ventral cross sections b/c I got confused

## cerebellar cortex cell types (con't)

- in text, the lists of cell categories is confusing to comprehend — I think it would be easier to understand/group if there was indentation/bullets:

"by where their cell processes lie:

molecular layer: stellate cells  
basket cells

Purkinje layer: Purkinje cells

← this one is the most difficult in the text because of the double word s. I skipped over it accidentally when reading the first time

## cerebellar cortex 3D model

- ✓ • "fan-like" (needs hyphen)
- ✓ • space after italicized dendrites needed

## cerebellar cortex signal pathways

- I would want to see the cells labeled or color coded so you know which cells excite/inhibit other ones

## Intro to the Functional Divisions

- ✓ • colon instead of hyphen:
- ✓ • "functional divisions: the vestibulocerebellum"
- in rollover information — I think it would look better/more consistent if everything were aligned left instead of center:

Cerebrocerebellum	lateral hemispheres	Deep Nuclei	Major input
	lateral hemispheres	dentate nuclei	cerebral cortex connections 70%

## Spinocerebellar Efferent

- ✓ • "projections from the white the paravermal: ?"
- could you see both pathways displayed at once?
- ✓ • \* labels on cerebrocerebellar projections does not turn on

## Cerebrocerebellar Efferent

- ✓ • you're going to hate me for this one.. the hyperlink for the visual pathway (cerebro, efferents button) jumps on rollover

✓ 8. Consciousness. Efficient → Rolling over blue box shifts text a little

✓ 9. [HELP]

↑ not centered properly in brackets in vertical direction



## Cerebellum →

- starting out on the superior view was kind of confusing. I would have liked to start on the ventral view so I could orient myself better.
- I like how parts are removed to see more interior landmarks.
- I wish the rollover information was in a more prominent location. Also, the text seems small.

## Cortex Anatomy →

- I know I am in the cerebellum, but I wish I had some sort of way to connect the slides to the muscle in the previous section.
- you have lower case + caps for all types. I would capitalize them all.
- "Cerebellar glomerulus is unclear." I would show it somehow what having to rollover it.
- I didn't really understand the signal pathway animation → but that could just be because I don't know a damn thing about neuro!!
  - maybe there should be a specific order to how you can view it?

**APPENDIX D**  
**PreTests**

5/20

Test #: 1

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- ☒ A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Basket cells
- C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- ☒ B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- ☒ A. Dentate nucleus
- B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- ☒ A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- ☒ C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- ☒ B. Inhibition of Golgi cells
- C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- ☒ C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- ☒ B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- ☒ C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- ☒ D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- ☒ B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- ☒ A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☐ B. An infarct involving the left lateral medulla oblongata
- ☐ C. An infarct involving the right middle cerebellar peduncle
- ☐ D. A tumor involving the superior cerebellar vermis

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Test #: 2

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- ☒ A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- B. Fastigial nucleus
- ☒ C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- ☒ A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- C. Dentate nucleus
- ☒ D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- C. Red nucleus
- ☒ D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- ☒ D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- C. Dorsal spinocerebellar tract
- ☒ D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- ☒ C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- ☒ C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract



Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- ☒ B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- ☒ B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- C. A wide-based, staggering gait
- ☒ D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- ☒ C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 3

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- B. Fastigial nucleus
- ☒ C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- ☒ A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- ☒ C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- ☒ B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- C. Red nucleus
- ☒ D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- ☒ A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- C. Dorsal spinocerebellar tract
- ☒ D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- ☒ A. Granule cells
- B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- ☒ A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- ☒ A. Purkinje cells
- B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- ☒ C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- C. Cerebellar tonsils
- ☒ D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- ☒ C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- ☒ B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- ☒ A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- ☒ B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- B. An infarct involving the left lateral medulla oblongata
- ☒ C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

7/20

Test #: 4

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- B. Nodulus
- ☒ C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- ☒ C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- C. Dentate nucleus
- ☒ D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
  - B. Vestibular nuclei
  - C. Red nucleus
  - ☒ D. Thalamus
-

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- B. Thalamus
- ☒ C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- ☒ B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- ☒ B. Inhibition of Golgi cells
- C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- ☒ D. Dorsal spinocerebellar tract



Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- ☒ C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- ☒ C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- ☒ C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

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- A. Generalized hypotonia
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- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- ☒ A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
  - B. An infarct involving the left lateral medulla oblongata
  - C. An infarct involving the right middle cerebellar peduncle
  - ☒ D. A tumor involving the superior cerebellar vermis
-

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Test #: 5

~~Pre-~~  
~~Post-~~program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- B. Fastigial nucleus
- ☒ C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- ☒ A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- ☒ B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- ☒ A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- ☒ C. Dorsal spinocerebellar tract
- ☒ D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- ☒ C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- ☒ B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- ☒ D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- ☒ C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- ☒ C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 6

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- ☒ D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- ☒ A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- ☒ B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- ☒ C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- ☒ B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- ✓ ~~B. Red nucleus~~
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- ☒ C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- ☒ A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract



Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- C. Cerebellar tonsils
- ☒ D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- ☒ B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- ☒ D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 7

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- ☒ D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- ☒ C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- ☒ C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- ☒ B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- ☒ D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- ☒ B. Red nucleus
- C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- ☒ C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- ☒ C. Stellate cells
- ☒ D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- ☒ D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- ☒ A. Dentate nucleus - Red
- B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- ☒ D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- ☒ B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- C. A wide-based, staggering gait
- ☒ D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- ☒ D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- B. An infarct involving the left lateral medulla oblongata
- ☒ C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 2

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- B. Fastigial nucleus
- ☒ C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- ☒ C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- ☒ B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- ☒ C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- B. Thalamus
- ☒ C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- ☒ B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- ☒ B. Inhibition of Golgi cells
- C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract



Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- ☒ B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- ☒ C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- ☒ B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- ☒ A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- ☒ B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 9

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- ☒ D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- ☒ C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- ☒ A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- ☒ B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- C. Red nucleus
- ☒ D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- B. Thalamus
- ☒ C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- ☒ C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- ☒ C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- ☒ A. Dentate nucleus
- B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- ☒ D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- ☒ A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- ☒ D. A tumor involving the superior cerebellar vermis

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Test #: 10

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- ☒ A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- B. Fastigial nucleus
- ☒ C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Basket cells
- C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- ☒ C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- ☒ A. Fastigial nucleus
- B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- ☒ C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- ☒ B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- C. Dorsal spinocerebellar tract
- ☒ D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- ☒ C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- ☒ C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract



Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- ☒ C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- ☒ C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

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- C. A wide-based, staggering gait
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- B. A tumor involving the cerebellar vermis
- ☒ C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

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Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- B. An infarct involving the left lateral medulla oblongata
- ☒ C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 11

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- ☒ D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- ☒ C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- ☒ C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- ☒ C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- ☒ C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- ☒ A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- ☐ D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- ☒ B. Red nucleus
- C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- ☒ A. Red nucleus
- B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- ☒ D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- ☒ B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- ☒ C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- ☒ B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- B. An infarct involving the left lateral medulla oblongata
- ☒ C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 12

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- ☒ A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- B. Fastigial nucleus
- ☒ C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Basket cells
- C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- ☒ A. Fastigial nucleus
- B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- ☒ C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- B. Thalamus
- ☒ C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- C. Dorsal spinocerebellar tract
- ☒ D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- ☒ A. Granule cells
- B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- ☒ B. Inhibition of Golgi cells
- C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract



Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- ☒ C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- ☒ C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- ☒ B. A generalized increase in deep tendon reflexes
- C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- ☒ A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- ☒ A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☐ B. An infarct involving the left lateral medulla oblongata
- ☐ C. An infarct involving the right middle cerebellar peduncle
- ☐ D. A tumor involving the superior cerebellar vermis

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Test #: 13

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- ☒ A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- ☒ C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- C. Red nucleus
- ☒ D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- B. Thalamus
- ☒ C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- ☒ C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- ☒ C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- ☒ D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- C. Cerebellar tonsils
- ☒ D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- ☒ C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- ☒ C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- ☒ A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- ☒ B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 14

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- ☒ D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- ☒ C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- ☒ B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- ☒ C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- ☒ A. Inferior olive
- ☐ B. Thalamus
- ☐ C. Basal ganglia
- ☐ D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- ☒ A. Dorsal spinocerebellar tract
- ☐ B. Red nucleus
- ☐ C. Basal pons
- ☐ D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- ☐ A. Red nucleus
- ☐ B. Inferior olive
- ☒ C. Dorsal spinocerebellar tract
- ☐ D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- ☐ A. Granule cells
- ☐ B. Golgi cells
- ☒ C. Stellate cells
- ☐ D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- ☐ A. Inhibition of stellate cells
- ☐ B. Inhibition of Golgi cells
- ☐ C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- ☒ A. Purkinje cells
- ☐ B. Golgi cells
- ☐ C. Stellate cells
- ☐ D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- ☐ B. Olivocerebellar tract
- ☐ C. Pontocerebellar tract
- ☐ D. Dorsal spinocerebellar tract



Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- ☒ A. Dentate nucleus
- ☐ B. Flocculus
- ☐ C. Cerebellar tonsils
- ☐ D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- ☐ A. Superior cerebellar peduncle
- ☐ B. Middle cerebellar peduncle
- ☒ C. Dorsal spinal columns
- ☐ D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- ☐ B. Middle cerebellar peduncle
- ☐ C. Olivocerebellar tract
- ☐ D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- ☐ A. Superior cerebellar peduncle
- ☐ B. Vestibulocochlear nerve
- ☒ C. Middle cerebellar peduncle
- ☐ D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- ☐ A. Generalized hypotonia
- ☐ B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- ☐ D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- ☐ A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- ☐ B. A tumor involving the cerebellar vermis
- ☒ C. A tumor involving the middle cerebellar peduncle
- ☐ D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- B. An infarct involving the left lateral medulla oblongata
- ☒ C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 15

### Pre-program Questions

Which one of the following structures is part of the cerebellar vermis?

- ☒ A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Basket cells
- C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- ☒ B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- ☒ A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- C. Basal pons
- ☒ D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- C. Dorsal spinocerebellar tract
- ☒ D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- ☒ C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- ☒ B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- ☒ B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- ☒ B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- ☒ A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- ☒ B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

**APPENDIX E**  
**PostTests**

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Test #: 1

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- ☒ C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- ☒ A. Fastigial nucleus
- B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus



Which one of the following is a major direct target of projections from the cerebrocerebellum?

- ☒ A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- C. Dorsal spinocerebellar tract
- ☒ D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- ☒ B. Inhibition of Golgi cells
- C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- ☒ C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- ☒ D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- ☒ B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

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- C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

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- B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- ☒ D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 2

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- B. Fastigial nucleus
- ☒ C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Basket cells
- C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- ☒ A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- ☒ C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- ☒ C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- ☒ A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- C. Basal pons
- ☒ D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- ☒ C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- ☒ B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- ☒ C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- ☒ C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- ☒ D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
  - B. A tumor involving the cerebellar vermis
  - ☒ C. A tumor involving the middle cerebellar peduncle
  - D. A tumor involving the dentate nucleus of the cerebellum
-

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- ☒ A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☐ B. An infarct involving the left lateral medulla oblongata
- ☐ C. An infarct involving the right middle cerebellar peduncle
- ☐ D. A tumor involving the superior cerebellar vermis

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Test #: 3

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

D E G F

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- ☒ C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus



Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- ☒ D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- ☒ B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- ☒ A. Granule cells
- B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- ☒ B. Inhibition of Golgi cells
- C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- ☒ C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- ☒ C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- ☒ D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- C. A wide-based, staggering gait
- ☒ D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- ☒ C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 4

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- ☒ C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- ☒ D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- C. Basal pons
- ☒ D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- ☒ A. Red nucleus
- B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- ☒ A. Granule cells
- B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- ☒ C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- ☒ C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- ☒ C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- ☒ D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- C. A wide-based, staggering gait
- ☒ D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- ☒ D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 5

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- ☒ C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus



Which one of the following is a major direct target of projections from the cerebrocerebellum?

- ☒ A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- ☒ B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- ☒ A. Granule cells
- B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- ☒ B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- ☒ C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- ☒ C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- ☒ C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 6

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- ☒ C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- ☒ C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- ☒ A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- C. Basal pons
- ☒ D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- ☒ C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- ☒ B. Inhibition of Golgi cells
- C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- ☒ A. Dentate nucleus
- B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- ☒ D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

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- B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- ☒ D. A tumor involving the dentate nucleus of the cerebellum

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Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 7

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- ~~D. Globose nucleus~~

D E G F

Which one of the following is a source of direct excitatory input to Purkinje cells?

- ☒ A. Golgi cells
- B. Basket cells
- ~~C. Mossy fibers~~
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- ~~B. Mossy fibers~~
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- ~~A. Fastigial nucleus~~
- ☒ B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus



Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- ☒ D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- ☒ A. Dorsal spinocerebellar tract
- B. Red nucleus
- C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- C. Dorsal spinocerebellar tract
- ☒ D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

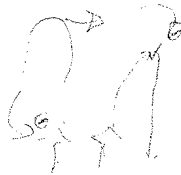
- ☒ A. Granule cells
- B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Basket cells



Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
  - B. Olivocerebellar tract
  - C. Pontocerebellar tract
  - ☒ D. Dorsal spinocerebellar tract
-

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- ☒ A. Dentate nucleus
- B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- ✓ ~~A. Superior cerebellar peduncle~~
- ☒ B. Middle cerebellar peduncle
  - C. Dorsal spinal columns
  - D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- ☒ D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- ☒ B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- ☒ D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- ☒ A. Metastatic lung cancer involving the left cerebellar hemisphere
- B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 8

~~Pre~~ <sup>Post</sup>-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- ☒ D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- B. Fastigial nucleus
- ☒ C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Basket cells
- C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- ☒ B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- ☒ A. Fastigial nucleus
- B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- C. Red nucleus
- ☒ D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- ☒ B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- ☒ A. Dorsal spinocerebellar tract
- B. Red nucleus
- C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- ☒ B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- ☒ A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- C. Cerebellar tonsils
- ☒ D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- ☒ D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- ☒ C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- ☒ B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- ☒ A. Metastatic lung cancer involving the left cerebellar hemisphere
- B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 9

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- B. Nodulus
- C. Emboliform nucleus
- ☒ D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- B. Fastigial nucleus
- ☒ C. Dentate nucleus
- D. Globose nucleus

DEGF

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- ☒ A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- ☒ A. Fastigial nucleus
- B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- ☒ A. Dentate nucleus
- B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus



Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- B. Thalamus
- C. Basal ganglia
- ☒ D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- C. Basal pons
- ☒ D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- C. Dorsal spinocerebellar tract
- ☒ D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- ☒ C. Excitation of granule cells
- D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- ☒ C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
  - B. Olivocerebellar tract
  - C. Pontocerebellar tract
  - ☒ D. Dorsal spinocerebellar tract
-

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- ☒ A. Dentate nucleus
- ☐ B. Flocculus
- ☐ C. Cerebellar tonsils
- ☐ D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- ☐ A. Superior cerebellar peduncle
- ☐ B. Middle cerebellar peduncle
- ☒ C. Dorsal spinal columns
- ☐ D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☐ A. Superior cerebellar peduncle
- ☐ B. Middle cerebellar peduncle
- ☒ C. Olivocerebellar tract
- ☐ D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- ☒ A. Superior cerebellar peduncle
- ☐ B. Vestibulocochlear nerve
- ☐ C. Middle cerebellar peduncle
- ☐ D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- ☐ A. Generalized hypotonia
- ☐ B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- ☐ D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- ☐ A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
  - ☐ B. A tumor involving the cerebellar vermis
  - ☒ C. A tumor involving the middle cerebellar peduncle
  - ☐ D. A tumor involving the dentate nucleus of the cerebellum
-

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- B. An infarct involving the left lateral medulla oblongata
- ☒ C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 10

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

DEGF

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- ☒ B. Vestibular nuclei
- C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- B. Vestibular nuclei
- C. Red nucleus
- ☒ D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- ☒ B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- ☒ B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- ☒ A. Granule cells
- B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- ☒ C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- ☒ A. Purkinje cells
- B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- ☒ B. Olivocerebellar tract
- C. Pontocerebellar tract
- ☒ D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- B. Flocculus
- ☒ C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- ☒ A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- B. A tumor involving the cerebellar vermis
- ☒ C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 11

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- ☒ A. Golgi cells
- ☒ B. Basket cells
- ☒ C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- ☒ A. Golgi cells
- ☒ B. Mossy fibers
- ☒ C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- ☒ C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus



Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- ☒ B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- ☒ B. Red nucleus
- C. Basal pons
- ☒ D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- B. Inferior olive
- C. Dorsal spinocerebellar tract
- ☒ D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- ☒ A. Granule cells
- B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- ☒ D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- ☐ A. Dentate nucleus
- ☒ B. Flocculus
- ☐ C. Cerebellar tonsils
- ☐ D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- ☐ A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- ☐ C. Dorsal spinal columns
- ☐ D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- ☐ B. Middle cerebellar peduncle
- ☐ C. Olivocerebellar tract
- ☐ D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- ☐ A. Superior cerebellar peduncle
- ☐ B. Vestibulocochlear nerve
- ☐ C. Middle cerebellar peduncle
- ☒ D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- ☐ A. Generalized hypotonia
- ☐ B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- ☐ D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- ☐ A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- ☒ B. A tumor involving the cerebellar vermis
- ☐ C. A tumor involving the middle cerebellar peduncle
- ☐ D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- ~~A~~ Metastatic lung cancer involving the left cerebellar hemisphere
- ~~B~~ An infarct involving the left lateral medulla oblongata
- ☒ C An infarct involving the right middle cerebellar peduncle
- ~~D~~ A tumor involving the superior cerebellar vermis

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Test #: 12

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- ☒ C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- ☒ B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- ☒ B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- ☒ A. Granule cells
- B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- ☒ D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- ☒ B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- ☒ A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- ? D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- ☒ D. Inferior cerebellar peduncle

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- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

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Which one of the following lesions would explain her abnormalities?

- ☐ A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- ☐ C. An infarct involving the right middle cerebellar peduncle
- ☐ D. A tumor involving the superior cerebellar vermis

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Test #: 13

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- C. Mossy fibers
- ☒ D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- ☒ C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus



Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- ☒ B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- ☒ B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- A. Granule cells
- B. Golgi cells
- C. Stellate cells
- ☒ D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- ☒ D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- ☒ B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
- B. Vestibulocochlear nerve
- C. Middle cerebellar peduncle
- ☒ D. Inferior cerebellar peduncle

Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
- ☒ C. A wide-based, staggering gait
- D. Impaired control of the intrinsic muscles of the hands

A 6 year old male presents for evaluation of increasing "clumsiness" and headaches. He is unable to stand or walk without assistance, and has horizontal gaze nystagmus. Examination of the pupils reveals evidence of papilledema (blurring of the margins of the optic discs, indicating increased intracranial pressure). Which of the following would be most compatible with the patient's signs and symptoms?

- A. An infarct (stroke) involving the cortex of the lateral cerebellar hemisphere
- ☒ B. A tumor involving the cerebellar vermis
- C. A tumor involving the middle cerebellar peduncle
- D. A tumor involving the dentate nucleus of the cerebellum

A 52 year old right-handed woman with a history of cigarette smoking presents with a sudden onset of slurred speech and "clumsiness". Your evaluation reveals an intention tremor on the right side, and difficulty performing rapidly alternating movements on the same side. Her left side is unaffected.

Which one of the following lesions would explain her abnormalities?

- A. Metastatic lung cancer involving the left cerebellar hemisphere
- ☒ B. An infarct involving the left lateral medulla oblongata
- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 14

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

- A. Cerebellar tonsil
- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

- A. Emboliform nucleus
- ☒ B. Fastigial nucleus
- C. Dentate nucleus
- D. Globose nucleus

Which one of the following is a source of direct excitatory input to Purkinje cells?

- A. Golgi cells
- B. Basket cells
- ☒ C. Mossy fibers
- D. Granule cells

Which one of the following provides direct inhibitory input to Purkinje cells?

- A. Golgi cells
- B. Mossy fibers
- C. Climbing fibers
- ☒ D. Basket cells

Which one of the following receives projections from Purkinje cells in the lateral cerebellum?

- A. Fastigial nucleus
- B. Vestibular nuclei
- ☒ C. Dentate nucleus
- D. Interposed nucleus

Which one of the following is the major target of projections from the flocculonodular lobe?

- A. Dentate nucleus
- ☒ B. Vestibular nuclei
- C. Red nucleus
- D. Thalamus

Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- ☒ B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- ☒ B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

- ☒ A. Granule cells
- B. Golgi cells
- C. Stellate cells
- D. Purkinje cells

Which one of the following best describes the function of parallel fibers in the cerebellar cortex?

- A. Inhibition of stellate cells
- B. Inhibition of Golgi cells
- C. Excitation of granule cells
- ☒ D. Excitation of Purkinje cells

Which one of the following cells provides direct inhibitory input to granule cells?

- A. Purkinje cells
- ☒ B. Golgi cells
- C. Stellate cells
- D. Basket cells

Which one of the following pathways to the cerebellum remains ipsilateral throughout its course?

- A. Ventral spinocerebellar tract
- B. Olivocerebellar tract
- C. Pontocerebellar tract
- ☒ D. Dorsal spinocerebellar tract

Which one of the following parts of the cerebellum is most intimately associated with eye movements?

- A. Dentate nucleus
- ☒ B. Flocculus
- C. Cerebellar tonsils
- D. Lateral cerebellar cortex

Which one of the following structures contains only afferent pathways to the cerebellum?

- A. Superior cerebellar peduncle
- ☒ B. Middle cerebellar peduncle
- C. Dorsal spinal columns
- D. Inferior cerebellar peduncle

Which one of the following structures contains information traveling from the cerebellum to the red nucleus?

- ☒ A. Superior cerebellar peduncle
- B. Middle cerebellar peduncle
- C. Olivocerebellar tract
- D. Inferior cerebellar peduncle

Which one of the following structures contains information carrying between the cerebellum and the vestibular nuclei?

- A. Superior cerebellar peduncle
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- C. Middle cerebellar peduncle
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Which one of the following would be the most characteristic abnormality in an alcoholic with evidence of cerebellar cortical atrophy limited to the cerebellar vermis?

- A. Generalized hypotonia
- B. A generalized increase in deep tendon reflexes
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- A. Metastatic lung cancer involving the left cerebellar hemisphere
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- C. An infarct involving the right middle cerebellar peduncle
- D. A tumor involving the superior cerebellar vermis

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Test #: 15

### Post-program Questions

Which one of the following structures is part of the cerebellar vermis?

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- ☒ B. Nodulus
- C. Emboliform nucleus
- D. Flocculus

Which one of the following cerebellar nuclei lies in the most medial part of the cerebellum?

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Which one of the following is a major direct target of projections from the cerebrocerebellum?

- A. Inferior olive
- ☒ B. Thalamus
- C. Basal ganglia
- D. Cerebral cortex

Which one of the following has major input to the cerebrocerebellum?

- A. Dorsal spinocerebellar tract
- B. Red nucleus
- ☒ C. Basal pons
- D. Vestibular nuclei

Which one of the following sends input to the contralateral cerebellar hemisphere?

- A. Red nucleus
- ☒ B. Inferior olive
- C. Dorsal spinocerebellar tract
- D. Ventral spinocerebellar tract

Which one of the following is the source of parallel fibers in the cerebellar cortex?

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- ☐ D. A tumor involving the superior cerebellar vermis

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