ORGAN OF CORTI "THE RECEPTOR ORGAN OF HEARING": A 3D ANIMATION TO SUPPLEMENT THE GRADUATE, MEDICAL, AND HEALTH PROFESSIONS NEUROSCIENCE COURSE

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DEDICATION

I would like to thank the members of my Graduate Committee:

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Very special thanks to Darya Fakhretdinova, my mom, mi familia, and friends for all their support and encouragement. I could not have done it without you.

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by

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THESIS

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CARLOS G. GONZALEZ, M.A.

The University of Texas Southwestern Medical Center at Dallas, 2010

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The goal of this thesis project was to produce and evaluate a supplementary 3D animated educational tool about the organ of Corti. This project was designed for the graduate, medical school and health professions neuroscience courses. Students have access to the animation through the Internet by clicking a link from the online auditory system lecture notes. The goal of the animation was to help students to better understand the neuroanatomy and physiology of the organ of Corti. Evaluation showed a positive response to the animation. This thesis document describes the current needs for animations on the organ of Corti in the medical, graduate, and health professions

curriculum, documents the existing resources on the subject, and describes the objectives, goals, background, significance, research, project design, and technical implications of the process to create the final product.

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LIST OF DEFINITIONS

Adobe® After Effects® – A digital motion graphics and compositing software published by Adobe Systems. It's main purpose is for film and video post-production.

Autodesk® Maya® – High-end 3D computer graphic and modeling software package originally developed by Alias Systems Corporation, but now owned by Autodesk as part of the Media and Entertainment division.

Adobe® Photoshop® – A graphics-editing program developed by Adobe Systems.

Adobe® Premiere® – A real-time, timeline based video editing software application developed by Adobe Systems.

Adobe® Soundbooth® – A digital audio editor developed by Adobe Systems.

Camtasia Studio® – Screen video/audio capture software published by TechSmith.

Portable Document Format (PDF) – A file format created by Adobe Systems for document exchange.

UV Mapping – The process of making a 3D object with dimensions X, Y, and Z into a 2D plane with coordinates U and V.

CHAPTER ONE
Introduction

The thesis involved the production and testing of a narrated 3D animation on the neuroanatomy and physiology of the organ of Corti. This animation was intended to be a teaching and review tool targeting medical, graduate, and health professions students enrolled in the Neuroscience and Systems Neurophysiology courses at the University of Texas Southwestern Medical Center at Dallas. This project was designed to be used as a web-based supplementary educational tool. In order to make the animation accessible to all students, it appears as a link in the course's online auditory system notes. Students can review the content prior to lecture, as well as during and after the course.

At present, there are no 3D animated tools to supplement lectures to medical, graduate, and health professions students' on the organ of Corti. Furthermore, textbook material only consists of 2D images on the subject. Therefore, the development of a 3D animated video has the potential to greatly enhance the understanding of this complex subject and thus improve the care of patients in the future.

Goal and Objectives

The goal of this project was to produce an animation that would combine 3D models, animations, and narration to describe the anatomy and neurophysiology of the organ of Corti. In order to achieve this goal, several objectives were proposed. The first objective

was to analyze and define the problem. I did research on the neuroanatomy and physiology of the organ of Corti by means of textbooks, journal articles, and Internet resources. I also became familiar with the Neuroscience and Systems Neurophysiology syllabi. This helped me to understand what the course instructors wanted to teach in their lectures. .

Next, I had to come up with a dynamic and original way to present the material so that the animation would enhance the students understanding of the neuroanatomy and physiology of the organ of Corti. Research had to be done to determine an effective way of presenting the animation. It was important to keep the students interested in the subject. The information collected from the research was used to develop a useful animation that covered the objectives and content of the lectures. Once the research was completed, the next objective was to create a preliminary script based on the current lecture notes and an online draft storyboard was developed. The online draft storyboard included objectives from the auditory lecture notes. These components were overseen and approved by Dr. Paul Blount, Ph.D., Associate Professor in the Department of Physiology at UT Southwestern. Dr. Blount is currently the instructor for the auditory systems lectures in the medical school Neuroscience, Health Professions Physiology and graduate Fundamentals of Neuroscience courses. Once the preliminary script and online draft storyboard were approved, a final storyboard was created and printed. The script was recorded and saved as an audio file to be used as narration to the animation.

When the storyboard and narration were approved, 3D models of the structures of the outer, middle, and inner ear were created. The 3D models were animated to show an overview of the external ear to the function of the organ of Corti in the inner ear. When all models were completed, I animated them to match the narration.

The final objective was to evaluate my project. The project was shown to 41 graduate students, post-doctorate, and staff in the Southwestern Department of Neuroscience. The participants evaluated the animation and gave feedback on its effectiveness. The results of the evaluation determined that the animation needed further revisions and additions. Revisions to the animation were made from consistent feedback. Comments and suggestions were taken in consideration to improve the effectiveness of the animation. A future evaluation can be done to the revised animation once it has been integrated into the curriculum.

Background

"To hear, our ears must capture sound, transmit it to the organ of Corti, and translate it into neural impulses to be delivered to the brain." The scala media houses the organ of Corti, the site of mechanoelectrical transduction in the cochlea containing the hair cells and a variety of supporting cells. The organ of Corti, also known as, "the receptor organ of hearing, is located in the cochlea—a spiral, three-chambered, snail-like structure embedded within a dense structure of the temporal bone. "Approximately 16000 hair

cells in each cochlea are innervated by afferent nerve fibers, which carry information into the brain along the cranial nerve VIII." [1]

"In the inner hear, the cochlea is arguably considered the most critical structure in the auditory system; energy from sonically generated pressure waves is transformed into neural impulses." [2] "The cochlea not only amplifies sound waves and converts them into neural signals, but it also acts as a mechanical frequency analyzer, decomposing complex acoustical waveforms into simpler elements. Many features of auditory perception derive from aspects of the physical properties of the cochlea; hence, it is important to consider this structure in some detail." [3]

Significance and Contribution

This organ is one of the most amazing & intricately functionally structure in our body. It is a constantly working elaborate mechanism transforming the mechanical energy of sound waves into the nerve signals. It is difficult for static illustrations to adequately depict that process. Animation using 3D models can show the stages of hearing process not as isolated steps but as a continuous process involving the activity of many structures and cells within the organ of Corti. With access through the curriculum website, students of different specializations can benefit from using the informative and entertaining

[1] Kandel ER, Schwartz JH, Jessell TM. Principles of Neural Science. 4th ed. USA: McGraw-Hill Companies, 2000.
[2] Purves D, Augustine GJ, Fitzpatrick D, Hall WC, LaMantia AS, McNamara JO, Williams SM. Neuroscience. 4th ed. USA: Sinauer, 2008.

animation as a supplementary learning tool. They can gain special insights on how the organ of Corti actually works within the cochlea. Combined with textbook, the animation watching will potentially increase the understanding of the organ of Corti works and be helpful for the exam preparation. The animation may also prove advantageous in the learning process of students with attention deficit disorders.

The project

The project consists of a five minutes and thirty seconds 3D narrated animation. The animation was exported using Adobe® Premiere® to be viewed and played using internet connection by clicking a link from the online lecture notes. Flash Player is needed to view the animation online.

Evaluation and Outcome

A formative evaluation was implemented to assess the effectiveness of the preliminary animation. The animation was well received. Consistent feedback to the animation's main topics dictated that changes needed to be made to the animation. Comments and suggestions were also taken into consideration to improve the effectiveness of the animation. The animation was corrected. A summative evaluation can only be done after this has been incorporated into the curriculum.

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[3] Purves D, Augustine GJ, Fitzpatrick D, Hall WC, LaMantia AS, McNamara JO, Williams SM. Neuroscience. 4th ed. USA: Sinauer, 2008.

CHAPTER TWO
Literature Review

An important objective of this project was to do a thorough review of the literature available on the neuroanatomy and physiology of the organ of Corti. There are many resources such as textbooks, journal articles and Internet that describe the neuroanatomy and physiology of the organ of Corti, but many of them do not have helpful visual media. All images in the literature reviewed were static drawings, and if a 3D animation was present, it was either scientifically inaccurate or artistically inaccurate. By reviewing the literature of the organ of Corti, it is evident that it is very important topic for medical, graduate, and health professions students to understand because it is essential in diagnosing and treating dysfunctions associated with the ear.

Analysis

The first step of the literature review was to determine what students at the University of Texas Southwestern Medical Center are required to know about the organ of Corti. A review of course syllabi indicated that it was mandatory for students to understand the neuroanatomy and physiology of the inner ear including the processing and perception of sound.

In the UT Southwestern curriculum, suggested learning material consisted only of textbooks. Three books currently used by students are, Neuroscience (4th ed.) by Purves, Principles of Neural Science (4th ed.) by Kandel, and Human Physiology (11th ed.) by Fox. No 3D animations were suggested. I reviewed the textbook material based on the subject matter, primarily for scientific accuracy and artistic clarity.

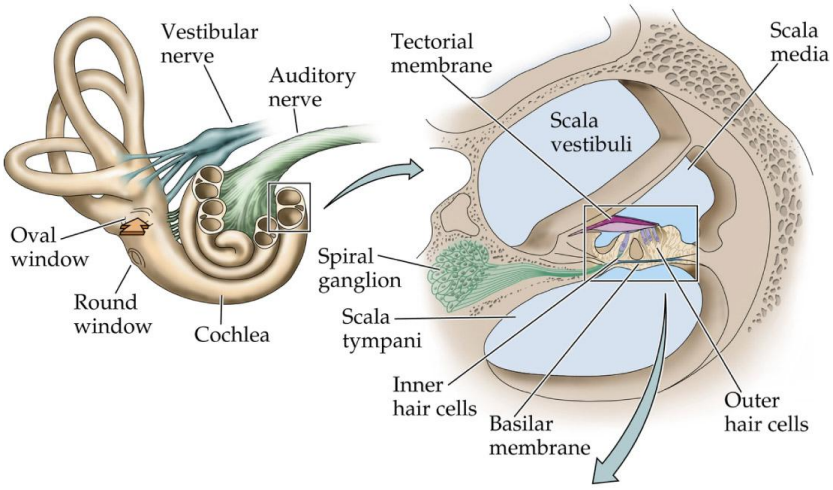
The textbook material was evaluated based on the following criteria:

- Images
  - Scientific accuracy
  - Clarity
  - Artistic quality
- Narration (If applicable)
  - Scientific accuracy
  - Audio quality
- Successful / Unsuccessful

To show the effectiveness of textbook material based on the criteria above, a chart was created and placed under each illustration and/or animation. Stars were given to rank each category if applicable. Four starts being the most effectiveness and zero starts for less effectiveness.

Textbooks

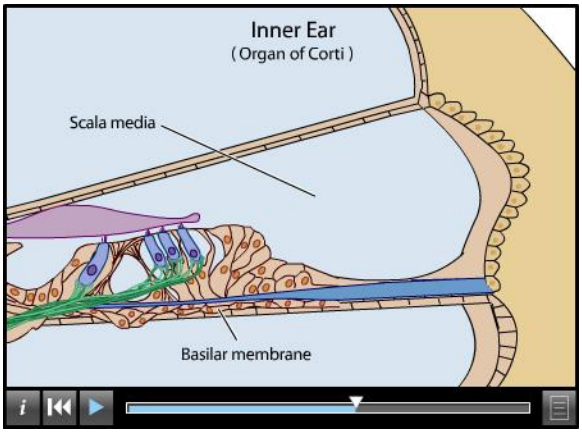
Neuroscience (4th ed.) by Purves. The Neuroscience textbook was first published in 1997. It has been updated four times with the 4th edition released in 2008. The professors considered this one of the best textbooks available on my topic. This textbook is primarily used by medical, health professions, and neuroscience students. This textbook is considered an introductory /overview book about neuroscience. It includes scientifically accurate static illustrations about the organ of Corti **(Figure 2-1)**.



Images		Narration
Scientific accuracy	★★★	Scientific accuracy
Clarity	★★	Audio quality
Artistic Quality	★★	

Figure 2-1. Neuroscience static illustrations.

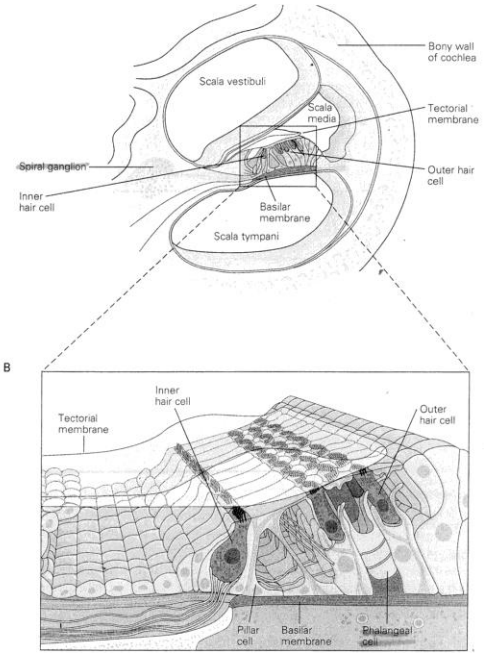
This textbook does not include a CD with animations, but it comes with a companion website for students to access. The website includes a 2D animation about the human ear, flashcards, and key terms. The animation's narration and image content is scientifically accurate, but it lacks artistic quality **(Figure 2-2)**. There is not a 3D animation either in the textbook or online website. Overall, the animation is successful but it lacks that 3D dimensionally that is critically important for the student to understand.



Images		Narration	
Scientific accuracy	★★	Scientific accuracy	★★★★
Clarity	★★	Audio quality	★★★
Artistic Quality	★		

Figure 2-2. Neuroscience 2D animation.

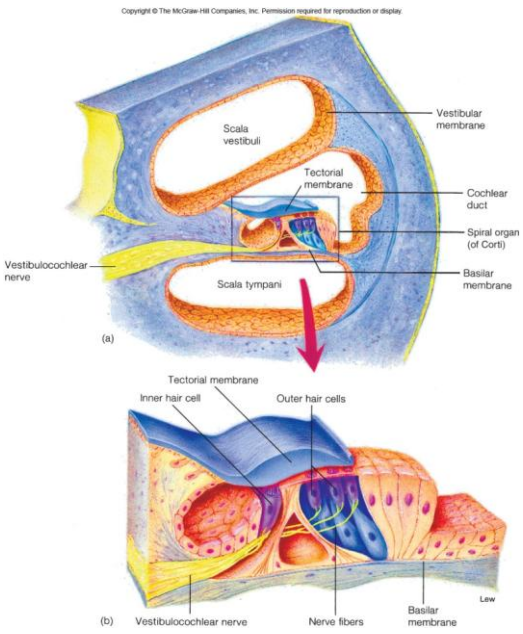
Principles of Neural Science (4th ed.) by Kandel. The Principles of Neural Science textbook was first published in 1981. It has been updated four times with the 4th edition released in 2000. This textbook is primarily used by neuroscience graduate students. No companion CD or website is included with this textbook. Static illustrations within the book are scientifically and artistically accurate **(Figure 2-3)**. A 3D animation is not available to describe the anatomy and physiology of the organ of Corti.



Images		Narration
Scientific accuracy	★★★★	Scientific accuracy
Clarity	★★★	Audio quality
Artistic Quality	★★★	

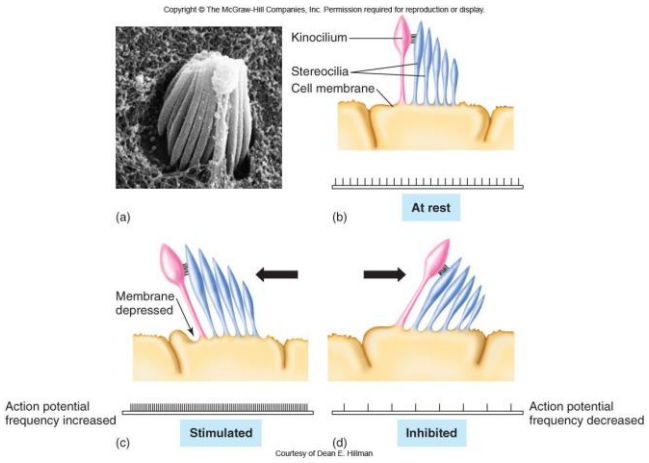
Figure 2-3. Principles of Neural Science static illustrations.

Human Physiology (11th ed.) by Fox. The Human Physiology textbook was first published in 1984. It has been updated eleven times with the 11th edition released in 2008. This textbook is primarily used for health professions. The textbook does not include a CD with animations, but it comes with a companion website for students to access. The website includes practice tests, labeling exercises, and 2D animations. Flat illustrations are scientifically accurate but fall short in artistic quality. **Figure 2-4** show the organ of Corti while **Figure 2-5** shows stereocilia being depicted anatomically inaccurately.



Images		Narration
Scientific accuracy	★★	Scientific accuracy
Clarity	★★	Audio quality
Artistic Quality	★★	

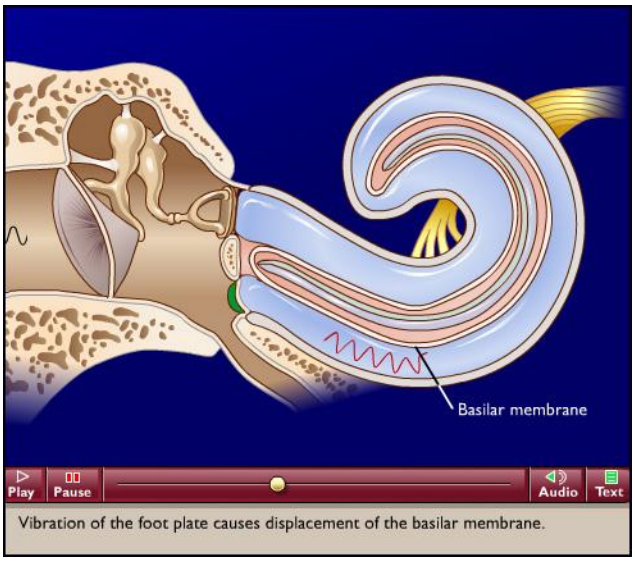
Figure 2-4. Human Physiology static illustrations.



Images		Narration
Scientific accuracy	★★	Scientific accuracy
Clarity	★	Audio quality
Artistic Quality	★	

Figure 2-5. Human Physiology static illustration.

The 2D animations are not specifically about the organ of Corti. Two animations are about the effects of sound waves in the cochlea but none descriptive fully the organ of Corti. The two animations in the companion website are very similar in content and style. In the second animation the narrator mentions twice "Detected by haircells not visible in the animation" to describe how sound is detected **(Figure 2-6)**. This is an important step for a student to see and comprehend, apparently is lacking in both animations.



Images		Narration	
Scientific accuracy	★★	Scientific accuracy	★★★★
Clarity	★	Audio quality	★★★
Artistic Quality	★		

Figure 2-6. Human Physiology 2D animation screenshot.

These three textbooks are examples of important resources for the student. Both textbooks have information about the organ of Corti in the form of text, static illustrations, and in the case of the Neuroscience by Purves and Human Physiology by Fox, it includes a companion website. The three textbooks have static illustrations that are for the most part simplified and scientifically accurate. These illustrations are great references for quick review and studying. However, the learning experience could be enhanced (especially for students learning about the organ of Corti for the first time) if there were more detailed images (such as 3D images) included.

Illustrations

The illustrations available in neuroscience books of the organ of Corti are two-dimensional still images and cannot clearly describe the 3D space, which is important for the student to comprehend and appreciate.

The 3D nature of the organ of Corti within the cochlea and how it relates to the anatomy surrounding it, is an important concept for students to grasp. 3D animation allows the viewer to clearly see three-dimensional arrangements, while textbooks do not have this capacity.

Limitations

Textbooks in general are lacking the ability to convey 3D spatial information. The organ of Corti is such a complex organ that can be difficult to visualize.

Necessity of a 3D Animation

There are currently no 3D animations to accompany UT Southwestern's Neuroscience and Systems Neurophysiology lecture notes. The only video available is on the topic of the brain and spinal slices.

Animation

Animation can be an effective way to get closer to the experience of "flying" through the ear. "There is accumulating evidence that animations are more effective than static sequential images in learning techniques." [4] Motion distinguishes animations from static images and captures critical steps. 2D animations are not ideal for illustrating such dynamic structures and actions. After searching libraries, bookstores, the Internet, and asking students and faculty if they knew about any available animations about the organ of Corti, I was able to find several videos about the ear **(See Appendix A)**.

I viewed all the animations with a critical eye so I could determine what made them successful or unsuccessful learning objects. I also took notes about what made some animations visually pleasing. The narration, the overall quality of the images, and the timing are important pieces that contribute to the success or failure of an animation. "According to multimedia learning, people benefit better from graphics with spoken words rather than graphics with printed text." [5] These principles helped me determine how to integrate 3D and narration into animation rather than using images with text descriptions. Clarity is critical in order for viewers to understand what exactly is being portrayed in the animation. Adding clear labeling such as a structure's name and other graphical components can help clarify confusing areas of the animation. The success of an animation in general, can be attributed to informative narration, clear labeling, and

[4] O'Day DH. "Animated Cell Biology: A Quick and Easy Method for Making Effective, High-Quality Teaching Animations." CBE – Life Sciences Education 5 (2006): 255-63
[5] Mayer RE. "The promise of multimedia learning: using the same instructional design methods across different media." Learning and Instruction 13 (2003): 125-139.

outstanding quality. I took note of all these factors for the future production of the animation of my project.

Of the numerous animations viewed I narrowed it down to 22 that consisted of what I was looking for in an animation, 3D models and audio narration. All of animations viewed had strengths and weaknesses. Some of them had great scientific narration but lacked artistic quality. Others had great artistic quality but missed the scientific accuracy.

Animations were evaluated based on the following criteria:

- Narration (If applicable)
  - Scientific accuracy
  - Audio quality
- Images
  - Scientific accuracy
  - Clarity
  - Artistic quality
- Successful / Unsuccessful

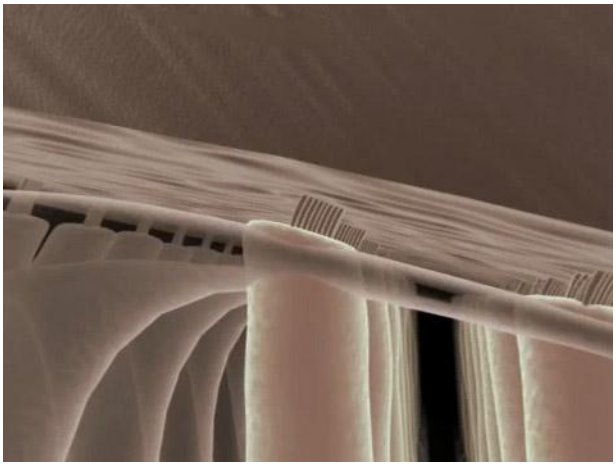
"Colour of Sound" **(Figure 2-7)** has great modeling structures of the tympanic drum, ossicles, cochlea, cochlear nerve and brain. But it lacks the most important structure, the organ of Corti, the receptor organ of hearing. This animation has pleasing camera moves as well as artistic quality but eventually never makes it to the inside the cochlea where the organ of Corti is located. Waveforms are pleasing at the beginning but later in the

animation, they tend to be a little distracting. This animation mentions most of the structures but never shows and animates the basilar membrane, etc. Not only that, but whenever the animation mentioned the structures, it doesn't even highlights them. No labels and not details on how sound is transducer in the cochlea.

Narration		Images	
Scientific accuracy	★★	Scientific accuracy	★★
Audio quality	★★	Clarity	★★
		Artistic quality	★★★★

Figure 2-7. *"Colour of Sound"*

"Auditory Transduction," **(Figure 2-8)** has a good scientific background. The animation starts and ends very well. There are only a few things wrong, one of them is the haircells, haircells are typically 3-4 rows in v-shaped but this animation does not show that.



Narration		Images	
Scientific accuracy	★	Scientific accuracy	★★
Audio quality	★★	Clarity	★★
		Artistic quality	★★

Figure 2-8. *"Auditory Transduction"*

"El Oido y la Audicio" **(Figure 2-9)** has probably the best narration sound quality, very pleasing. I realized this animation had a different approach, it went from using and displaying 3D models, to illustrations, to photographs. It also showed correct scientific anatomy and physiology.

"Causes and types of Hearing Loss" **(Figure 2-10)** has great narration but lacks anatomy and physiology accuracy.

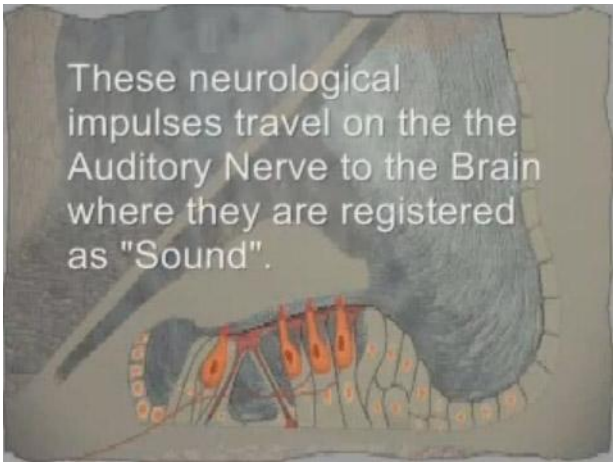
Narration		Images	
Scientific accuracy	★★★	Scientific accuracy	★★★
Audio quality	★★	Clarity	★★
		Artistic quality	★

Figure 2-9. *"El Oido y la Audicion"*

Narration		Images	
Scientific accuracy	★	Scientific accuracy	★
Audio quality	★	Clarity	★
		Artistic quality	

Figure 2-10. *"Causes and Types of Hearing Loss"*

Other illustrations were rated as follows:



Narration	Images
Scientific accuracy ★	Scientific accuracy ★
Audio quality	Clarity ★
	Artistic quality ★★

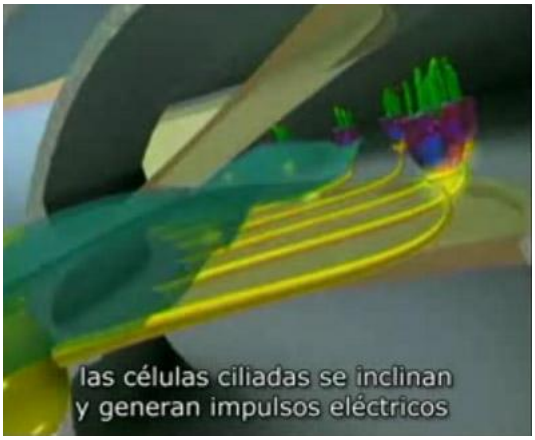
Figure 2-11. *"How we hear"*

Narration		Images	
Scientific accuracy	★★	Scientific accuracy	★
Audio quality	★★	Clarity	★★
		Artistic quality	★★★

Figure 2-12. *"S 007 Horen / Ear and Hearing"*

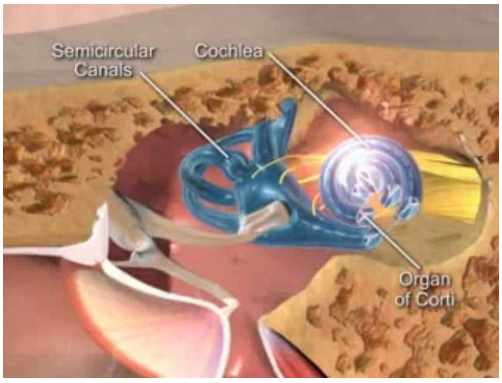
Narration		Images	
Scientific accuracy	★	Scientific accuracy	
Audio quality	★	Clarity	★
		Artistic quality	★

Figure 2-13. *"Stereocilia"*



Narration		Images	
Scientific accuracy	★	Scientific accuracy	
Audio quality	★	Clarity	★
		Artistic quality	★

Figure 2-14. *"¿Cómo oímos?"*



Narration		Images	
Scientific accuracy	★	Scientific accuracy	★ ★
Audio quality	★	Clarity	★
		Artistic quality	★

Figure 2-15. *"Process of Hearing Animation"*

Narration		Images	
Scientific accuracy	★★	Scientific accuracy	
Audio quality	★	Clarity	★
		Artistic quality	★★

Figure 2-16. *"El Oido Humano"*

Narration		Images	
Scientific accuracy		Scientific accuracy	★
Audio quality		Clarity	★
		Artistic quality	★★★

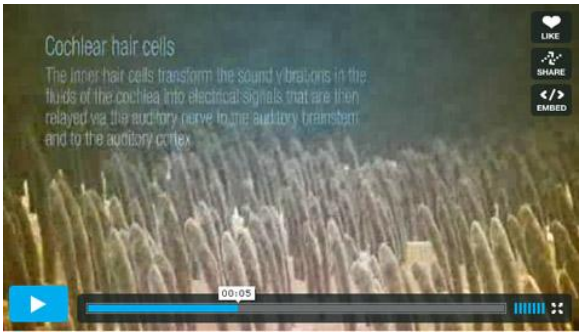
Figure 2-17. *"Xvivo Demo Reel"*

Narration		Images	
Scientific accuracy	★★	Scientific accuracy	★
Audio quality	★	Clarity	★
		Artistic quality	

Figure 2-18. *"Quieting The Skies"*

Narration		Images	
Scientific accuracy	★	Scientific accuracy	★
Audio quality	★	Clarity	★
		Artistic quality	★★

Figure 2-19. *"Seeing Sound"*

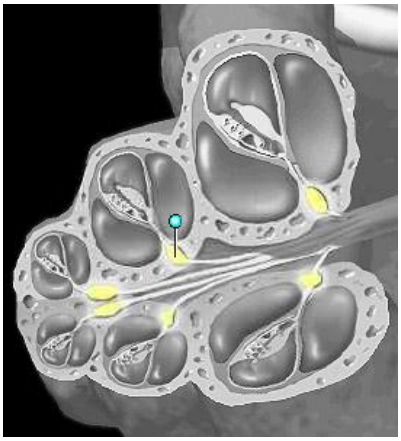


Narration		Images	
Scientific accuracy	★	Scientific accuracy	
Audio quality	★	Clarity	★★
		Artistic quality	★★★

Figure 2-20. *"Cochlear Haircells"*

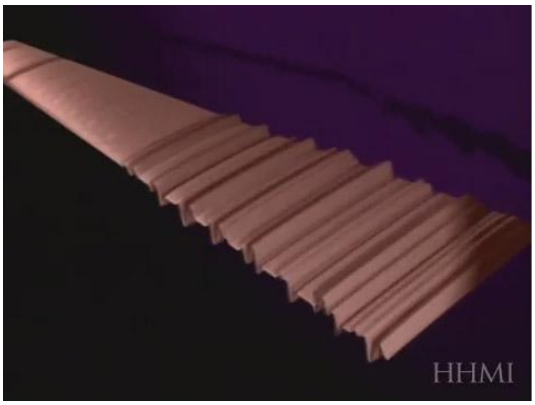
Narration		Images	
Scientific accuracy		Scientific accuracy	
Audio quality	★	Clarity	★
		Artistic quality	★

Figure 2-21. *"Deep into the Ear"*



Narration	Images
Scientific accuracy	Scientific accuracy ★
Audio quality	Clarity ★
	Artistic quality ★

Figure 2-22. *"Ear Interactive Tool"*



Narration	Images
Scientific accuracy ★★	Scientific accuracy ★★
Audio quality ★★	Clarity ★
	Artistic quality ★

Figure 2-23. *"Basilar Membrane"*

Conclusion

The analysis of literature & web resources concerning the organ of Corti showed that there is a discrepancy between the state of current scientific knowledge on how the organ works and visual resources depicting that. If we look at the textbook illustrations, we see that they are flat and the maximum information you can get from those illustrations is the anatomy of the organ of Corti.

There are some currently available animations similar to mine. The majority of them are not fully 3D rendered. The rest of them have problems with the reliability of the scientific content. For teaching purposes content of the animation should be as close as possible to the current state of knowledge. My animation meets this criteria. First, I reviewed many textbooks available on the topic. Second, I had a content advisor who has expertise in the field of the organ of Corti and who teaches this topic to the graduate, medical, and health professionals' students.

CHAPTER THREE
Methodology

Concept Development

The goal of this thesis project was to create a narrated 3D animation on the organ of Corti as a supplementary educational tool for the graduate, medical, and health professions neuroscience curriculum at UT Southwestern Medical Center, Dallas, Texas. Discussions with my mentors, content expert, and review of many textbooks, animations, and syllabus material, resulted in the decision of what material needed to be presented. While reading through and analyzing the syllabus material, it was important for me to identify what material in the text was effective, what could be improved, and what was lacking. The sequence of project development was the production of a preliminary script, storyboard, 3D models and a final animation. The animation was edited and exported using Adobe Premiere® as a flash file to be played using an Internet connection from a link on the online lecture notes. After the final formative evaluation, final revisions were made.

Script

A preliminary script was developed of the organ of Corti based on the Neuroscience & Neurophysiology syllabi. This allowed me to write about main topics students were responsible for and clearly explained the topic.

Storyboard

The preliminary script was used to produce an online storyboard for my committee members to view and comment on as I built it **(Figure 3-1)**. The storyboard breaks down the animation shot by shot. Each visual shot reflected what the camera would see and included the script under each shot.

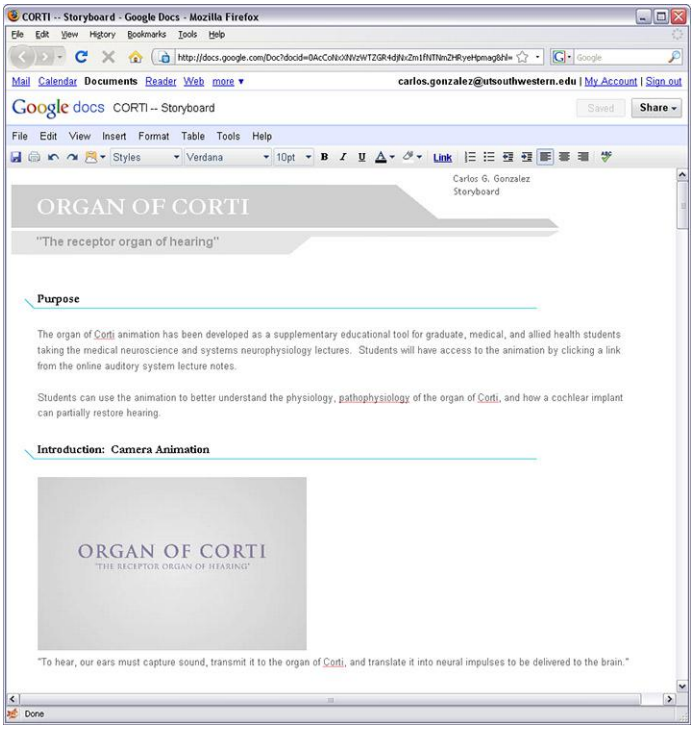


Figure 3-1. Draft Storyboard created using Google docs

Once the storyboard was completed, a more refined storyboard was brought to InDesign® to layout and type the script **(Figure 3-2)**. The storyboard was printed **(See Appendix B)** and shared with my committee members to allow for feedback.

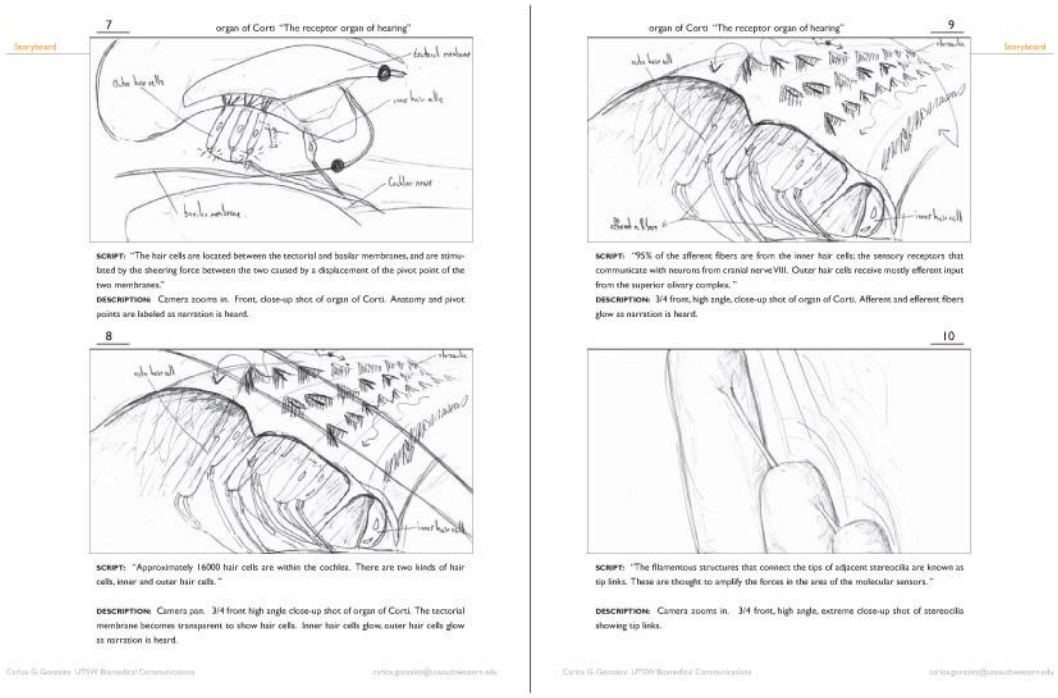


Figure 3-2. Storyboard created using Adobe InDesign®

Camtasia® software was used to record the script narration. Camtasia files were exported out as .WAV audio files and imported into Adobe® Soundbooth® to edit.

3D Models

I created 3D models using Autodesk Maya® that were based on the storyboard. Microscope slices, Scanning Electron Microscope (SEM), Magnetic Resonance Imaging (MRI), photographs, and illustrations from textbooks, websites, journals, and lecture

notes were used as references to create and depict the most accurate models of the external, middle, and inner ear.

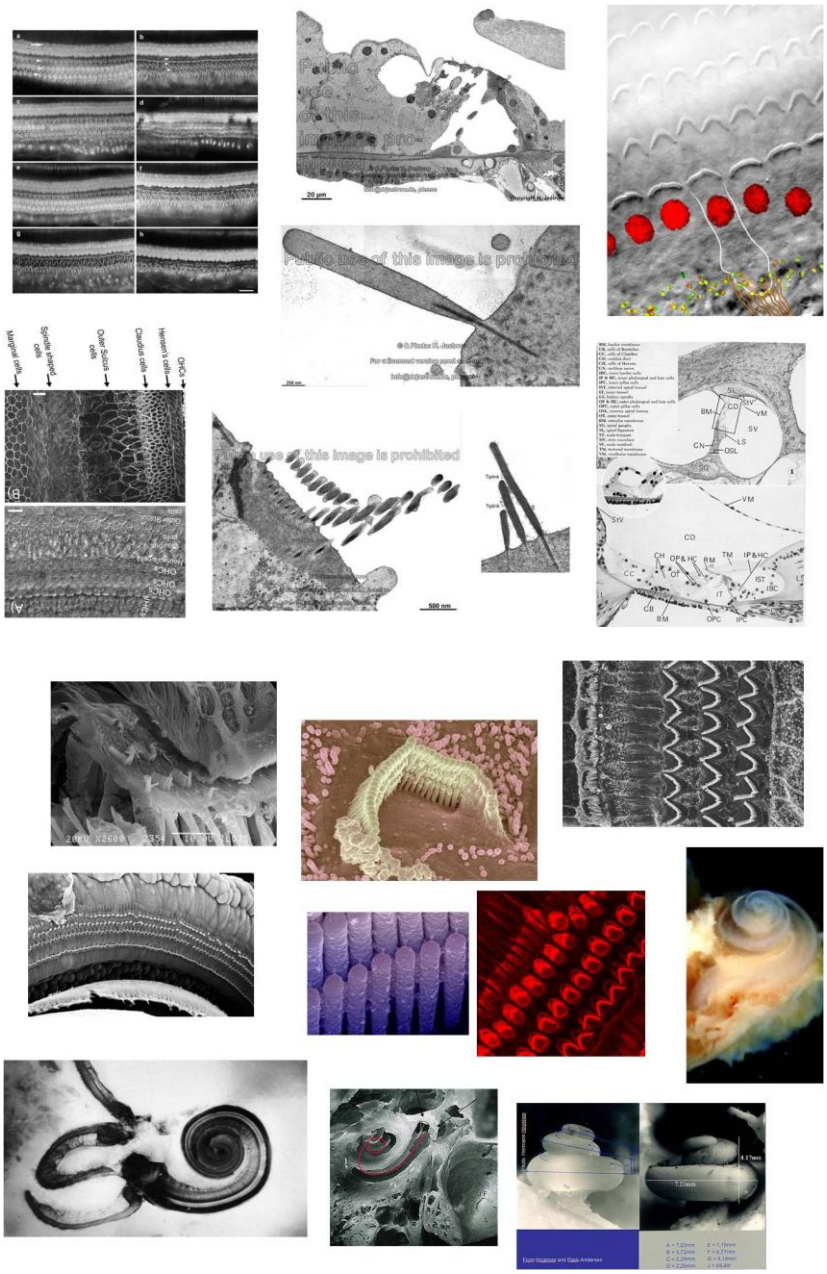


Figure 3-3. References

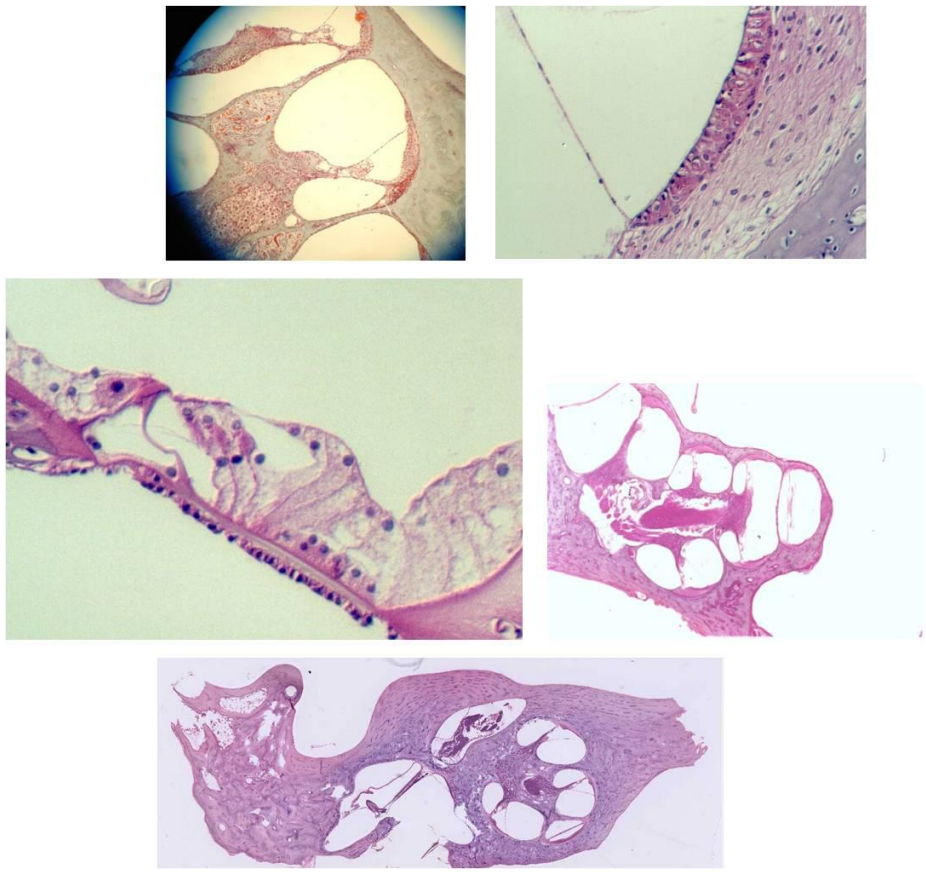


Figure 3-3. References

In Maya®, I had two options of building my 3D models, NURBS or Polygons? I preferred to use the polygonal modeling approach. Polygons were easier to modify because they included many individual surfaces. In addition, polygons rendered faster than NURBS, which allowed for quicker rendering time.

Once the models were built, the uvs were laid out in Maya® and brought into Photoshop® to paint textures on them. Some models were textured with shaders within Maya®.

A micrographic look was chosen. A micrographic look shows the appearance of objects as seen or photographed through a microscope.

In Maya® cameras were set and locked in place to define the visible rendered size and to prevent further camera moving. The cameras resolution gate size was set to 852 pixels width by 420 pixels height **(Figure 3-3)**.

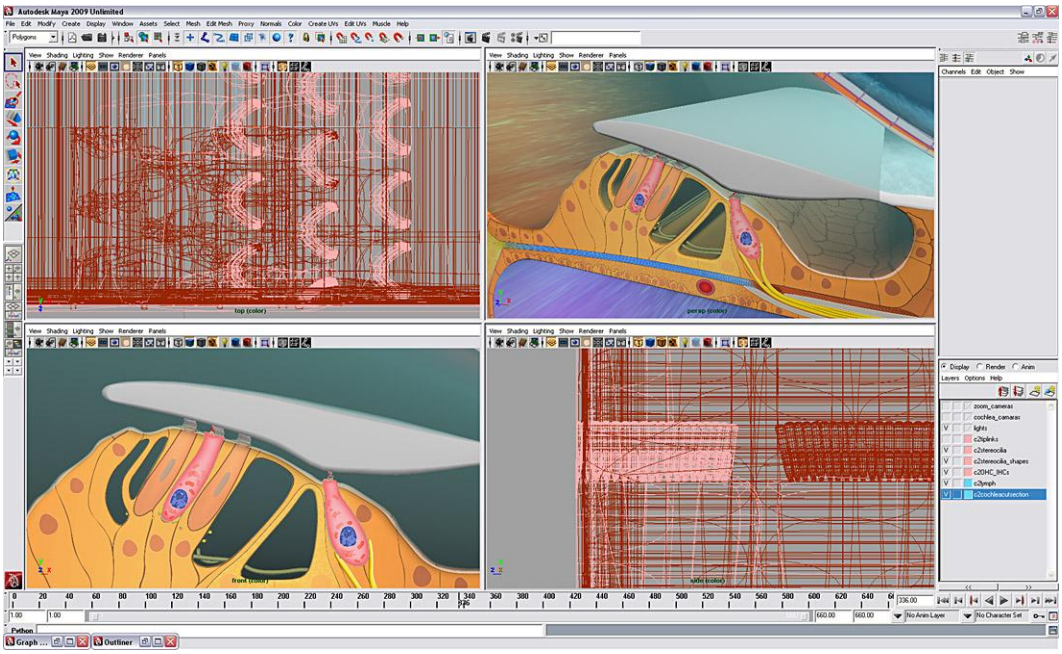


Figure 3-3. Autodesk Maya® Screenshot

Standard three-point lighting was setup, which consisted of a key light, fill light, and back light. The key light (main light) was used with an emitter and used to create shadows. A fill light was used to fill the harsh shadows created by the key light and the back light was used to add a highlight to the upper edges of models to emphasize their contours. All three lights were added color to them to match color range of objects.

Animation

The 3D models were animated in Autodesk Maya®. During the animation process, several playblasts were rendered to preview the animation. Playblast is a hardware-rendered animation taken straight from Maya® window's view panel. It provides a quick means for previewing an animation at a lower quality cost either in an .avi or in QuickTime.[6]

By using Maya's layers, I was able to organize my scene by separating geometry, lights, and cameras. Four render layers were created and included: Color, Microscribe, Ambient Occlusion **(Figure 3-4),** and Shadows.

[6] Sharpe J, Lumsden C, Woolridge N. In Silico: 3D Animation and Simulation of Cell Biology with Maya and Mel. China: Elsevier, 2008.

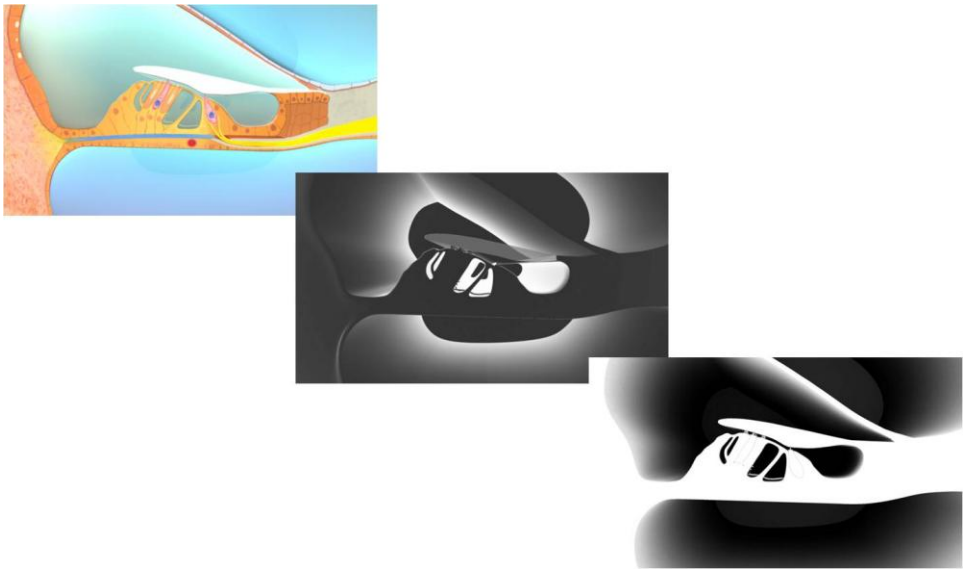


Figure 3-4. Color, Microscribe, Ambient Occlusion

The color layer included the models, texture, and lights. The Microscribe layer was used to add a scanning electron microscope look and feel. The Ambient Occlusion layer was used as a method to add realism to models, this layer is light independent; therefore no lights and textures were applied to these layer. The Shadows layer was used to capture shadows.

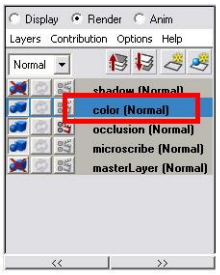


Figure 3-4. Render layers

The images were saved as individual picture files or as a group in one movie file and were then displayed in a viewing application. Render size was assigned in the render settings.

Before starting the editing process, I had to create a way to organize all of my rendered image files that were to be used in the production of the animation. A filing system was made. I batched rendered still images of the animation for each camera from Maya® as .PNG format because it was essential for the transparent background to be maintained **(Figure 3-6)**. All layers were rendered using mental ray at production setting **(Figure 3-6)**. I made one folder for each camera to include its series of .PNGs.

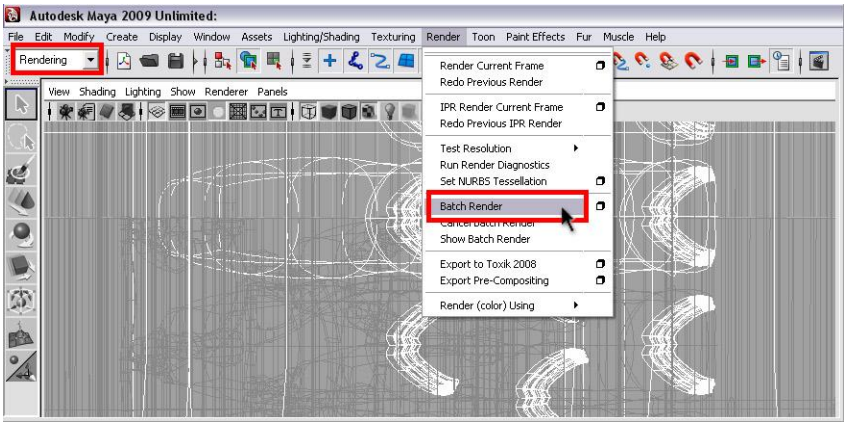


Figure 3-5. Batch render

Rendered images were composed using Adobe After Effects®. I did this step so that when I worked I could create a separate compositions based on the audio clip. In After Effects®, special effects were added to the sequences to enhance the appearance of the

footage. When all compositions were completed, I brought them into two main compositions, one anatomy and the other physiology **(Figure 3-7)**. Working with different compositions kept me organized throughout the project. If I was not organized, I would have ended up with too many compositions.

Once the footage was complete, the After Effects® file was linked to Adobe Premiere® via a "dynamic link", this means that any time you modify and save your After Effects® file, it will automatically update in Adobe Premiere®. I was ready to begin editing in Adobe Premiere®. Narration and sounds were edited using Soundbooth® and brought into Adobe Premiere®. Adobe Premiere® was used for final composing of images and synch of sound with the animation. Each paragraph of the script was matched with a .WAV audio over a sequence **(Figure 3-8)** in Adobe Premiere®.

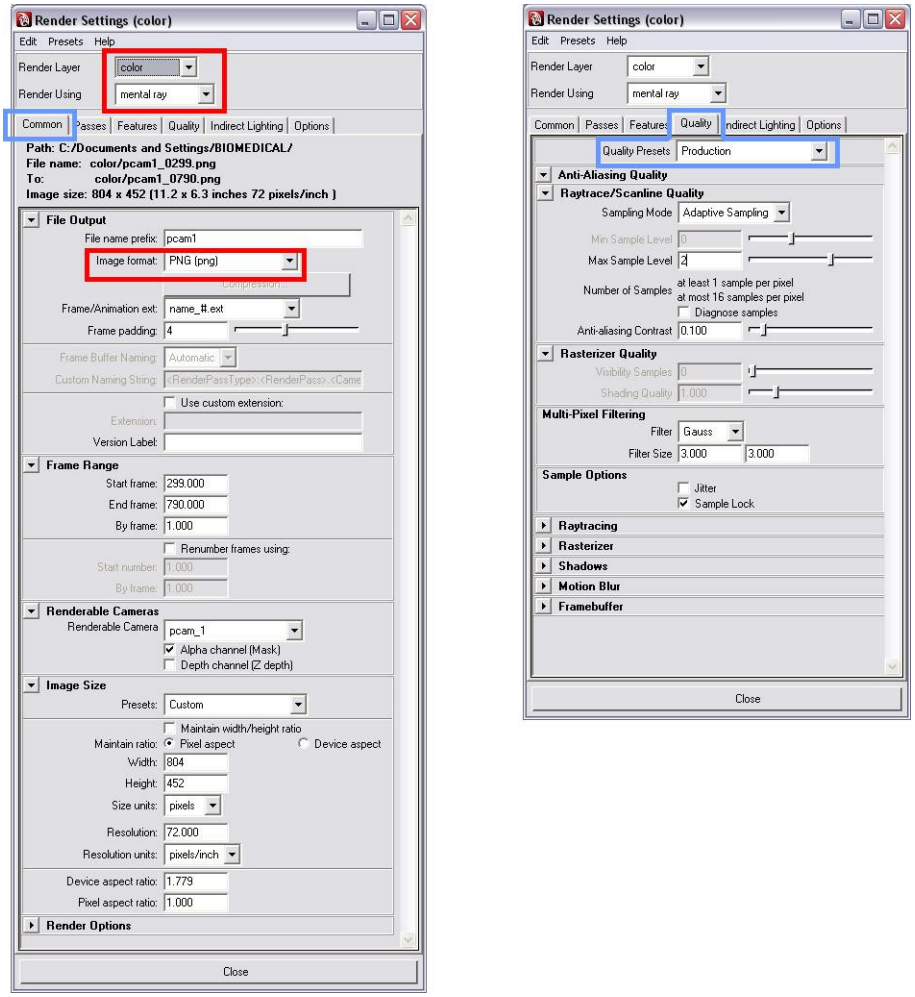


Figure 3-6. Render settings

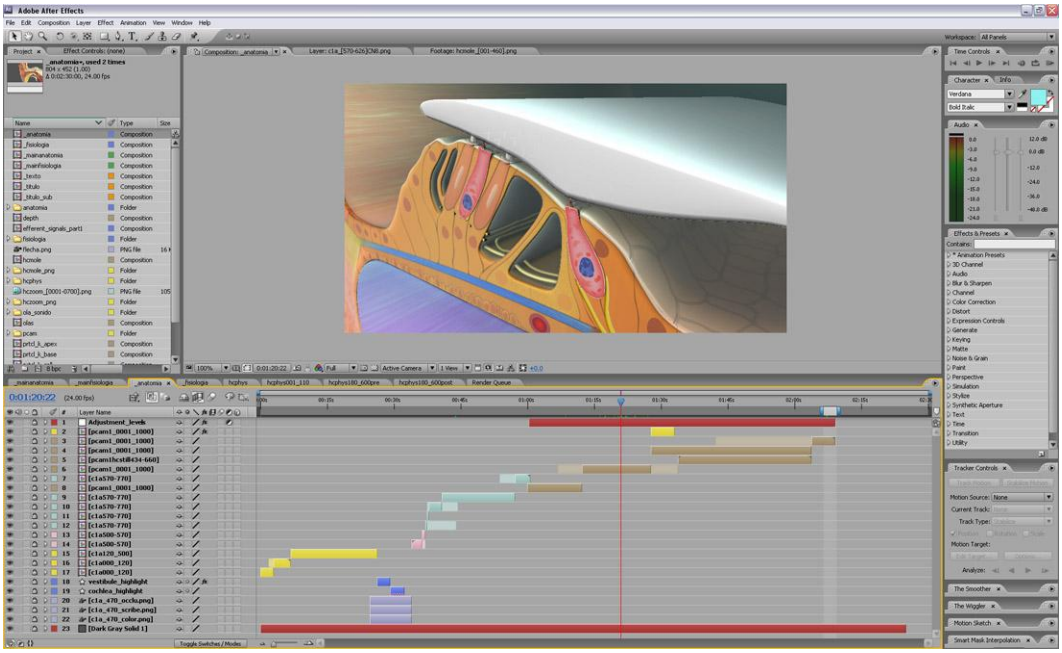


Figure 3-7. Adobe® After Effects® Screenshot

The animation was edited in chronological order, one composition at a time. When the first draft of the animation was completed, I was able to show it to my committee for critique. Following the critiques, I improved my models and paid extra attention to timing the audio, imagery and text. Any texture map that I altered in Adobe Photoshop® had to be re-imported into Maya® and Adobe After Effects®. Luckily this process was very simple but time re-rendering was crucial. In Maya®, I would select the texture shader and update it. Once I re-rendered the batch-render for that camera, in After Effects® I selected the sequence and chose to reload it and replace footage. The image would automatically be replaced in the timeline of all the compositions it was in.

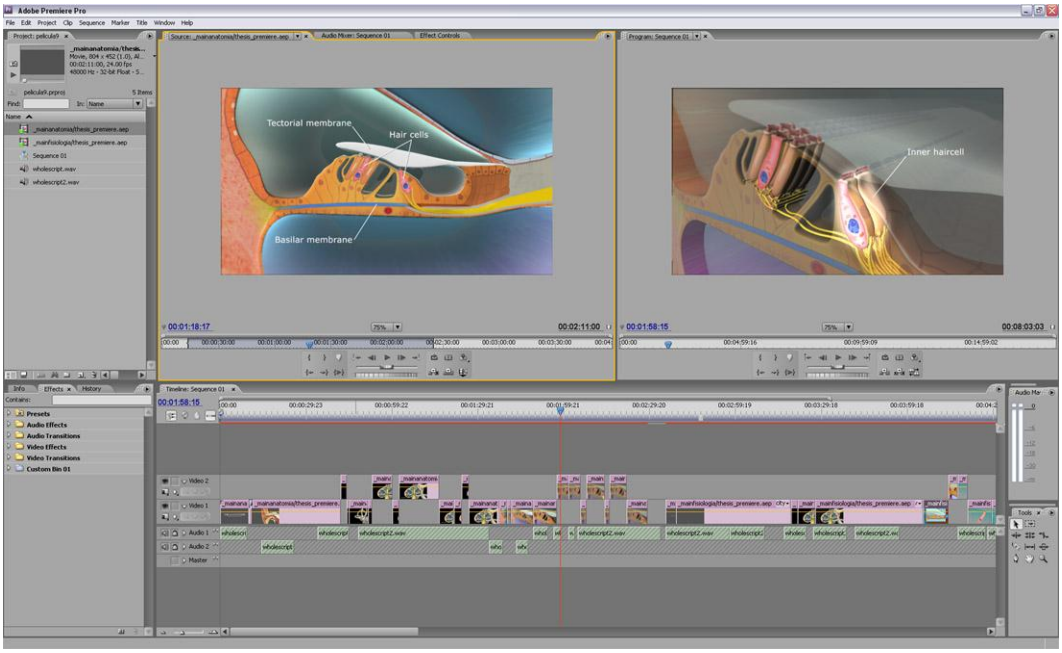


Figure 3-8. Adobe Premiere® Screenshot

As a final method of output, the video was exported out of Adobe Premiere® as a Flash Video File (FLV). FLV files are streaming video files that are played over the internet and are known for great internet compressions allowing fast downloading time. Several FLV export settings were tested to see which one was more suitable for the internet. The final video settings were set to 852 pixels width by 420 pixels height, video codec at On2 VP6, bitrate settings at 2400kbps, and audio encoding at stereo 160kbps **(Figure 3-9)**.

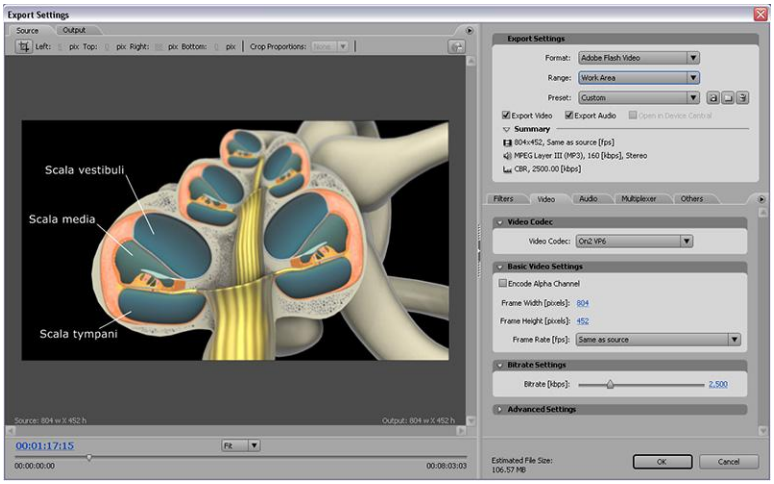


Figure 3-9. FLV Settings

CHAPTER FOUR
Evaluation/Revision

After the preliminary animation was completed, a formative evaluation was conducted to determine if revisions were needed for the final version. The process of testing consisted of the preparation of the evaluation sheet with questions, the presentation of the animation to the chosen group of respondents, evaluation of the animation by respondents, and analysis of the evaluations.

Analysis of the evaluation results dictated what changes were to be done to the organ of Corti animation before it can be used as an additional learning tool in neuroscience curriculum.

The evaluation form consisted of a question about the position of the respondent and four statements reflecting major scientific content points of the animation **(See Appendix C)**.

The questions were as follows:

1. Which describes you?
2. Function of the Organ of Corti. Clear Unclear
3. Afferent and efferent fibers. Clear Unclear
4. Tonotopic map. Clear Unclear
5. Depolarization and Hyperpolarization of the haircell. Clear Unclear

The respondents had the choice to answer clear or unclear. Questions were asked in the order of the animation's main points. Also, they were asked to make additional comments and suggestions concerning the content of the animation. This would be a valuable basis for the animation's improvement.

The presentation and evaluation of the animation took place at the Neuroscience Department's weekly Work in Progress (WIP) meeting on February 22, 2010, attended by graduate students, faculty and staff. This audience was suitable for the purpose of the evaluation because the majority of attendants had the prior knowledge in the topic and they could give feedback that is more informed.

The evaluation sheets were distributed to all participants before the WIP started. After the animation was introduced (1 minute), it was projected on the screen under dim light. All the participants could see the animation and hear the narration. The animation lasted for 5 minutes and 30 seconds. The participants were then given 10 minutes to fill out their evaluation forms. The evaluation sheets were returned to me for the following review and analysis.

Evaluation Responses

According to the data, the overall responses were very positively and helpful. The feedback allowed me to improve and finish my animation. **Figure 4-1** shows the academic levels of the respondents. **Figure 4-2** shows the other evaluation responses.

The question and statements were answered as follow:

Question 1: Which describes you? Grad student Post-Doc Faculty Other:_____

34 Grad Students, 4 Faculty, 1 Post-Doc, 1 Research Assistant, 1 Tech

This was a favorable sampling because the vast majority of respondents were graduate students, the target audience of the animation.

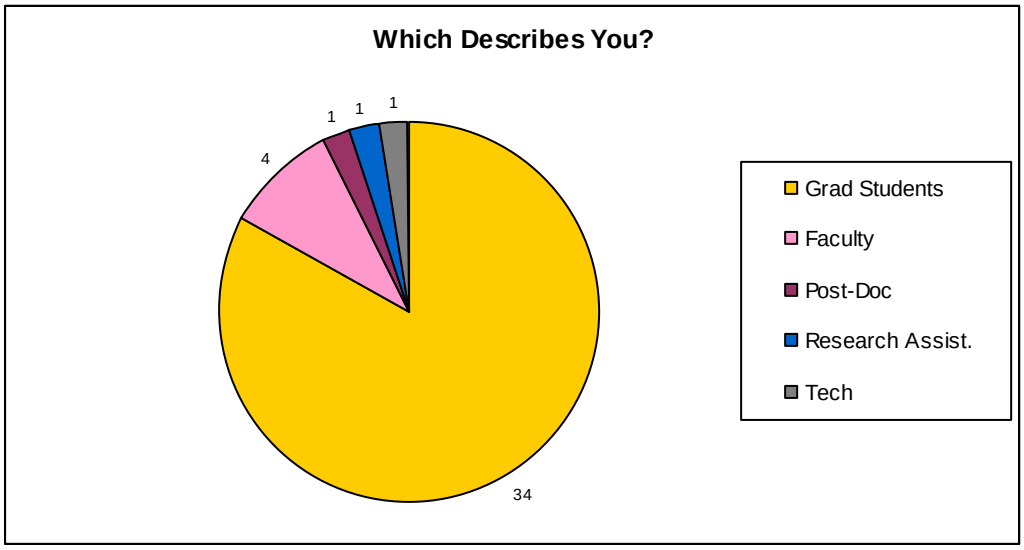


Figure 4-1. Question 1. Which describes you?

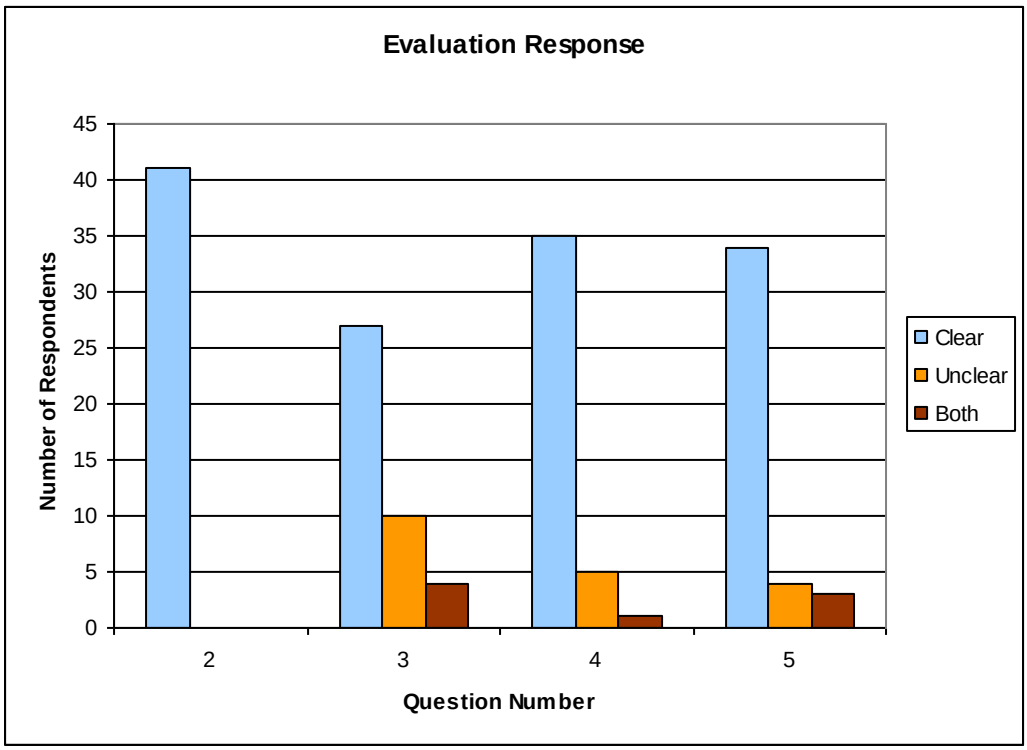


Figure 4-2. Questions 2,3,4, and 5. Evaluation Response

Question 2: Function of the organ of Corti. Clear Unclear

41 clear, 0 unclear

All respondents circled clear, indicating that the overall function of the organ was understandable.

Suggestions:

Even though all the respondents answered clear, a few consistent suggestions were shared such as:

"The beginning had a few sections where there was no speaking and it seemed a bit awkward."

"Slow down the initial presentation. This section moves too fast."

"There is more time for verbal explanation to supplement your animation."

Such suggestions can be due to lack of timing, lack of sound effects to animation, or just personal viewing preferences.

Notable Comments:

"Very beautifully done."

"Well done!

Question 3: Afferent and efferent fibers. Clear Unclear

27 clear, 10 unclear, 4 both

About one-third of the respondents found the depiction of afferent & efferent fibers both clear and unclear.

Suggestions:

"Mostly clear, could have more detail and color."

"Slow down and show impulses moving back and forth."

"Perhaps add arrows indicating afferent and efferent fibers."

"Efferent less clear."

"Could be better explain."

Consistent suggestions showed that it was logical to add impulses or arrows going from the inner haircells, to afferent fibers, to the brain coming back to the efferent fibers to outer haircells. Others commented to assigned different colors to differentiate fibers from one other. It is unclear whether respondents simply needed to watch the animation more than once. I also became aware that respondents were interested in viewing more that was shown. One suggested, "Maybe it would be good to tell a little bit more about where impulses go, cranial nerve & then…" "Maybe show auditory cortex connections." Overall, I believe the confusion was the lack of labels, color, impulses, and content description.

Question 4: Tonotopic map. Clear Unclear

35 clear, 5 unclear, 1 both

Respondents found some of the answers to be right and wrong because they confused the tonotopic map with that of the brain. This might explain why some respondents believe it was unclear.

Suggestions:

"Clear, but it is unclear why?"

"I remember it being mentioned, but I wasn't sure whether it is referring to the tonotopic map in the brain."

"Could be better explained. Too brief, maybe add sound to the vibrations in the cross-section."

Question 5: Depolarization and Hyperpolarization of the hair cell. Clear Unclear

34 clear, 4 unclear, 3 both

The overall strong response indicates that the respondents found the depolarization and hyperpolarization to be effective. Consisted responses suggested adding color and more labels could improve the scene. One reason some chose unclear was due to scene been too busy with information.

Suggestions:

"More labels."

"Maybe spend more time explaining the signal transduction for K+ in & K+ out."

"Make the vesicles and plasma membrane of the same composition."

"There was some kind of fusion event maybe that was unclear."

"Might want to label ions"

"Better to label ion"

Notable comments:

"Very good animation. It was illustrative without being distracting."

"Very clear – animations and verbal descriptions were wonderful. Nice flow – moves from general to specific very well."

"Very well explained & detailed."

"Good job!"

"I wish our lectures had teaching tools like this! Great visualization for such a microscopic view. Loved how it went from very broad to very detailed. Very clear."

"The presence of increased K+ and decreased K+ or the K+ gradient was clear."

"This part is very nicely done!"

Revisions

Based on the evaluation results, the animation was well received and perceived. Suggestions for the question about the function of the organ of corti were considered. The timing and tempo for the animation was modified throughout the animation to fill what seem to be gaps in the video. For question three, labels, color, and impulses were added to the afferent/efferent fibers. The resonance of the basilar membrane was slowed down to display impulses moving away from the afferent fibers and impulses coming from the outer haircells via efferent fibers. Sounds were added to the tonotopic map section to avoid confusion to the tonotopic map in the brain. Narration and video were slowed down and sounds effects were added to display low sounds and high sounds in the tonotopic map. Impulses were added as well to show impulses leaving the tonotopic map view the cochlear nerve. For questions five, part of the scene was redone to display a clearer and less busy ionic scene. Labels and arrows were added. The ion colors were changed. The plasma membrane and vesicle colos were simplified to help decrease the busyness of the scene. The scene was slowed down about a quarter of time.

CHAPTER FIVE
Conclusions and Recommendations

Project Summary

The animation was designed out of a need of a 3D animation as a supplementary educational tool to be used by medical, graduate, and health professions students enrolled in the Neuroscience and Systems Neurophysiology courses. The animation is available before, during and after lectures so students can review and study to prepare for class. The animation is web-based. The animation includes information used in the lecture notes about neuroanatomy and physiology of the organ of Corti.

Conclusion

Based on the evaluation results, the animation was well received and perceived as a helpful tool. The organization of the animation was a helpful component; it facilitated increased awareness about the organ of Corti.

Revisions were made to address the concerns of the evaluation respondents. The final revised animation is a web-based Adobe Flash Player file to be loaded to UT Southwestern neuroscience web curriculum as a supplement to the syllabus. A summative evaluation can be done once the animation has been incorporated into the curriculum.

Future Research

In addition to a more comprehensive evaluation, the following areas of future research and development could be explored. The animation is one of what could be a series for the neuroscience web curriculum. Future animations could be created for other sections with the same style of learning and structure or confusing lectures within the syllabus. Closed caption for the hearing impaired can also be added as an option to future animations.

Further consideration may also lead to addressing different learning styles. One example is by using and creating interactive programs. Such options may provide a larger diversity of options for students to use in their supplementary materials.

The animation can also be included on a stand-alone website devoted to the organ of Corti. This website could be used for future reference and updates on any new information related to the organ of Corti. The website can include new discoveries and animations.

APPENDIX A
List of Animations

1. http://www.sinauer.com/neuroscience4e/animations13.1.html (online) accessed (2009)

2. http://highered.mcgraw-hill.com/classware/ala.do?isbn=0073525642&alaid=ala_1704539&showSelfStudyTree=true (online) accessed (2009)

3. http://www.youtube.com/watch?v=w1dDFjuu_To&feature=related (online) accessed July 2009

4. http://www.youtube.com/watch?v=bwQdTctM9eU&feature=related (online) accessed (2009)

5. http://www.youtube.com/watch?v=46aNGGNPm7s&feature=related (online) accessed September 2009

6. http://www.youtube.com/watch?v=lioNIbtFxSY&feature=related (online) accessed (2009)

7. http://www.youtube.com/watch?v=rd6_zrvwk7U&feature=related (online) accessed (2009)

8. http://www.youtube.com/watch?v=o3CUiltfCXA&feature=related (online) accessed (2009)

9. http://lisar.larc.nasa.gov/MOVIES/SMALL/LV-1999-00021.mov (online) accessed (2009)

10. http://www.youtube.com/watch?v=30mjb4xe4Zc&feature=related (online) accessed (2009)

11. http://www.xvivo.net/xvivo-demo-reel/ 00:44 – 00:48 sec, 01:14 – 01:20 sec (online) accessed (2009)

12. http://www.pennmedicine.org/encyclopedia/em_DisplayAnimation.aspx?gcid=000063&ptid=17 (online) accessed (2009)

13. http://www.pennmedicine.org/encyclopedia/em_DisplayAnimation.aspx?gcid=000043&ptid=17 (online) accessed (2009)

14. http://www.youtube.com/watch?v=tkPj4IGbmQQ (online) accessed October 2009

15. http://vimeo.com/2235530 (online) accessed July 2009

16. http://vimeo.com/8159066 (online) accessed January 2009

17. http://www.youtube.com/watch?v=R0DChkKJAxk&feature=related (online) accessed July 2009

18. http://www.youtube.com/watch?v=3qeIJz7aUo8&NR=1 (online) accessed July 2009

19. http://www.youtube.com/watch?v=oACMn0KvFPI (online) accessed June 2009

20. http://www.uaf.edu/theater/courses/sound/Ear5.swf (online) accessed January 2010

21. http://www.medindia.net/animation/ear_anatomy.asp (online) accessed March 2010

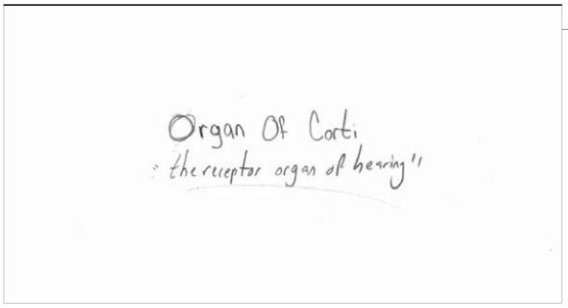
22. http://www.hhmi.org/biointeractive/media/cochlea-lg.mov (online) accessed March 2010

23. http://www.blackwellpublishing.com/matthews/ear.html (online) accessed March 2010

APPENDIX B
Storyboard

organ of Corti "The receptor organ of hearing" 1

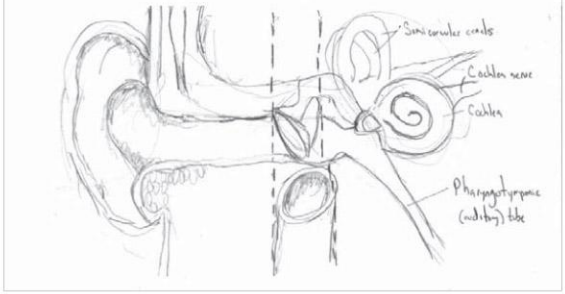
Storyboard



SCRIPT: "The organ of Corti. The receptor organ of hearing."

DESCRIPTION: Title and subtitle fade in, then fade out.

2



SCRIPT: "To hear, our ears must capture sound, transmit it to the organ of Corti, and translate it into neural impulses to be delivered to the brain."

DESCRIPTION: Establishing, front, wide shot, fades in. Coronal view of head displaying anatomy of the outer, middle, and inner ear.

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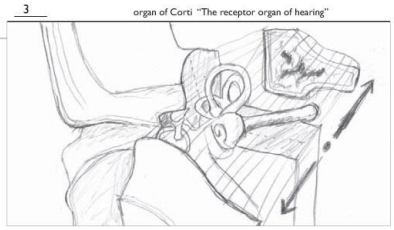
Storyboard

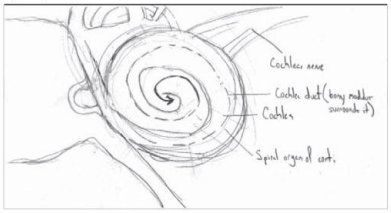
3 organ of Corti "The receptor organ of hearing"



SCRIPT: "The organ of Corti is located in the cochlea--a spiral, three-chambered, snail-like structure (10mm wide) within a bony matrix."

DESCRIPTION: 3/4 front, high angle, wide shot. Removal part of petrous bone exposing cochlea and nerve.

4



SCRIPT: "The organ of Corti extends from the anterior part of the vestibule and coils for about 2.5 turns around a bony pillar, called the modiolus."

DESCRIPTION: Camera zooms in. Front, medium shot of cochlea. Vestibule highlights and a dotted line is animated to follow the curvature of the cochlea; 2.5 turns.

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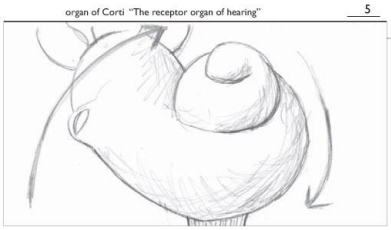
organ of Corti "The receptor organ of hearing" 5

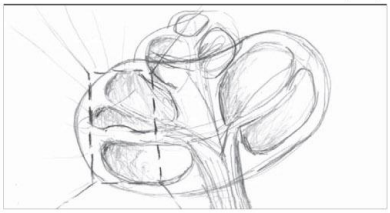
Storyboard



SCRIPT: "In cross section, the uppermost chamber is called the scala vestibuli. The oval window is situated at the base of this chamber. The lowermost chamber is called the scala tympani. At the base of this chamber is where the round window is located. Both the scala vestibuli and scala tympani contain perilymph. "

DESCRIPTION: Everything fades out except cochlea and nerve. Camera pan. Medium shot of cochlea. Cochlea rotates to a position as in a cinnamon roll lying flat on a table. Camera pauses and cochlea is cut in cross section.

6



SCRIPT: "Between the scala vestibuli and scala tympani is the scala media. This houses the organ of Corti, which is referred to as "the receptor organ of hearing." The scala media is filled with endolymph. The scala media includes structures from the tectorial membrane, basilar membrane, and hair cells, which sense the mechanical forces."

DESCRIPTION: Medium shot of cross section of cochlea. Anatomy is labeled as narration is heard.

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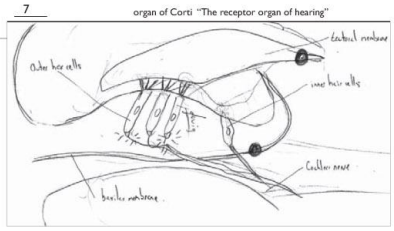
Storyboard

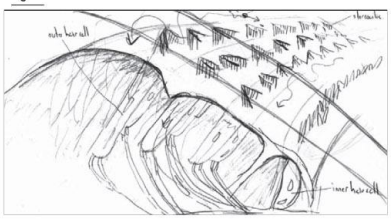
7 organ of Corti "The receptor organ of hearing"



SCRIPT: "The hair cells are located between the tectorial and basilar membranes, and are stimulated by the sheering force between the two caused by a displacement of the pivot point of the two membranes."

DESCRIPTION: Camera zooms in. Front, close-up shot of organ of Corti. Anatomy and pivot points are labeled as narration is heard.

8



SCRIPT: "Approximately 16000 hair cells are within the cochlea. There are two kinds of hair cells, inner and outer hair cells. "

DESCRIPTION: Camera pan. 3/4 front high angle close-up shot of organ of Corti. The tectorial membrane becomes transparent to show hair cells. Inner hair cells glow, outer hair cells glow as narration is heard.

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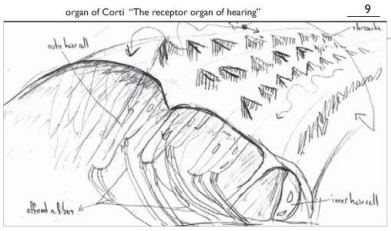
organ of Corti "The receptor organ of hearing" 9

Storyboard



SCRIPT: "95% of the afferent fibers are from the inner hair cells; the sensory receptors that communicate with neurons from cranial nerve VIII. Outer hair cells receive mostly efferent input from the superior olivary complex. "

DESCRIPTION: 3/4 front, high angle, close-up shot of organ of Corti. Afferent and efferent fibers glow as narration is heard.

10

SCRIPT: "The filamentous structures that connect the tips of adjacent stereocilia are known as tip links. These are thought to amplify the forces in the area of the molecular sensors. "

DESCRIPTION: Camera zooms in. 3/4 front, high angle, extreme close-up shot of stereocilia showing tip links.

Carlos G. Gonzalez UTSW Biomedical Communications carlos.gonzalez@utsouthwestern.edu

11 organ of Corti "The receptor organ of hearing"

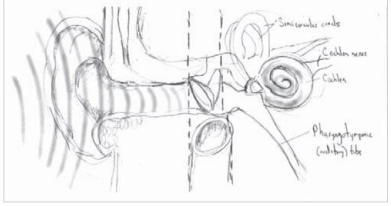
Storyboard

How does sound enter the cochlea?

SCRIPT: "How does sound enter the cochlea?"

DESCRIPTION: Text fades in, then fades out.

12

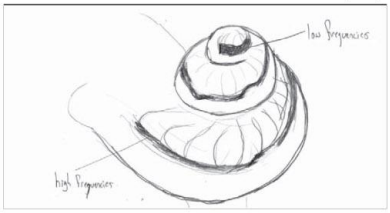


SCRIPT: "none"

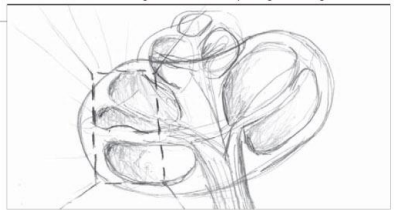
DESCRIPTION: Establishing, front, wide shot fades in. Sound waves come in and hit tympanic membrane, ossicles vibrate and sound enters the cochlea. Everything else fades out expect drum, ossicles, and cochlea.

SCRIPT: "Compression hits the tympanic membrane, causing the stapes to transfer force to the oval window. The sound travels down the scala vestibuli, around the helicotrema to the scala tympani, allowing its fluid perilymph to mix. From there, sound moves to the round window."
DESCRIPTION: Front, medium shot. Tympanic drum rocks back and forth, ossicles vibrate, and sound trasfers from oval window to helicotrema to round window.

14



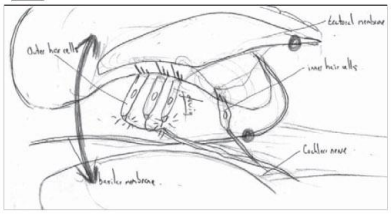
SCRIPT: "High frequencies are encoded at the base, and low frequencies at the apex. It is this property that leads to the tonotopic map along the basilar membrane. The manner in which the basilar membrane vibrates in response to sound is the key to understanding cochlear function."
DESCRIPTION: "Camera pan. Medium shot of cochlea. Cochela becomes semi-transparent to expose the labeled basilar membrane. Cochlea continues to rotate to a position as in a cinnamon roll lying flat on a table. Camera pauses and cochlea is cut in cross section."



SCRIPT: "The motion of the traveling wave initiates sensory transduction by displacing the hair cells that sit atop the basilar membrane."

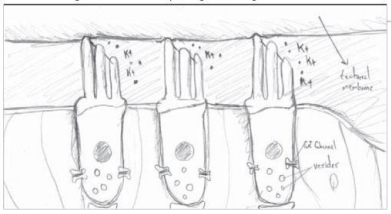
DESCRIPTION: Front, close-up shot of organ of Corti. Anatomy is labeled.

16



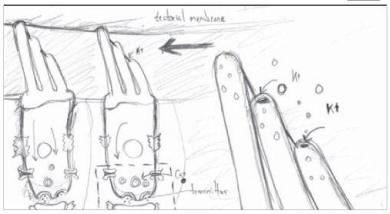
SCRIPT: "The pivot point of the basilar membrane becomes displaced, the tectorial membrane moves across the tops of the hair cells, causing the stereocilia to bend."

DESCRIPTION: Front, close-up shot of organ of Corti. Pivot points are highlighted and basilar and tectorial membranes move and stereocilia bend. Afferent and efferent fibers glow as signals are sent to and back from the brain.



SCRIPT: "The ionic environment of the compartments plays a critical role in signal transduction. The apical portion of the hair cell is bathed in high potassium solution and the base of the hair cell is bathed in potassium poor solution."
DESCRIPTION: Camera zooms in. Front, 2X close-up shot of haircells. Potassium molecules appear as the camera zooms in to the apical and base of hair cell.

18



SCRIPT: "This causes the opening of mechanosensitive channels allowing potassium to flow into the cell, leading to depolarization."

DESCRIPTION: Tectorial membrane moves. Front, 2X close-up shot of hair cells. Camera dolly and zooms in. Potassium goes into the cell.

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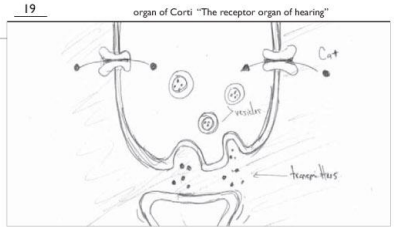
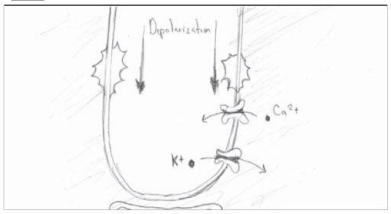


SCRIPT: "This in turn opens calcium channels at the basal end of the cell leading to vesicular transmitter release to stimulate the nerve and opening of calcium dependent potassium channels."

DESCRIPTION: Camera zooms in. Front, 2X extreme close-up shot. Calcium comes into the cell and neurotransmitters are released.

20



SCRIPT: "Because the relative voltage and potassium levels are low at the base of the hair cell, potassium flows out of the cell."

DESCRIPTION: Front, 2X extreme close-up shot. Cell depolarizes and potassium comes out of cell.

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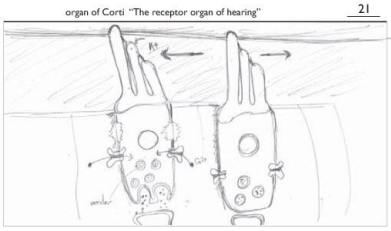
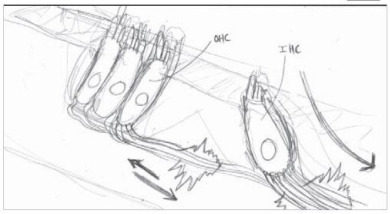


SCRIPT: "This establishes that potassium flow through the cell is used for both depolarization (potassium in at the apex) and repolarization (potassium out at the base) of the hair cell."

DESCRIPTION: Front, 2X close-up shot of hair cells. Tectorial membrane and stereocilia bend continually. Potassium comes in at apex and comes out at base. Hair cell pulsates.

22



SCRIPT: "The hair cells convert vibrations into neural impulses sent to the brain. Your brain then interprets these nerve impulses as sound."

DESCRIPTION: Camera pan, 3/4 front high angle 2X close-up shot of hair cells. Afferent fibers glow as signals go to brain. Efferent fibers glow as signals come from the brain.

Carlos G. Gonzalez UTSW Biomedical Communications carlos.gonzalez@utsouthwestern.edu

APPENDIX C
Evaluation

Name: Date:

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** Grad student Post-doc Faculty
   Other:_____

2. **Function of the Organ of Corti.** clear unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** clear unclear

   Comments/Suggestions

4. **Tonotopic map.** clear unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** clear unclear

   Comments/Suggestions

Thank you!

APPENDIX D
Evaluation Responses

Name: Ege Kavalali Date: Feb 22, 10

Email: ege.kavalali@utsouthwestern.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. Which describes you? Grad student Post-doc (Faculty) Other:_____

2. Function of the Organ of Corti. (clear) unclear

   Comments/Suggestions slow down the initial presentation of organ corti. This section moves too fast

3. Afferent and efferent fibers. (clear) unclear

   Comments/Suggestions Again I would slow down and actually show the fibers and impulses moving back & forth (sparks?)

4. Tonotopic map. (clear) unclear

   Comments/Suggestions → But it is unclear why?

5. Depolarization and Hyperpolarization of the haircell. (clear) unclear

   Comments/Suggestions Show the mechanosensitive channel → Make the vesicles and plasma membrane of the same composition —

Thank you!

Name: Matthew Goldberg **Date:** Feb 22 2010

Email: matthew.goldberg@utsouthwestern.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** Grad student Post-doc (Faculty) Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** clear (unclear)

   Comments/Suggestions

   perhaps animate arrows indicating afferent/efferent fibers?

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

Thank you!

Name: Chris [illegible] **Date:** 2/22/10

Email: christopher.[illegible]@utah.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** Grad student Post-doc (Faculty) Other:_____

2. **Function of the Organ of Corti.** clear unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** clear unclear

   Comments/Suggestions

   efferents less clear

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

   general: more labels.

Thank you!

Name: Adam Haberman **Date:** 2-22-10

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are clear or unclear, and add appropriate comments/suggestions.

1. **Which describes you?** Grad student Post-doc (Faculty) Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

   There is a general problem of explaining concepts before introducing them. For instance, tell me there is a tonotopic map before telling how it works

3. **Afferent and efferent fibers.** (clear) unclear

   Comments/Suggestions

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

Thank you!

Name: Rachel Arey **Date:** 2/22/10

Email: rachelarey@utsouthwestern.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear

   Comments/Suggestions

   Depending upon audience, more definition as to what afferent & efferent are maybe necessary

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

   Maybe a little more discription would have been helpful

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

   Very well explained & detailed

Thank you!

Name: Seth thys **Date:** 2/22/10

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear

   Comments/Suggestions

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

   Maybe spend more time explaining the signal transduction for K^+ in to K^+ out

Thank you!

Name: Michael Robichaux **Date:** 2/22/10

Email: michael.robichaux@utsouthwestern.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions
   Clear.

3. **Afferent and efferent fibers.** clear (unclear)

   Comments/Suggestions
   Can't remember this.

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions
   Would have been neat if you could have played high-freq. sound as you showed this region which is.

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions
   Well-explained.

Thank you!

Name: Katie Seamans **Date:** 2/22/10

Email: Katie.Seamans@ut...

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. Which describes you? (Grad student) Post-doc Faculty Other:_____

   well done!

   there is more time for verbal explanation to

2. Function of the Organ of Corti. (clear) unclear supplement your animation.

   Comments/Suggestions

3. Afferent and efferent fibers. (clear) unclear

   Comments/Suggestions could be better explained.

4. Tonotopic map. clear (unclear)

   Comments/Suggestions

   could be better explained. too brief

   maybe add "sound" to the vibrations in the cross-section

5. Depolarization and Hyperpolarization of the haircell. (clear) unclear

   Comments/Suggestions

Thank you!

Name: Date: 2-22-2010

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** clear unclear

   Comments/Suggestions could animate 1st few lines to put the organ of corti in the context of hearing

3. **Afferent and efferent fibers.** clear unclear

   Comments/Suggestions

4. **Tonotopic map.** clear unclear

   Comments/Suggestions but why does this organization matter?

5. **Depolarization and Hyperpolarization of the haircell.** clear unclear

   Comments/Suggestions It would be nice to see these followed by where does this signal go (ie, to brain to be processed as sound & speech)

Thank you!

Name: Nida Iqbal **Date:** 2/22/16

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear

   Comments/Suggestions

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

   There was one image with ~~but~~ depolarization/repolarization of a hair cell and it was difficult to see the ~~exact~~ K^+ ~~(unclear)~~ because of the color contrast (light blue, pink, gray) – make that more obvious

Thank you!

Name: Date:

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear

   Comments/Suggestions

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** clear (unclear)

   Comments/Suggestions

   ~~The~~ The presence of ↑ K^+ & ↓ K^+ or the K^+ gradient was clear.

Thank you!

Name: SARAH BOLIN **Date:** 2/22/10

Email: SARAH.BOLIN@UTSOUTHWESTERN.EDU

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear

   Comments/Suggestions
   COULD USE SOME MORE DETAIL

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** clear unclear

   Comments/Suggestions
   ASSUMES THAT THE AUDIENCE HAS BASIC NEUROSCIENCE BACKGROUND - MIGHT SPEND SOME MORE TIME EXPLAINING CHANNELS

Thank you!

Name: Wallace . . Date:

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** Grad student Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** clear unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** clear unclear

   Comments/Suggestions

4. **Tonotopic map.** clear unclear

   Comments/Suggestions Maybe have visualization of projections to [illegible] Pathways

5. **Depolarization and Hyperpolarization of the haircell.** clear unclear

   Comments/Suggestions There was some kind of [illegible] that was unclear

Thank you!

Name: Meghan Herris **Date:** 8/22/10

Email: [redacted] meghan.herris@ucdenver.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** clear unclear

   Comments/Suggestions mostly clear
   could have more detail - what is difference?
   could you show them in 2 different colors?

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** clear unclear

   Comments/Suggestions
   [redacted]
   You just showed depolarization and repolarization (not hyperpolarization)?

Thank you!

Name: Ankur Patel Date: 2-22-10

Email: ankur.patel@utsouthwestern.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** clear unclear

   Comments/Suggestions

   Outputs from organ of corti were too quickly stated? Maybe show Auditory Cortex connections!

4. **Tonotopic map.** clear unclear

   Comments/Suggestions

   Why the difference? low freq base vs high freq @ apex?

5. **Depolarization and Hyperpolarization of the haircell.** clear unclear

   Comments/Suggestions

   Might want to label ions better in the video. I was unclear which colored ion was what.

Thank you!

Name: Darya Fakhretdinova **Date:** 2/22/10

Email: Darya.Fakhretdinova@utsouthwestern.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear

   Comments/Suggestions

   May be it would be good to tell a little bit more about where impulses go, Cranial nerve 8, then... But it's just a suggestion.

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

Good job!

Thank you!

Name: Danielle Shingle **Date:** 2/22/10

Email: Danielle.Shingle@utsouthwestern

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are clear or unclear, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) **Post-doc** **Faculty** **Other:**_____

2. **Function of the Organ of Corti.** (clear) **unclear**

   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) **unclear**

   Comments/Suggestions

4. **Tonotopic map.** (clear) **unclear**

   Comments/Suggestions
   describe how the vibration is transmitted into waves a little more clearly

5. **Depolarization and Hyperpolarization of the haircell.** (clear) **unclear**

   Comments/Suggestions
   I would change the ions from circles to the actual ion

Thank you!

Name: Sonal . Thakar **Date:** 2/24/10

Email: Sonal-Thakar@UTSouthwestern

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear

   Comments/Suggestions

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

very good animation. It was illustrative without being distracting.

Thank you!

Name: Mark Burroughs **Date:** 2-27-13

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are clear or unclear, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) **Post-doc** **Faculty** **Other:**_____

2. **Function of the Organ of Corti.** (clear) **unclear**

   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) **unclear**

   Comments/Suggestions

4. **Tonotopic map.** (clear) **unclear**

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) **unclear**

   Comments/Suggestions

need to be smoothing it out

Thank you!

Name: Annie BST **Date:** 2/22/10

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear

   Comments/Suggestions

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

Thank you!

Name: Date: 2-22-2006

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** Grad student Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** clear unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** clear unclear

   Comments/Suggestions

4. **Tonotopic map.** clear unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** clear unclear

   Comments/Suggestions

Thank you!

Name: Yu Fu **Date:** 2/22/2010

Email: Yu.Fu@UTSouthwestern.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. Which describes you? (Grad student) Post-doc Faculty Other:_____

2. Function of the Organ of Corti. (clear) unclear
   Comments/Suggestions

3. Afferent and efferent fibers. (clear) unclear
   Comments/Suggestions

4. Tonotopic map. (clear) unclear
   Comments/Suggestions

5. Depolarization and Hyperpolarization of the haircell. (clear) unclear
   Comments/Suggestions

Thank you!

Name: Marilyn Archer Date: 2/22/10

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear
   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear
   Comments/Suggestions

4. **Tonotopic map.** (clear) unclear
   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear
   Comments/Suggestions

Thank you!

Name: Jesse Kumar **Date:**

Email: Kumar@gatech.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear

   Comments/Suggestions

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

Thank you!

Name: Date: 2/22/10

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear
   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear
   Comments/Suggestions

4. **Tonotopic map.** (clear) unclear
   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear
   Comments/Suggestions

Thank you!

Name: Ade Date: 2/28/20

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. Which describes you? (Grad student) Post-doc Faculty Other:_____

2. Function of the Organ of Corti. (clear) unclear

   Comments/Suggestions

3. Afferent and efferent fibers. (clear) unclear

   Comments/Suggestions

4. Tonotopic map. (clear) unclear

   Comments/Suggestions

5. Depolarization and Hyperpolarization of the haircell. (clear) unclear

   Comments/Suggestions

Thank you!

Name: Angela Ozburn **Date:** 2/22/10

Email: angela.ozburn@utsouthwestern.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

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2. Function of the Organ of Corti. (clear) unclear

   Comments/Suggestions

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   Comments/Suggestions

4. Tonotopic map. (clear) unclear

   Comments/Suggestions

5. Depolarization and Hyperpolarization of the haircell. (clear) unclear

   Comments/Suggestions

Thank you!

Name: Taehong Date: 2/22/10

Email: taehong.yang@ut~

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** clear (unclear)

   Comments/Suggestions

4. **Tonotopic map.** clear (unclear)

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** clear (unclear)

   Comments/Suggestions

Thank you!

Name: Stephanie Chase Date: 2/22/10

Email:

Organ of Corti: The receptor organ of hearing

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   Comments/Suggestions

3. **Afferent and efferent fibers.** clear (unclear)

   Comments/Suggestions

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

Thank you!

Name: Carly Hale Date: 2/22/10

Email: carly.hale@utsouthwestern.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

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   Comments/Suggestions

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   Comments/Suggestions

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

   Very clear - animations & verbal descriptions were wonderful. Nice flow - moves from general to specific very well.

Thank you!

Name: Jeremy Stallsford **Date:** 2/22/10

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. Which describes you? Grad student Post-doc Faculty Other:_____

2. Function of the Organ of Corti. clear unclear

   Comments/Suggestions
   The beginning had a few sections where there was no speaking and it seemed a bit awkward.

3. Afferent and efferent fibers. clear unclear

   Comments/Suggestions

4. Tonotopic map. clear unclear

   Comments/Suggestions

5. Depolarization and Hyperpolarization of the haircell. clear unclear

   Comments/Suggestions When you first showed the Ca^{2+} channels, it would have been good to zoom out to show the whole hair cell, then zoom back in on the Ca^{2+} channel.

Thank you!

Name: Date:

Email:

Organ of Corti: The receptor organ of hearing

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1. Which describes you? (Grad student) Post-doc Faculty Other:_____

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   Comments/Suggestions

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   Comments/Suggestions

4. Tonotopic map. (clear) unclear

   Comments/Suggestions

5. Depolarization and Hyperpolarization of the haircell. (clear) unclear

   Comments/Suggestions

I wish our lecturers had teaching tools like this! Great visualization for such a meeroscopic view. Loved how it went from very broad to very detailed. Very clear

Thank you!

Name: bradford casey Date: 2/22/10

Email: @ UTSW.EDU

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

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2. Function of the Organ of Corti. (clear) unclear

   Comments/Suggestions

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   Comments/Suggestions

4. Tonotopic map. (clear) unclear

   Comments/Suggestions

5. Depolarization and Hyperpolarization of the haircell. (clear) unclear

   Comments/Suggestions - could provide more clear information about how K^+ (cationic) is able to act to depolarize the haircell

Stylistic suggestions: serif typefaces often do not translate well to animation, especially in some of the transitions (tumble). Transitions, especially near the end, seem unfinished. Some choices (tumble) are awkward for a science crowd, and diminish legibility.

Thank you!

Transition between early (slice based anatomy) and late (cochlea and haircell) seems very distinct due to palette + texture choices. This feels a bit awkward.

overall, very nice work!

Name: Date:

Email:

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   Comments/Suggestions

3. **Afferent and efferent fibers.** (clear) unclear

   Comments/Suggestions

   could Maybe be a little more detailed in some areas depending on your target audience

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

   General comment - sometimes the narration seemed a little slow.

Thank you!

Name: David Ronderos **Date:** 2/22/10

Email: David.Ronderos@utsouthwestern.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** clear (unclear)

   Comments/Suggestions

   could elaborate more on the general functions of each. Why are the efferent fibers necessary?

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** clear (unclear)

   Comments/Suggestions

   What maintains the high/low K^+ gradient?

Thank you!

Name: Rui-Jiun Hung **Date:** Feb. 20. 2013

Email: rui-jiun.hung@utsouthwestern.edu

Organ of Corti: The receptor organ of hearing

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1. **Which describes you?** (Grad student) Post-doc Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

3. **Afferent and efferent fibers.** clear (unclear)

   Comments/Suggestions

   use different colors to label what are afferent / efferents fibers

4. **Tonotopic map.** (clear) unclear

   Comments/Suggestions

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

   better to label ions (K^+ Ca^{2+})

Thank you!

Name: Farr Nieve **Date:** 02/22/10

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. Which describes you? (Grad student) Post-doc Faculty Other:_____

2. Function of the Organ of Corti. (clear) unclear

   Comments/Suggestions

3. Afferent and efferent fibers. clear (unclear)

   Comments/Suggestions

   I don't remember these fibers in the animation

4. Tonotopic map. clear (unclear)

   Comments/Suggestions

   I remember it being mentioned, but I wasn't sure whether it is referring to the tonotopic map in the brain or difference in sound waves processed in the ear

5. Depolarization and Hyperpolarization of the haircell. (clear) unclear

   Comments/Suggestions

Thank you!

Name: Date: 2/22/2010

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

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   Comments/Suggestions

3. Afferent and efferent fibers. (clear) unclear
   Comments/Suggestions

4. Tonotopic map. (clear) unclear
   Comments/Suggestions

5. Depolarization and Hyperpolarization of the haircell. (clear) unclear
   Comments/Suggestions
   transitions in the Ca^{4} channel should be smoother if possible

Thank you!

Name: VIKRAM JAKKAMSETTI **Date:** 2/22/2010

Email: vikram.jakkamsetti@wustl.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. **Which describes you?** Grad student (Post-doc) Faculty Other:_____

2. **Function of the Organ of Corti.** (clear) unclear

   Comments/Suggestions

   VERY BEAUTIFULLY DONE

3. **Afferent and efferent fibers.** clear (unclear)

   Comments/Suggestions NOT CLEAR.
   EFFERENT FIBRES NOT MENTIONED MUCH

4. **Tonotopic map.** clear (unclear)

   Comments/Suggestions → showing tonotopic input in relation to sound characteristics might be helpful
   eg. low freq ⇒ slow vibration of oval window ⇒ waves travel further up

5. **Depolarization and Hyperpolarization of the haircell.** (clear) unclear

   Comments/Suggestions

   THIS PART VERY NICELY DONE! (we see the waves travel all the way)

Thank you!

Name: Marina Maksimova **Date:** 02/22/10

Email: Marina.Maksimova@UTsouthwestern.edu

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. Which describes you? Grad student Post-doc Faculty Other: Research Assistant

2. Function of the Organ of Corti. (clear) unclear

   Comments/Suggestions

3. Afferent and efferent fibers. (clear) unclear

   Comments/Suggestions

4. Tonotopic map. (clear) unclear

   Comments/Suggestions

5. Depolarization and Hyperpolarization of the haircell. (clear) unclear

   Comments/Suggestions

Great Job!

Thank you!

Name: Date:

Email:

Organ of Corti: The receptor organ of hearing

Please indicate if the following points are **clear** or **unclear**, and add appropriate comments/suggestions.

1. Which describes you? Grad student Post-doc Faculty Other: tech

2. Function of the Organ of Corti. (clear) unclear

   Comments/Suggestions

3. Afferent and efferent fibers. (clear) unclear

   Comments/Suggestions

4. Tonotopic map. (clear) unclear

   Comments/Suggestions

5. Depolarization and Hyperpolarization of the haircell. (clear) unclear

   Comments/Suggestions

Thank you!

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