

What Did You Say? How Hearing Works

by Eric DeJulio

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In collaboration with the Centers for Disease Control and Prevention's
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This lesson serves as an extension of a unit on waves that links the science of sound to the way that we hear. This lesson also investigates the role of hearing loss prevention as a way to improve public health. Students will wear earplugs while taking notes on vocabulary words, and then take a short vocabulary quiz as an exercise designed to show students what it might be like to have hearing loss. Next, students will generate a model of the process of hearing, and then complete a short group presentation on one of several hearing-related topics. This lesson is designed to be embedded within a unit on waves. This lesson should be introduced after students have an appropriate amount of background knowledge about waves.

Disclaimer: The findings and conclusions in this lesson plan are those of the author(s) and do not necessarily represent the views of the Centers for Disease Control and Prevention.

What Did You Say? How Hearing Works

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Summary

This lesson serves as an extension of a unit on waves that links the science of sound to the way that we hear. This lesson also investigates the role of hearing loss prevention as a way to improve public health. Students will wear earplugs while taking notes on vocabulary words, and then take a short vocabulary quiz as an exercise designed to show what it might be like to have hearing loss. Next, each student will generate a model of the process of hearing, and then complete a short group presentation on one of several hearing-related topics. This lesson is designed to be embedded within a unit on waves. This lesson should be introduced after students have an appropriate amount of background knowledge about waves.

Learning Outcomes

- Students will be able to explain how hearing loss occurs, how it is screened for in infants, and how it is treated.
- Students will develop and support opinions about screening for hearing loss in infants.
- Students will develop and interpret an individual model about hearing.
- Students will describe how a model is a representation of how some aspect of the natural world is structured or how it works.
- Students will examine their own model to determine its accuracy or inaccuracies.
- Students will propose a method to improve the accuracy of their model.

Social Outcomes

- Students will learn the importance of group interdependence and skills to achieve a result while working towards a collaborative goal.

Materials

1. Earplugs (1 pair per student)
2. Computers for student use or overhead transparencies (1 per group of 3–4 students)
3. Paper copies of student handouts
4. Optional: Teacher webpage with links for student group research information
5. Butcher paper (for creation of initial and revised model)

Total Duration

2 hours, 40 minutes

Procedures

Teacher Preparation

For this lesson, the teacher will need to purchase earplugs for each student. These earplugs should be distributed around the room before the students enter. The teacher will also need to download, print, and copy student handouts (the "Hearing Vocabulary Quiz", found in the "Supplemental Document" section of the introduction. The "Cooperative Learning Activity General Instructions" and the "Cooperative Learning Activity Topics", are found in the "Supplemental Document" section of Step 3. The "Hearing Posttest", is found in Step 5, and the

“Group Work Evaluation”, is found in the conclusion). Also, the teacher will need to have two separate sheets of butcher paper for creating models.

The teacher will need to acquire a laptop cart or computer laboratory for the research portion of this lesson and to have one overhead transparency per group and markers for the presentation portion of the lesson. If the teacher wishes to set up a simple webpage with the links from this lesson on it, this should be done before class as well.

The teacher might also want to review the anatomy of the ear and the science of hearing before teaching this lesson. See Web Resources for links.

Web Resources

Title: I Love What I Hear! Hearing

URL: <http://www.nidcd.nih.gov/health/education/teachers/hearing.asp>

Description: This is a resource for teachers. It describes the process of hearing in a very quick and easy manner. This background information will be helpful for the student’s construction of their model that occurs in steps 2 or 4, or both.

Title: Our Sense of Hearing

URL: <http://faculty.washington.edu/chudler/hearing.html>

Description: This is a resource for teachers that describes the process of hearing. It is slightly more in depth than the previous resource. This background information will be helpful for the construction of models that occurs in steps 2 or 4, or both.

Introduction:

Duration: 20 minutes

The teacher should begin the class with an exercise designed to help students realize how important hearing is and give them a glimpse of barriers that people who are hard of hearing must face. Students should be instructed to put in their earplugs upon entering class. Next, the teacher should read aloud five vocabulary words that are related to hearing for the students, and instruct the students to take notes.

The vocabulary words and their definitions are:

- Decibel—the force of sound waves against the ear.
- Malleus—the bone located in the middle ear, which is commonly called the “hammer”.
- Incus—the bone located in the middle ear, which is commonly called the “anvil”.
- Stapes—the bone located in the middle ear, which is commonly called the “stirrup”.
- Tympanic membrane—is located in the outer ear and is commonly called the “eardrum”.

The students should be allowed to use their notes to take a quiz. The quiz is multiple choice, with only minor differences between answers (see the “Hearing Vocabulary Quiz” in the “Supplemental Document” section of the introduction). Students should have difficulty answering correctly, because the earplugs will have affected their hearing.

Students should switch papers with one another and quickly grade their classmates’ quizzes.

Following the grading, students should be instructed to perform a quick-write addressing the following questions:

- How did you feel when you were taking the quiz?
- What difficulties did you have?
- How might your world be different if you were deaf or hard of hearing?

- What are some causes of hearing loss that you know of?

The teacher should instruct students to write everything they know about the questions and tell them that they should keep their pencils moving for the entire 3 minutes.

Next, the teacher should conduct a group discussion regarding the difficulties in taking a quiz when one cannot hear. The teacher should call on students at random so that a valid sample of student ideas is obtained.

Supplemental Documents

Title: Hearing Vocabulary Quiz

Description: This Word document contains the vocabulary quiz for the introductory activity.

Title: Hearing Vocabulary Quiz Answers

Description: This Word document contains the answer key for the vocabulary quiz.

Step 2

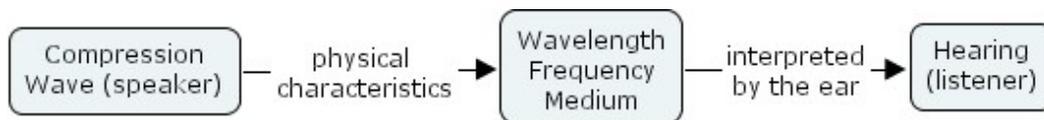
Duration: 20 minutes

Using the following prompts, the teacher should elicit student ideas about how speaking and hearing work:

- “When you talk to your friends, you are able to speak while your friends are able to hear your speech. How do you produce sounds?” *You create sound waves with your vocal cords.*
- “How are your friends able to ‘hear’ you?” *Your friends’ ears receive sound waves and converts them into electrical signals, which your brain interprets as sound.*

The teacher should quickly review wave concepts that have been introduced in a previous lesson. This should include, at the least, a review of frequency, wavelength, medium of travel, and compressional waves. To make the material more accessible to students, the teacher should discuss these topics in the context of a conversation between two friends.

The teacher will help the students develop their own model on paper. Then he or she will explain how frequency, wavelength, medium of travel, and compression waves (or longitudinal waves) contribute to hearing. This model should be copied onto a piece of butcher paper for easy reference later in the lesson. An example model is as follows:



Web Resource

Title: Waves

URL: <http://id.mind.net/~zona/mstm/physics/waves/waves.html>

Description: This website is a resource for teachers that reviews the physical characteristics of waves. Specifically, the “Introduction” and “Parts of a Wave” sections are the most relevant for this lesson.

Step 3

Duration: 60 minutes

Now that students have developed a model that displays their understanding about the process of hearing, they will participate in a cooperative learning activity to help them understand hearing, hearing loss, screening systems, and treatment options for hearing loss. This activity is set up in a modified jigsaw format. The teacher should divide students into groups of 3 or 4. There are four topics (“The Ear”, “How Does Hearing Work?”, “Genetic Hearing Loss”, and “Nongenetic Hearing Loss”), and each topic has specific guiding questions that students must answer. The guiding questions for each topic are contained in the “Cooperative Learning Activity” document contained in the “Supplemental Documents” section of step 3.

Each group of students should be assigned to one of the four topics and instructed to create a short presentation that addresses the guiding questions. Note: Most class sizes will require that there are two groups per topic. The teacher will give students Web resources to use for the information. Student groups will create an overhead transparency to teach other students about hearing, hearing loss, screening systems, and treatment options. The audience for the presentation should be other middle school students—their classmates should be able to understand the information presented. Each group of students will give a 2- to 3- minute presentation about the information found during their research of their specific topic. While each group presents, the other students must take notes on the presentations. Specific guiding questions to help students take notes are provided as part of the “Cooperative Learning Activity Topics”. Next, student groups should reassemble for 3 to 5 minutes to review the information just presented and compare notes. This ensures that everyone understands the information from the other group presentations.

Web Resources

Title: Let’s Hear It for the Ear!

URL: http://www.kidshealth.org/kid/body/ear_SW.html

Description: This website is a great resource for students, with an overview of the anatomy of the ear and the process of hearing.

Title: Neuroscience for Kids—The Ear

URL: <http://faculty.washington.edu/chudler/bigear.html>

Description: This website is a great resource for students, with some information on the anatomy of the ear and descriptions of a few different types of hearing loss and causes.

Title: Travel Inside the Ear Video

URL: http://www.nidcd.nih.gov/health/education/video/travel_vid.asp

Description: This website contains a short video for students that shows them visually how sound travels in the human ear.

Title: How the Ear Works: My Baby’s Hearing Loss

URL: <http://babyhearing.org/HearingAmplification/HearingLoss/earworks.asp>

Description: This website, a collaboration between the National Institutes of Health (NIH) and the Boy’s Town National Research Hospital, contains information and a diagram of how the ear works.

Title: The Genetics of Infant Hearing Loss, Early Hearing Detection and Intervention (EHDI), National Center on Birth Defects and Developmental Disabilities (NCBDDD), Centers for Disease Control and Prevention (CDC)

URL: <http://www.cdc.gov/ncbddd/ehdi/genetics.htm>

Description: This CDC website contains information about genetic causes of hearing loss.

Title: Causes of Hearing Loss; How Do Genetic Professionals View Hearing Loss?

URL: <http://babyhearing.org/HearingAmplification/Causes/prosview.asp>

Description: This website, a collaboration between the NIH and the Boy's Town National Research Hospital, contains information about genetic causes of hearing loss.

Title: Newborn Hearing Screening: Has Your Baby's Hearing Been Screened?

URL: <http://www.nidcd.nih.gov/health/hearing/screened.asp>

Description: This NIH website contains information about infant screening programs for hearing loss.

Title: Nongenetic Hearing Loss—Causes of Hearing Loss

URL: <http://babyhearing.org/HearingAmplification/Causes/nongenetic.asp>

Description: This website, a collaboration between the NIH and the Boy's Town National Research Hospital, contains information about nongenetic causes of hearing loss.

Supplemental Documents

Title: Cooperative Learning Activity General Instructions

Description: This Word document includes the group instructions for completing the cooperative learning activity. This document contains general information about the activity and should be passed out to all students.

Title: Cooperative Learning Activity Topics

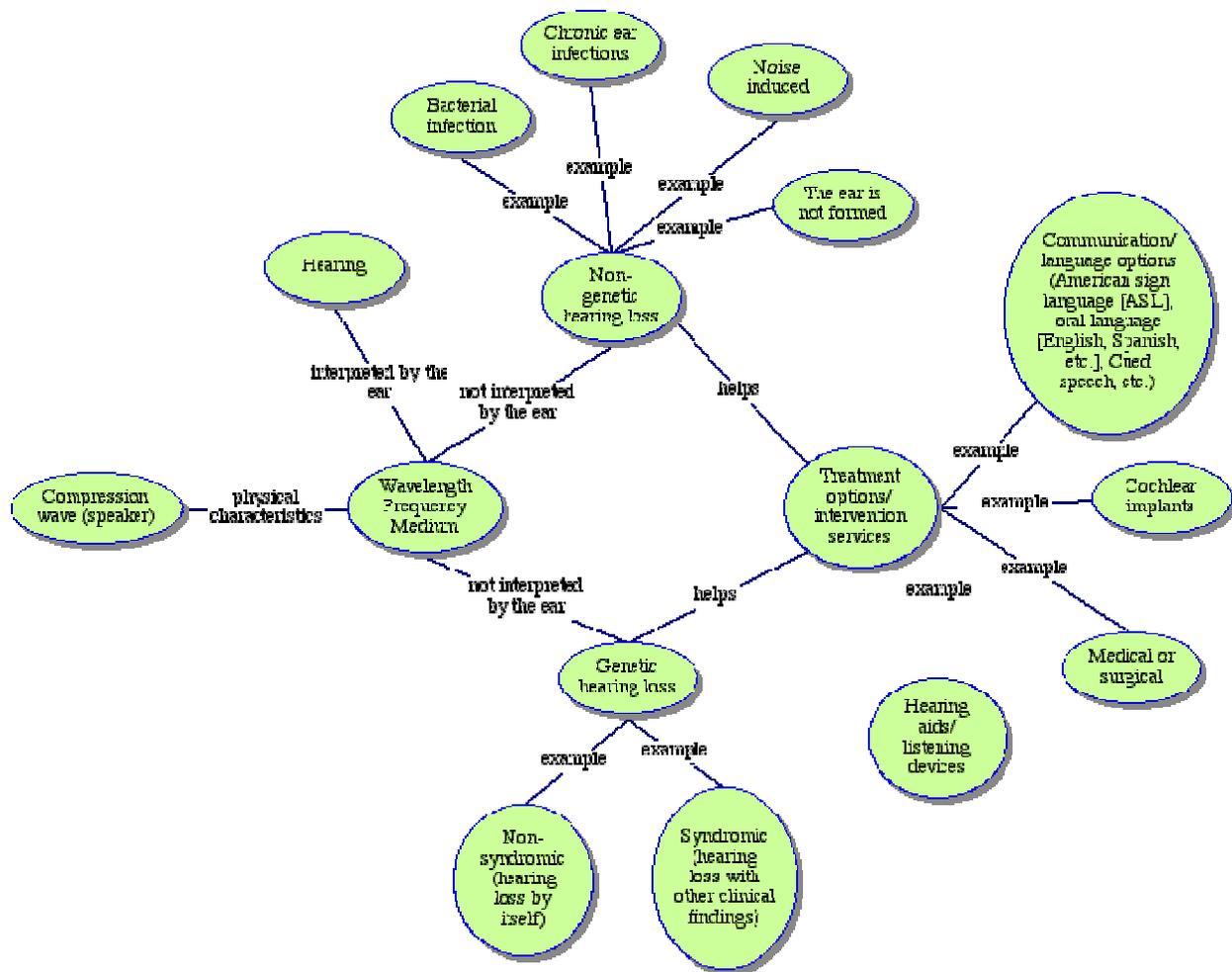
Description: This Word document includes topics and detailed instructions for each group. It contains a separate instruction page for each different topic, including the Web resources and guiding questions for the group presentations. Each student should receive the topic page for the topic that he or she has been assigned.

Step 4

Duration: 30 minutes

Teachers should instruct students that as a class they are to revise the model developed in step 2 that incorporates the new information that the students learned from the presentations.

Students should be instructed to transfer this model onto a piece of butcher paper. Make sure to keep this model, as it will be needed for the assessment. An example model follows:



1-3-6 Plan—Newborns can be screened for hearing loss before 1 month of age, diagnosed before 3 months of age, and receive intervention services before 6 months of age.

During this time, the teacher should lead a discussion regarding the limitations of models and the accuracies or inaccuracies that models contain. This discussion will probably include the following elements:

- Models do not show all of the relationships involved.
- Models are always being revised. There are possible errors in any model.
- Models represent an individual's understanding of the connections between ideas. They will not always be the same for everyone.
- Models are involved in how scientists do science. Scientists create a model with their understanding, and then they do experiments. They finish by revising their model to reflect their new understandings.

Step 5

Duration: 20 minutes

Students will take an individual assessment ("Hearing Quiz") to show their understanding about hearing. Students can use notes from presentations to complete the assessment. As an incentive for students to take an interest in the learning of other group members, there will be a bonus based upon group member scores. If all students in a group score above 80%, then each member of the group will get 2 bonus points on the quiz.

Supplemental Documents

Title: Hearing Posttest

Description: This Word document is an individual assessment for students to synthesize the information from all of the group presentations. This assessment also helps format the overall activity into a true cooperative learning activity, because provides both individual and group accountability.

Title: Hearing Posttest Answer Key

Description: This Word document contains the key for the "Hearing Posttest" assessment.

Conclusion

Duration: 10 minutes

Now that students have a better understanding of the process of hearing and the types of hearing loss, the teacher will instruct the students to do a 3 minute quick write in their journals, addressing the following topic:

- Should money be spent to test newborns for hearing loss? Why or why not?

The teacher should remind students of the hearing loss activity that they participated in on day 1 of this lesson (the vocabulary quiz). This exercise will help students begin to form opinions about topics and express those opinions.

As an exit activity, students will evaluate their group work skills. Teachers should ask students to write down their answers to the following questions about their participation and turn in before they leave class:

- How did you contribute to your group's success?
- How can you improve your group work skills for next time?

Web Resource:

Title: NIH consensus statement 92. Early Identification of Hearing Impairment in Infants and Young Children.

URL: http://consensus.nih.gov/cons/092/092_statement.htm

Description: This is a resource for teachers that reviews the reasons that the NIH supported the implementation of an infant screening program for hearing loss.

Assessment

In Step 3, students will give short group presentations that cover a variety of hearing-related topics. In Step 5, students will complete a quiz that demonstrates their understanding of the topics covered in class presentations and their comprehension of the relationship between hearing and the science of sound.

Education Standards

National Science Education Standards

SCIENCE AS INQUIRY, CONTENT STANDARD A:

As a result of activities in grades 5–8, all students should develop

- **Abilities necessary to do scientific inquiry**
- Understandings about scientific inquiry

PHYSICAL SCIENCE, CONTENT STANDARD B:

As a result of activities in grades 5–8, all students should develop an understanding of

- Properties and changes of properties in matter
- **Motions and forces**
- Transfer of energy

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES, CONTENT STANDARD F:

As a result of activities in grades 5–8, all students should develop understanding of

- **Personal health**
- Populations, resources, and environments
- Natural hazards
- Risks and benefits
- Science and technology in society

Washington State Standards

Essential Academic Learning Requirements (EALRs):

EALR 1.2.1—Analyze how the parts of a system interconnect and influence each other.

EALR 2.1.4—Analyze how models are used to investigate objects, events, systems, and processes.

EALR 3.2.2—Analyze scientific inquiry and scientific design and understand how science supports technological development and vice versa.

Hearing Vocabulary Quiz
What Did You Say?
Eric DeJulio, CDC's 2005 Science Ambassador Program

Name _____

Date _____

Period _____

1. A decibel measures
 - a. the force of sound waves against the ear.
 - b. the wavelength of a sound wave.
 - c. the force of a sound wave against the air.
 - d. the frequency of a sound wave.
 - e. the force of a sound wave in a vacuum.

2. The _____ is in the middle ear and is commonly called the "hammer".
 - a. malleus
 - b. incus
 - c. stapes
 - d. tympanic membrane

3. The _____ is in the middle ear and is commonly called the "anvil".
 - a. malleus
 - b. incus
 - c. stapes
 - d. tympanic membrane

4. The _____ is in the middle ear and is commonly called the "stirrup".
 - a. malleus
 - b. incus
 - c. stapes
 - d. tympanic membrane

5. The _____ is in the outer ear and is commonly called the "eardrum".
 - a. malleus
 - b. incus
 - c. stapes
 - d. tympanic membrane

Hearing Vocabulary Quiz Answers
What Did You Say?
Eric DeJulio, CDC's 2005 Science Ambassador Program

1. A decibel measures
 - a. **the force of sound waves against the ear.**
 - b. the wavelength of a sound wave.
 - c. the force a sound wave against the air.
 - d. the frequency of a sound wave.
 - e. the force of a sound wave in a vacuum.

2. The _____ is in the middle ear and is commonly called the "hammer".
 - a. **malleus**
 - b. incus
 - c. stapes
 - d. tympanic membrane

3. The _____ is in the middle ear and is commonly called the "anvil".
 - a. malleus
 - b. **incus**
 - c. stapes
 - d. tympanic membrane

4. The _____ is in the middle ear and is commonly called the "stirrup".
 - a. malleus
 - b. incus
 - c. **stapes**
 - d. tympanic membrane

5. The _____ is in the outer ear and is commonly called the "eardrum".
 - a. malleus
 - b. incus
 - c. stapes
 - d. **tympanic membrane**

Cooperative Learning Activity General Instructions
What did you say?
Eric DeJulio, CDC's 2005 Science Ambassador Program

Collaborative Group Instructions—General

How the ear works is a wonderful thing. How does the ear help us hear? What can cause hearing to work not so well (or not at all)? What options do people with hearing loss have?

Background:

We've recently been talking about sound waves and the different properties that they have. A related question that is relevant to our everyday lives is, "How is it that we are able to hear?"

Your Task/Your Audience:

Your task is to develop a short, 2- to 3- minute presentation about an assigned topic related to hearing, which you will teach to your fellow classmates.

Why am I doing this?

It is fun! You get to present your topic to the class in a situation that is informal—you are not being graded on how well you present. The focus for this presentation is on the content. Teaching your fellow students is a great way for you to really learn the material, and it's definitely more fun than listening to me stand up here and talk. By getting information on how hearing works, we can start to understand a complex biological system.

Materials:

Your group will get one overhead transparency to use for your presentation. You will use computers (and the websites I've provided) to research your topic.

Cooperative Learning Activity Topics
What Did You Say?
Eric DeJulio, CDC's 2005 Science Ambassador Program

Topic: The Structure of the Ear

You will have 20 minutes to complete this step.

Before you begin working, I want the designated group leader to assign each member of your group one question that he or she will be responsible for researching. These questions will also be the ones that you will present to your classmates. In groups of four, one person will be responsible for developing the graphical representation.

Your group will describe the structure of the ear to the class, and discuss the different parts of the ear.

Websites:

http://www.kidshealth.org/kid/body/ear_SW.html

<http://faculty.washington.edu/chudler/bigear.html>

http://www.nidcd.nih.gov/health/education/video/travel_vid.asp

In your presentation, your group should include the following:

1. A graphical representation of the structure of the ear. This should help your classmates understand your presentation.
2. An oral and written description addressing the following questions:
 - a. What is the outer ear? What does it do?
 - b. What is the middle ear? What does it do?
 - c. What is the inner ear? What does it do?

Your task as a listener:

When you are listening to presentations by other groups, you will take notes on the answers to the following questions for the different groups. You can use these notes on the quiz.

How does hearing work?

- How do we hear? This should be a general overview of HOW we hear.
- What do frequency and wavelength have to do with hearing? How do changes in these two characteristics affect how you "hear" sound?
- How do we know where a sound is coming from?

Genetic hearing loss

- What are some genetic reasons for hearing loss?
- What types of intervention efforts are being used to identify and help children with hearing loss? (HINT: Check out the 1-3-6 plan)
- What types of treatment options or services, or both exist for people who have genetic hearing loss? How do these treatments work?

Nongenetic hearing loss (hearing loss that is NOT genetic)

- What are some nongenetic reasons for hearing loss?
- What are some methods for preventing hearing loss of this type? How do these work?
- What types of treatment options or services, or both are there for people who have nongenetic hearing loss? How do these treatments or services work?

Cooperative Learning Activity Topics
What Did You Say?
Eric DeJulio, CDC's 2005 Science Ambassador Program

Topic: How Does Hearing Work?

You will have 20 minutes to complete this step.

Before you begin working, I want the designated group leader to assign each member of your group one question that he or she will be responsible for researching. These questions will also be the ones that you will present to your classmates. In groups of four, one person will be responsible for developing the graphical representation.

Your group will investigate how hearing actually works in the human ear.

Useful websites:

<http://babyhearing.org/HearingAmplification/HearingLoss/earworks.asp>

http://www.kidshealth.org/kid/body/ear_SW.html

<http://faculty.washington.edu/chudler/bigear.html>

http://www.nidcd.nih.gov/health/education/video/travel_vid.asp

In your presentation, your group should include the following:

1. A graphical representation (or some other creative form) of something relating to your topic. This should help you classmates understand your presentation.
2. An oral and written description addressing the following questions:
 - a. How do we hear? This should be a general overview of HOW we hear.
 - b. What do frequency and wavelength have to do with hearing? How do changes in these two characteristics affect how you "hear" sound?
 - c. How do we know where a sound is coming from?

Your task as a listener:

When you are listening to presentations by other groups, you will take notes on the answers to the following questions for the different groups. You can use these notes on the quiz.

The ear

- A diagram of the ear
- What is the outer ear? What does it do?
- What is the middle ear? What does it do?
- What is the inner ear? What does it do?

Genetic hearing loss

- What are some genetic reasons for hearing loss?
- What types of intervention efforts are being used to identify and help children with hearing loss? (HINT: Check out the 1-3-6 plan)
- What types of treatment options or services, or both exist for people who have genetic hearing loss? How do these treatments work?

Nongenetic hearing loss (hearing loss that is NOT genetic)

- What are some nongenetic reasons for hearing loss?
- What are some methods for preventing hearing loss of this type? How do these work?
- What types of treatment options or services, or both are there for people who have nongenetic hearing loss? How do these treatments or services work?

Cooperative Learning Activity Topics
What Did You Say?
Eric DeJulio, CDC's 2005 Science Ambassador Program

Topic: Genetic Hearing Loss

You will have 20 minutes to complete this step.

Before you begin working, I want the designated group leader to assign each member of your group one question that he or she will be responsible for researching. These questions will also be the ones that you will present to your classmates. In groups of four, one person will be responsible for developing the graphical representation.

Did you know that there are several different ways that a person can lose his or her hearing? For your portion of this activity, you will be researching the genetic causes for hearing loss.

Websites:

<http://babyhearing.org/HearingAmplification/Causes/prosview.asp>

<http://www.cdc.gov/ncbddd/ehdi/genetics.htm>

<http://www.nidcd.nih.gov/health/hearing/screened.asp>

In your presentation, your group should include the following:

1. A graphical representation (or some other creative form) of something relating to your topic. This should help you classmates understand your presentation.
2. An oral and written description addressing the following questions:
 - a. What are some genetic reasons for hearing loss?
 - b. What types of intervention efforts are being used to identify and help children with hearing loss? (HINT: Check out the 1-3-6 plan)
 - c. What types of treatment options or services, or both exist for people who have genetic hearing loss? How do these treatments or services work?

Your task as a listener:

When you are listening to presentations by other groups, you will take notes on the answers to the following questions for the different groups. You can use these notes on the quiz.

The ear

- A diagram of the ear
- What is the outer ear? What does it do?
- What is the middle ear? What does it do?
- What is the inner ear? What does it do?

How does hearing work?

- How do we hear? This should be a general overview of HOW we hear.
- What do frequency and wavelength have to do with hearing? How do changes in these two characteristics affect how you "hear" sound?
- How do we know where a sound is coming from?

Nongenetic hearing loss (hearing loss that is NOT genetic)

- What are some nongenetic reasons for hearing loss?
- What are some methods for preventing hearing loss of this type? How do these work?
- What types of treatment options or services, or both are there for people who have non-genetic hearing loss? How do these treatments or services work?

Cooperative Learning Activity Topics
What Did You Say?
Eric DeJulio, CDC's 2005 Science Ambassador Program

Topic: Nongenetic Hearing Loss (hearing loss that is NOT genetic)

You will have 20 minutes to complete this step.

Before you begin working, I want the designated group leader to assign each member of your group one question that he/she will be responsible for researching. These questions will also be the ones that you will present to your classmates. In groups of four, one person will be responsible for developing the graphical representation.

Did you know that there are several different ways that a person can lose their hearing? For your portion of this activity, you will be researching the nongenetic causes of hearing loss.

Websites:

<http://babyhearing.org/HearingAmplification/Causes/nongenetic.asp>

<http://www.nidcd.nih.gov/health/hearing/screened.asp>

In your presentation, your group should include the following:

1. A graphical representation (or some other creative form) of something relating to your topic. This should help you classmates understand your presentation.
2. An oral and written description addressing the following questions:
 - a. What are some nongenetic reasons for hearing loss?
 - b. What are some methods for preventing hearing loss of this type? How do these work?
 - c. What types of treatment options or services, or both that exist for people who have nongenetic hearing loss? How do these treatments or services work?

Your task as a listener:

When you are listening to presentations by other groups, you will take notes on the answers to the following questions for the different groups. You can use these notes on the quiz.

The ear

- A diagram of the ear
- What is the outer ear? What does it do?
- What is the middle ear? What does it do?
- What is the inner ear? What does it do?

How does hearing work?

- How do we hear? This should be a general overview of HOW we hear.
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- How do we know where a sound is coming from?

Genetic hearing loss

- What are some genetic reasons for hearing loss?
- What types of intervention efforts are being used to identify and help children with hearing loss? (HINT: Check out the 1-3-6 plan)
- What types of treatment options or services, or both exist for people who have genetic hearing loss? How do these treatments work?

Modeling the Process of Hearing Posttest
What Did You Say?
Eric DeJulio, CDC's 2005 Science Ambassador Program

Name _____

Date _____

Period _____

1. Take a look at the final model that we developed for hearing.

Using your newly acquired knowledge and the notes you took in class, explain what the model says about hearing. Your answer should mention the following topics:

- Inner, middle, and outer ear
- Waves, frequency, and wavelength
- Genetic hearing loss causes and treatments or services, or both
- Nongenetic hearing loss causes and treatments or services

In your answer, you should make sure to emphasize how these topics interact.

2. What is a model?

3. How is our model accurate and inaccurate? Give one example of each.

4. Provide one example of a change that would make our model more accurate and explain why it would be more accurate.

Modeling the Process of Hearing Posttest
What Did You Say?
Eric DeJulio, CDC's 2005 Science Ambassador Program

Name _____

Date _____

Period _____

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Using your newly acquired knowledge and the notes you took in class, explain what the model says about hearing. Your answer should mention the following topics:

- Inner, middle, and outer ear
- Waves, frequency, and wavelength
- Genetic hearing loss causes and treatment options or services, or both
- Nongenetic hearing loss causes and treatment options or services

In your answer, you should make sure to emphasize how these topics interact. **(8 pts)**

Student answers will vary, but should contain some form of these ideas:

- **The physical characteristics of a wave (waves/frequency/wavelength) all influence how and what we hear (2 pts)**
- **The different parts of the ear (inner, middle, and outer) are all important for hearing, and they are all involved in the processing of sound from waves to a form that the brain recognizes. (2 pts)**
- **Genetic hearing loss can be caused by (examples from model) and have treatment options and/or services such as (examples from model). (2 pts)**
- **Nongenetic hearing loss can be caused by (examples from model) and have treatment options or services such as (examples from model). (2 pts)**

2. What is a model? **(2 pts)**

Student answers will vary.

The answer should contain elements that describe a model as a representation of a process (it shows how something works).

3. How is our model accurate and inaccurate? Give one example of each. **(2 pts)**

Student answers will vary. An example answer follows:

- **My final model does not specifically mention the inner, middle, and outer ear and therefore, is inaccurate, because they are important to the process of hearing. (1 pt)**
- **My model is accurate in that it defines how hearing loss can occur and describes some treatment options. (1 pt)**

4. Provide one example of a change that would make our model more accurate and explain why it would be more accurate. **(2 pts)**

Student answers will vary. An example answer follows:

My final model does not specifically mention the inner, middle, and outer ear and therefore, is inaccurate. I could add this portion into my model and define the relationships that this addition incurs.