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Marblehead Veterans Middle School
Marblehead, Massachusetts
July 2011

Lesson Plan

Title – Can You Hear Me Now?

Primary Subject Area – Technology/Engineering

Grade Level – 7 & 8

Overview – Advances in technology have expanded the different modes we use to communicate with each other. Along with different communication modes, the speed at which information is able to pass from the source to the receiver has increased exponentially. For this lesson, students will review the components (e.g., source, encoder, transmitter, receiver, decoder, and destination) that comprise a typical communications system.

Approximate Duration – The lesson will last two (2) 55-minute class periods.

MA Frameworks – The lesson aligns with the 2006 edition of the Massachusetts Science and Technology/ Engineering Curriculum Framework. More specifically, the strands discussed during the lesson include:

1. Materials, Tools, and Machines
Central Concept: Appropriate materials, tools, and machines enable us to solve problems, invent, and construct.

1.1 Given a design task, identify appropriate materials (e.g., wood, paper, plastic, aggregates, ceramics, metals, solvents, and adhesives) based on specific properties and characteristics (e.g., strength, hardness, and flexibility).

2. Engineering Design
Central Concept: Engineering design is an iterative process that involves modeling and optimizing to develop technological solutions to problems within given constraints.

2.6 Identify the five elements of a universal systems model: goal, inputs, processes, outputs, and feedback.

3. Communication Technologies
Central Concept: Ideas can be communicated though engineering drawings, written reports, and pictures.

3.1 Identify and explain the components of a communication system, i.e., source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination.

3.3 Identify and compare communication technologies and systems, i.e., audio, visual, printed, and mass communication.

Interdisciplinary Connections – *Social Studies* – a brief history of the telephone. *Science* – the scientific principles of how a telephone operates and fiber optic cable technology.

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Lesson Objectives – The objectives for the lesson are as follows:

- Students will be able to describe the major components and the associated basic functionality of each component in a typical communications system.
- Students will reinforce their understanding of the universal systems model.
- Students will gain an understanding of how fiber optic cables work.
- Students will be able to make connections with information presented in the classroom and their own lives – e.g., how telephones and fiber optic cables work.

Lesson Materials and Resources – The following materials and resources will be required for this lesson:

- Communications System Components worksheet
- *How Stuff Works* – Destructed: Telephone (http://communication.howstuffworks.com/telephone.htm)
- Museum of Science Boston - *Engineering the Future* – Communications System (http://link.brightcove.com/services/player/bcpid888056069)
- *The Engineering Guy* video on fiber optic cables *(http://www.youtube.com/watch?v=0MwMkBET_5I)*

Technology Tools and Materials – For this lesson, we need the following tools & materials:

- Short section of typical copper telephone cable
- Short section of fiber optic cable
- Basic communication circuit – copper-based
- Basic communications circuit – fiber-optic based

Background Information – An important aspect for middle school students is staying connected with their friends. They use a variety of new technologies such as social networking, texting, e-mailing, and cell phones. Most of the students take these technologies for granted, but do they actually know what technology is working in the background in order for them to stay connected with their friends? This lesson will provide students with a better understanding of the technology so they will 1.) Appreciate the advanced technology they use every day; 2.) Recognize typical terminology used in a communications system; 3.) Reinforce the concept of a technology "system" being a collection of parts working together to achieve a goal; and 4.) Be informed consumers the next time they have to purchase another piece of technology.

Useful Vocabulary

New Vocabulary Word	Meaning
Encoder	A device that converts a voice or image into a signal that can be transmitted.
Transmitter	A device that sends the encoded signal over a specific communications channel. This channel is the path over which the message must travel to get from the sender to the receiver.
Receiver	A device that receives a message, that is still scrambled.
Decoder	A device that changes the encoded message into an understandable language.
Destination	The final output of the communications signal/message.
Signal	The part of a communications system that carries information.
System	A collection of parts that work together to achieve a goal.
Fiber Optic Cable	A flexible, transparent fiber (not much wider than a human hair) made of very pure glass (silica) that transmits light between the two ends of the fiber.

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Essential Questions to be Answered; Grand Challenges – What are some of the different ways we can electronically communicate with each other and what are the technologies that allow this to occur? How can a collection of parts be used to achieve a desired goal?

Misconceptions – Middle school students typically do not know how their technology devices such as their cell phones operate with components that must work properly for their call or text to be sent/received. Although they are bombarded in the media about the use of fiber optic communications (e.g., Verizon is *bringing you the light*) they don't understand how it operates.

Lesson Procedures – The following is the sequence for this lesson:

DAY # 1

1. Have the students respond to the following *Question of the Day*: "Develop a list in your journal of all the different ways we communicate with each other." Review the student's responses to the *Question of the Day*. For the student's responses to this lesson, I typically don't allow any student to repeat an earlier response. This requires that they listen to their classmates' responses and also develop a long enough list so they have several responses. Depending on the size of the class, you might be able to go around and have students respond twice. Length of activity: 10 minutes.
2. Review lesson goals with the students to gain insight into the components of a communications system. Also, review the concept of a "system" being a collection of parts all working together. If they don't work together, then the system doesn't work and you don't achieve your goal. Length of activity: 5 minutes.
3. Using the Communications System Components handout, have students read aloud the different components. Stop after each one and restate and answer questions as to the component's function within the overall system. Use the diagram at the bottom of the sheet to demonstrate how these devices work in a radio station. Length of activity: 10 minutes
4. After completing the review of the information on the handout, ask students seated together at the same table to come up with additional examples of communications systems and their associated components. Provide each table with an envelope that contains the name of a communications system. If students cannot come up with an example, allow them to open the envelope and discuss the example provided. A possible example is the classroom's telephone. Length of activity: 2 minutes.
5. Show the video from *How Stuff Works* – Destructed: Telephone (http://communication.howstuffworks.com/telephone.htm) – video is 3 minutes in length.
6. Discuss the video and any other questions the students have on communications system components. Length of activity: 2 minutes.
7. Play a game on the white board. Before class starts put two coded messages on your white board and cover them so the students can't see them. Tell your students that your white board is "magical." Tell them that earlier in the day you had told the magical white board two messages and the board encoded these messages. Now remove the cover and tell the students that the white board is transmitting the messages to them. The students now need to decode the message so they can be understood. You can use any type of code for your messages, but don't make it too easy. My code is that I replace a letter in the alphabet with a number. The twist in my code is that I go backwards with my numbering. Therefore, Z=1, Y=2 … B=25, and A=26. Students silently work to decode the two messages and raise their hands when they have decoded both of them. Once the majority of the students have decoded the two messages, call on two different students to decode the messages. Length of activity: 7 minutes.
8. Students split into pairs to develop their own coded messages. Each pair to create their own message than swap with another pair. If they want, they can either design their own code or use the teacher's code. The goal of the exercise is to give the other team an encoded message along with the code they had used to develop the message. The other team is then meant to decode the

message. They continue to pass coded messages back and forth. Length of activity: 10 minutes.

9. At the end of the first class have students put away their journals and other materials. Review the main concepts discussed during the class. You can also discuss the concept of encryption. This is another form of a communications system used to protect sensitive information on the Internet such as on-line shopping. This is a way to tie the lesson back to the student's everyday lives. Length of activity: 6 minutes.

Day #2

1. Start the class with the students answering the following *Question of the Day*: "Is an engineering drawing a form of communications? If so, why? If not, why? Go around and have each of the students provide their verbal response to the question. Review the results. The answer is yes, an engineering drawing is a form of communications. If the drawing is done correctly, it will provide detailed information to the contractor on how to proceed with the project. As they say, "A picture's worth a thousand words." This also can be said of an engineering drawing. Length of activity: 10 minutes.
2. Review lesson goals with the students – specifically the idea of fiber optic communications and the comparison between copper-based and fiber optic-based communications systems. Also, reinforce the concept of a system is a collection of parts all working together to achieve the final goal. Length of activity: 5 minutes.
3. During the second day of the lesson I would introduce the concept of fiber optic cables. During yesterday's lesson I would have mentioned that fiber optic cables are gaining in popularity as a method to transmit information. In today's lesson I would review how fiber optic cables are fabricated and provide them with some basic information about the pros/cons of using fiber optic cables. I would have the students watch the following video on the science behind a fiber optic cable. Total length of the activity: 15 minutes. http://www.youtube.com/watch?v=0MwMkBET_5I (the length of the video is 5:36 minutes)
4. After the video, review some of the topics discussed. Length of activity: 5 minutes.
5. Have students will do a hands-on activity in which they physically set up two different types of communication circuits – one that uses copper cables and the other that uses fiber optic cables. Each circuit would consist of a microphone, an encoder to change the speaker's voice into and electrical signal, wires (either copper or fiber optic) to transmit the electrical signals, a decoder at the end of the wires, and a speaker as the final destination. Each of the different parts would be labeled with the appropriate terminology. After the circuits had been arranged, students would demonstrate each of the circuit and have them write in their journals the similarities and differences between a traditional copper-based (analog) versus a fiber optic-based (digital) communications system. Length of time for activity: 15 minutes.
6. At the end of the second class, have students put away their journals and other materials. Review the main concepts discussed during the class. Length of activity: 5 minutes.

Assessment Procedures – I am planning on using formative assessments on this lesson. During the two class periods, I plan to circulate around the classroom and listen to my student's comments about the topics as well as verbally quiz them on the main concepts. No formal summative assessment is planned.

Accommodations/Modifications – Will work with students on IEPs or 504s to adjust the curriculum to meet their individual needs. Some of the possible modifications could include:

- During the first class provide them with prepared encoded messages and the code for them to decode. The complexity of the code would be simplified.
- Provide a pre-built – or nearly completed – communications circuit for the student during the second class period so they can experiment with how it functions.

- Provide sentence starters for their journal entries as to the similarities and differences between the communications systems.
- Provide copies of the video transcripts shown in class.
- Provide seating close to the video display for visually impaired students.

Reproducible Materials – The reproducible materials include:

- Communications System Components Worksheet
- Instructions on how to construct the two different types of communications circuits

Explorations and Extensions – Investigate the possible experiments using fiber optic cables and laser pointers.

Lesson Development Resources – *Brain Pop* videos, *How Things Work* website, *The Engineering Guy* videos, and Mike Ruane – Boston University's Photonics Center

Reflections – While I haven't taught this specific lesson before, I have taught certain aspects of it. One of my frustrations in the past is not being able to have a lesson that clearly educates my students on the components of a communications system and the issue of parts of a technology system. These are major concepts that are routinely assessed on the MCAS. My hope is that this "new and improved" lesson that includes more hands-on activities and demonstrations will increase their engagement and retention of the materials.

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