

NGSS Standard: MS-PS4-3



Adventure Description:

In this activity, you will think like a fiber optic cable engineer and test signal transmission in a device that can be used as part of space exploration.

Activity

Step 1: Background Information on Fiber Optic Cable Engineers and Signals (5 minutes)

- Show [Video: Installing Fiber Optic Cables](#)
- Show [Handout: Digital vs. Analog Signals](#). Discuss the difference between digital and analog signals. Then, discuss how fiber optic cables use digital signals instead of analog signals. Analog signals are less exact and can be more easily disrupted. For example, you might take a quick look at an analog clock and it says “about one fifteen.” If you have take a quick look at a digital clock at the exact same time you might see that it is EXACTLY 1:14.
- Next, explain to students that fiber optic cables are used to send digital signals as part of space exploration. Show [Handout: Space Exploration and Fiber Optic Cables](#).

Step 2: Teacher Demonstration (5 minutes)

- Tell students that you will do a quick demonstration to show the differences between digital and analog signals.
- Follow the instructions for the demonstration on [Handout: Teacher Demonstration](#).
- Tell students that you create digital signals using light pulses. It will be up to the students to decode the messages that you create using a flashlight.

Step 3: Creating a Device to Explore Europa (20+ minutes)

- Provide students with [Handout: Exploring Europa](#). Discuss with students how they will build a device that can send digital signals through the icy shell to the surface. The signals can then tell us if there is liquid water beneath the ice. If there is liquid water, there is a potential for life!
- Divide students into pairs or small groups. Provide groups with the following materials:
 - Cardboard box
 - Clear plastic rod

Please contact Allison Bischoff, Director of Customer Service, at allison@rozzylearningcompany.com or 314-272-2560 with questions.



Engineer: Installing Fiber Optic Cables

- Art supplies and building materials (more cardboard, popsicle sticks, glue)
- Guide students through step 1 on [Handout: Steps to Build Your Device](#) to make sure all students are able to get their fiber optic cable run through the surface of Europa and can see light passing through the cable.
- Next, have students complete step 2 to design and build both parts of their device.
- When complete, students should attach each part of their device to one end of their cable.
- Finally, students should test to make sure they are still able to send a signal through their cable.

Step 4: Testing Signal Transmission (15-20 minutes)

- Explain to students that they will now test their device to see if they can send a signal that another group can read.
- Provide students with [Handout: Creating a Code](#). Read through Steps 1 and 2 as a class.
- Allow students 5-7 minutes to write their code. Remind students that there must be 3 beats between each pulse of their code.
- Provide students with a flashlight.
- Have students complete Step 3. They will test whether light travels through the plastic rod. If they are unable to shine the light through the plastic rod inside their device, students should make changes to their design so the light can shine through.
- Next, have students complete Step 4. Pair two groups together to see if they can interpret the other group's code.

Step 5: Discussion (5 minutes)

- Have students showcase their devices and show whether a code can be sent through their rod.
- Ask students if they think that describing different brightness levels would be more difficult to describe than a simple on and off code, like 0s and 1s. Explain to students that describing brightness levels would be like an analog code. Analog codes are sent in a continuous wave, so they can be misinterpreted more easily. Digital signals are very black and white and sent in steps.
- Explain to students that because of the large change in temperature that can occur, fiber optic cables are much more reliable to send data than other kinds of wire or cables. The digital signals that will be sent through the fiber optics are also more reliable than analog signals (for example, there is less chance of interference with other electrical signals)

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Engineer: Installing Fiber Optic Cables

Materials List

Provided online:

- Video: Installing Fiber Optic Cables
- Handout: Digital vs. Analog Signals
- Handout: Space Exploration and Fiber Optic Cables
- Handout: Teacher Demonstration
- Handout: Exploring Europa
- Handout: Steps to Build Your Device
- Handout: Creating a Code

Not Provided online (each student or group needs):

- Flashlight
- Cardboard box
- Clear plastic rod (like these from Amazon: American Educational Acrylic Friction Rod, 3/8" Diameter, 10" Length (Bundle of 5))
- Art supplies and building materials (more cardboard, popsicle sticks, glue)

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