

Science Explorers: Energy lesson #2
Date: 1/24/2013
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Title: What are waves and how do they transfer energy

Goal:

Prepwork:

1) Read lesson plan in advance. Each tutor will ideally work with 2 students. Your students should either be in 2nd/3rd OR 4th/5th (i.e. do not mix 2nd/5th...)
2) When you arrive to the class, make sure you have the following supplies for your group.

- 1 pen or pencil/person (supplied by CDSA)
- 10 dominoes
- 2 cups/student
- 1 fishing line/student
- 2 paper clips/student
- 1 general worksheet/student
- copy of lesson plan

Activity 1: Introduction to waves: transmitting energy without exchanging stuff
[small groups]

15 minutes

Supplies: worksheet, dominoes

Ask the students what they think waves are. Brainstorm different kinds of waves (water, earthquakes, sound, “the wave” in sports stadiums, string instruments, light...). At the same time fill in the table on the worksheet. If water waves come up, it might be good to address the common “misconception” that water waves carry water with them as they travel. Likely the picture kids have in mind when they think about water waves is the part of the wave that really does carry water with it, i.e. when the wave comes ashore. Unfortunately this contradicts one of the main points we would like to get across in this lesson: that waves allow for energy to be carried from place to place WITHOUT carrying any physical stuff along, so maybe address this point. Or not. After you are done brainstorming different waves, move on to the domino demo.

Dominoes demo. Can I push over this domino (standing on end on the table/desk) by pushing on it a little? Yes. [do so]. What about if I set it up at the end of the table, and do the same push way over at this end of the desk? [demo...it won't work]. How can I push it over by just doing the same push, but at the other end of the desk? [take suggestions (maybe at first take suggestions with no prompt, then

ask for suggestions again after you show them that you have a bunch of additional dominoes)] What if I set up a bunch of them? (everyone helps to very quickly set up a line of dominoes between the beginning and end of the desk). Now, if I put in a little energy, can I knock it over? [yes.] Watch as I start a wave, and how that wave travels all along the desk to knock over our goal at the other end. [demo]. Note how each individual domino doesn't need to move very far for the wave to move a long distance. Relate this to the point that waves allow for energy to be carried from place to place without carrying any physical stuff along.

Really try to be done with this section at 4:15 so that we can bring everyone together for the next demo.

**Activity 2: Demonstrations with slinkies and water waves [full group activity]
<10 minutes**

Supplies: 1 long slinky, pyrex baking dish, food coloring

The main purpose of showing the kids waves on the big slinky (other than that big slinkies are super-cool) is to give you a model for how the cup phones work in the next activity. The pulses on the slinky are big and obvious, whereas it is difficult to see that the string connecting the cups is even moving in a way that is clearly connected to you talking. We will probably not take very long on this activity, just long enough to show them that the pulses mainly don't change shape as they move down the slinky and to hit the main theme again that the slinky itself doesn't have to move for it to transmit energy from end to end. Also note that the slinky must be stretched in order to transmit pulses, try to send a pulse on an unstretched slinky and see what happens.

Activity 3: Construct cup phones [small groups]

20 minutes +

Supplies: general worksheet, 2 cups, string, 2 paper clips

This is a classic demo. Here we will let them play with the famous cup/string telephone. The principle, which we should at least try to get across, is that the cup vibrates like a drum when you talk into it. This pulls/pushes on the string (if it is pulled to be taut), and that push/pull is sent all the way down the string to the other cup. What happens on the other cup? They should be able to guess that the string vibrates the bottom of the cup to make sound come out. Have the students take turns talking and listening on each of the telephones. You can also hold the string at different places and have them pluck it to hear different tones. Talk about string instruments (especially with the 4th and 5th graders, some of whom are in a school orchestra). You can talk about sound waves and ears and eardrums and how they work if you are ambitious. You can talk about how sound is transmitted through air versus through the string. Additions: What happens if the string is too loose? What

if I barely hold the cup? What if I grab it with both hands? What if I touch the bottom of the cup (that should make the biggest difference)? Do high pitches or low pitches seem to transmit better? Once you have discussed it sufficiently, have them fill out the part of the worksheet on the cup phones.

Activity 4: Air pusher demo [full group]

10 minutes or whatever time remains in practice

Supplies: Air pusher

Air pusher demo: Has anyone seen one of these before? It is a wave-launching device. Can anyone guess how it works? I just said that it sends a wave, where is the pushing? Am I storing energy? When does it turn into moving energy? Where does the wave start? What's going to happen if I release it at that can over there (empty soda can)?

Basically, it pushes the air in its reservoir out the front very quickly. They should recognize that by pulling back on the elastic band, we are storing energy in the elastic. When we let go, it pushes very hard on the air in the drum, and the wave continues out the front (and all the way across the room).

Much experimenting can be done. Each student can line up and take turns feeling the energy (one by one across the line...and we should de-emphasize the 'shooting' aspect). We can try one weak push, and one strong push each. Perhaps setting up empty cans and knocking them over, seeing what the students suggest. It is probably best to keep it out of the students's hands, if possible, or to really enforce the idea that everyone gets exactly one or two pulls/pushes on the air. We can also try to stand farther back, and discuss how far they think it will go. Why doesn't it go forever? (friction!)

Lesson wrap up:

Explain their "homework" which is listed on the sheet..

1) Show their cup phones to a parent/sibling/friend and explain how it works.