12

Texas Essential Knowledge and Skills - Grade Three

(6) Force, motion, and energy. The student knows that forces cause change and that energy exists in many forms. The student is expected to:

(A) explore different forms of energy, including mechanical, light, sound, and heat/thermal in everyday life;
(B) demonstrate and observe how position and motion can be changed by pushing and pulling objects to show work being done such as swings, balls, pulleys, and wagons; and
(C) observe forces such as magnetism and gravity acting on objects.

Crank it Up

Student Project Edition
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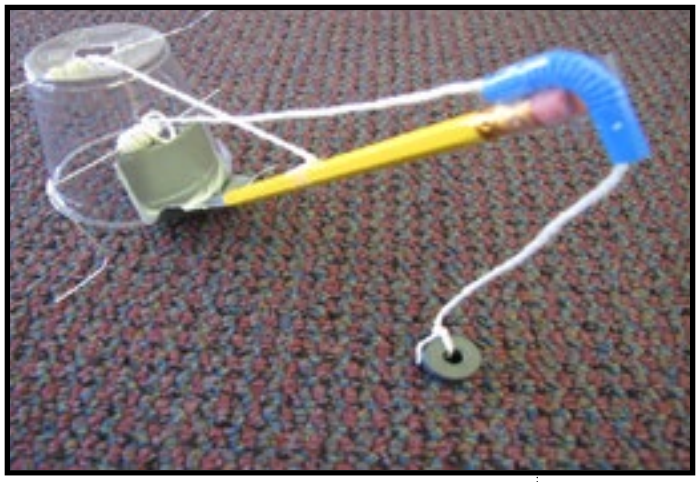
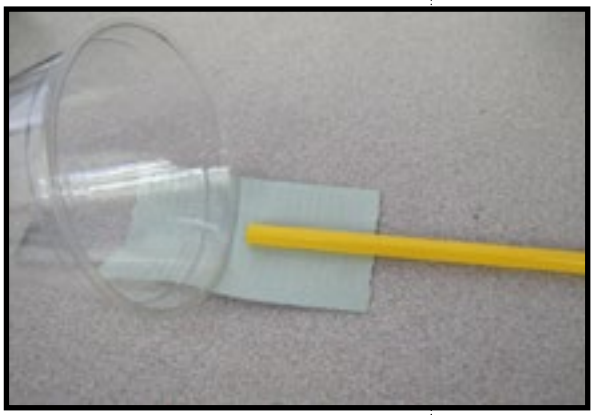
In this activity, you are going to be introduced to physics. It will be fun. One thing about physics, though, is that it is very important to use the terms properly. When physicists talk about "energy" or "force" or "work," they mean very specific things. As you work on this project, you will learn how cranes and other equipment use energy to apply force to do work.



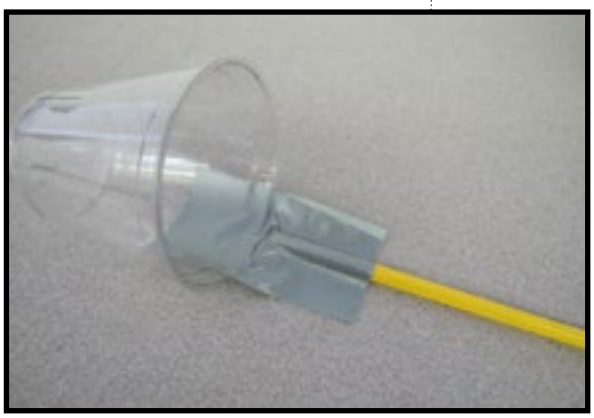
Explore It 1

Make the Base

1. Put a piece of duct tape 8 cm long on the bottom edge of a plastic cup so that it hangs down about 4 cm.



2. Stick an unsharpened pencil to the duct tape. There should be about 5 mm gap between the end of the pencil and the edge of the cup.



3. Put another piece of duct tape on the inside of the cup and over the pencil.

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4. Cut a hole in the bottom of the cup.

5. Poke or drill a hole on each side just big enough for a paper clip.

6. Unbend a jumbo paper clip and put it through the holes.

7. Bend one end into a crank.

8. Tape the end of a piece of string to the center of the paper clip in the middle of the hole.

9. Tape the other end of the string to the middle of the pencil.

10. Crank the paper clip.

11. What happens?

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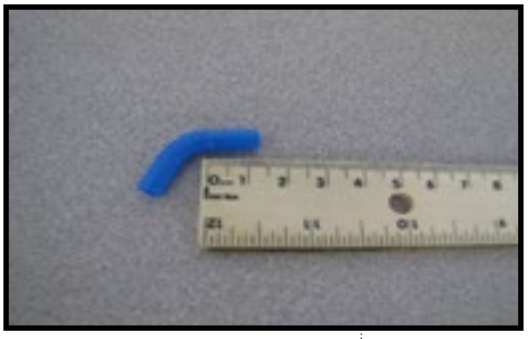
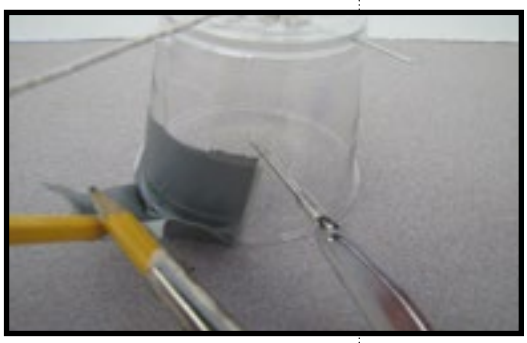
Make the Arm

1. Cut a drinking straw about 1 cm above and 1 cm below the bendy part.



2. Tape it to the eraser of the pencil and bend it so that it hangs down over the end.

3. Cut a hole in the side of the cup just above the tape.



4. Poke a small hole on each side of the hole you just made. These holes should be about at the corners of the tape.

5. Straighten out another jumbo paper clip.

6. Stick it through the two holes.

7. Bend one end into a crank.

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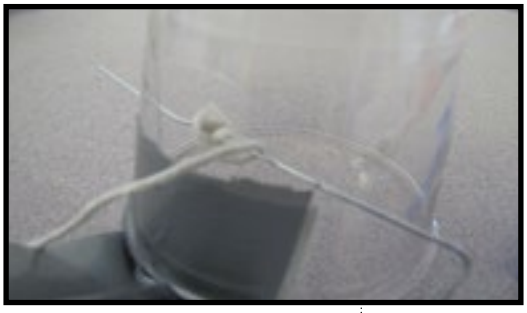
8. Tape a piece of string to the middle of the paper clip.

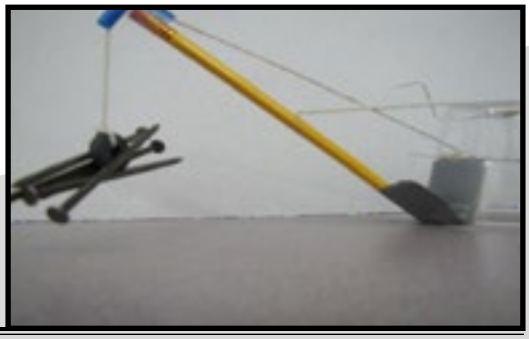


9. Stick the other end of the string through the bendy straw.

10. Tie a magnet to the end of the string.

11. What happens when you turn the crank?

12. Use your device to pick up and move objects.



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Describe It 1

1. What did you just make? Where have you seen them used?

_____

2. What can be used to power them?

_____

3. What kind of energy is used; mechanical, light sound or thermal?

_____

4. What motion does the magnet have?

_____

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5. What motion does the crank have?

_____

6. Where have you seen a crane use a magnet?

_____

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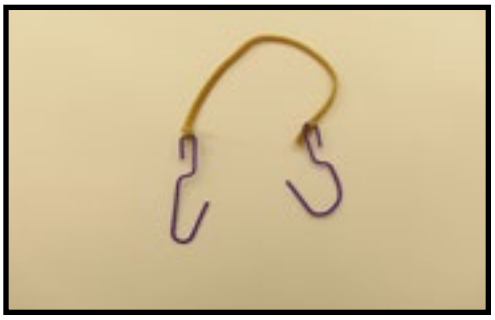
Explore It 2



Make a scale

1. Get a long skinny rubber band from your teacher.

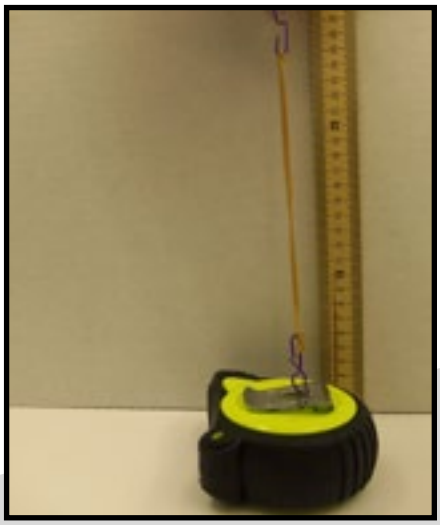
2. Cut it once so that you have a long piece of rubber.

3. Form two small paper clips into hooks.

4. Tie a hook on each end of the rubber string as close to the ends as possible.

Use your scale

1. Hook one end onto a small object and lift it straight up until the rubber string is just **barely** tight. Be sure that you are holding the other hook.



2. Record how far the top hook is from the table.

_____

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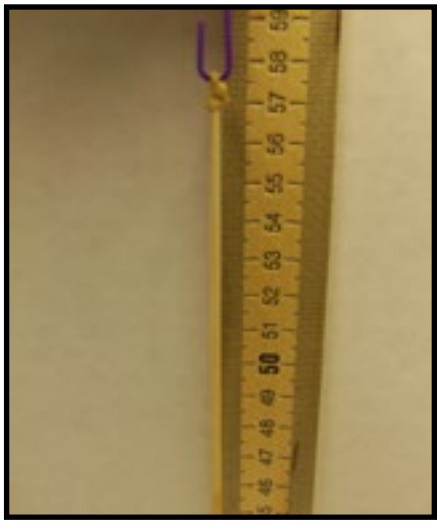
3. Raise the top hook until the object just barely lifts off the ground.

4. Measure how far the top hook is from the table now.

_____

5. Do it again with a different object.



_____ _____

_____ _____

Mechanical force of your crane

1. Set up your crane so that it can lift the objects using the rubber string.

2. Turn the crank until the rubber string is just barely tight.

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3. Count how many times you have to crank the handle to until the object is just barely rising off the table.

4. Write down the number of turns of the handle.

_____

5. Do it again with the other object.

_____ _____

_____ _____

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Describe It 2

1. What did the stretch of the rubber string tell you?

_____

2. When you lifted the object with your fingers, how much force did you use compared to the weight of the object?

much less a little less the same a little more much more

3. If you tied a rope to a bucket holding 50 pounds of water balloons, how much force would it take to lift it up to your tree house?

_____

4. Did the objects weight the same when you lifted them with the crane?

_____

5. How could you tell?

_____

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6. How much force was needed to turn the crank compared to the force needed to lift the object directly?

much less a little less the same a little more much more

7. Was using the crane faster or slower than lifting the object directly with your fingers?

much slower a little slower the same a little faster much faster

8. If you made a crane for a tree house, you would be able to lift much heavier loads, but what is the trade-off? What do you give up to gain force?

_____

_____

Pushing, pulling or lifting requires force. When the force makes something move, you have done work. How fast you do the work is called power. Your crane is a simple machine that makes doing work easier.

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Use It

1. Now that you know how a crane uses mechanical energy to do work, how could you improve your crane?

   a. Make it lift more weight

   b. Make it lift higher

   c. Make it lift faster

   d. Make a base so it can rotate with another crank

   e. Attach a second arm on the end of the first arm

   f. Make an entirely different design

2. Make some sketches of your ideas.

3. Try your ideas.

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