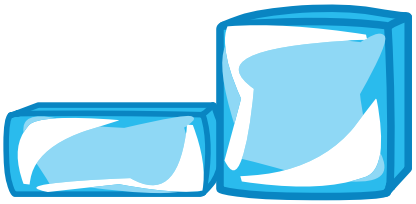
PULLEY ACTIVITY



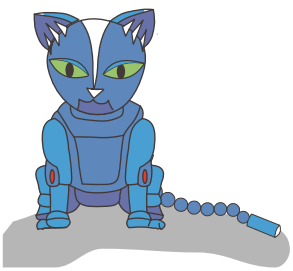
SCIENCE: Simple machines
MATHEMATICS: Finding patterns
LANGUAGE ARTS: Research skills
ART: Photography

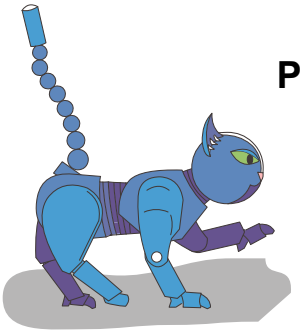
AIM: Students understand the purpose of—and the science behind—simple machines, namely the pulley.

BACKGROUND: Machines help us do many things that we could not do on our own. A simple machine is a device that changes a force applied to it. It increases the force that we apply to a task.
A force, or effort, is applied to one part of the simple machine. Another part of the machine then moves to overcome a resistance, called the load. A simple machine often magnifies the force applied to it, so that a small effort can move a large load. For example, a pulley helps us lift heavy objects. Other simple machines include the inclined plane, lever, wedge, wheel and axle, screw, and gear.
A pulley system changes the direction of the force we apply. Rather than pulling up, we pull down. This makes it easier to lift an object. We can use our own weight as a counterweight.
There are different types of pulleys systems. A single pulley has only one wheel. Multiple pulley systems utilize two or more wheels. With each additional pulley wheel, the job of lifting becomes easier. Using a two-wheeled pulley, you can lift twice as much weight than if you were to use no pulley at all. A three-pulley system can lift three times as much weight, and so on.

BEFORE PLAYING
Discussion: Explain to students that simple machines enable us to do many things that we couldn't do on our own. Ask students to choose which method would make the following tasks easiest:
1. Move a grand piano by picking it up or pushing it up a ramp (pushing it up a ramp—inclined plane)
2. Lift a friend into the air by sitting on one end of a seesaw while your friend sits on the other or by picking him or her up (sitting on a seesaw—lever)
3. Lift a steel beam ten stories by using a crane or carrying it up ten flights of stairs (using a crane—pulley)
4. Open a soda bottle cap with your fingernails or a bottle cap opener (using a bottle cap opener—lever)

AFTER PLAYING
Research and Report: The pulley is one type of simple machine. Have your students use the library or Internet to research three other simple machines. (Examples: inclined plane, lever, wedge, wheel and axle, screw, gears.) Students should describe and give an example of those that they researched.





PULLEY ACTIVITY

ASSESSMENT: Assess students' answers on the After Playing Worksheet.

EXTENSION: Have students refer to their research from **After Playing: Research and Report**. Ask each student to choose a theme: "Simple Machines Around the House," or "Simple Machines Around Town." Students should look around their house or hometown to find an example of each simple machine that they researched. (Example: A bottle opener is a common household lever.) Then, have them take a photo of—or sketch—each example. Award bonus points for additional examples.

RESOURCES
http://www.fi.edu/qu97/spotlight3/spotlight3.html
This site from the Franklin Institute gives examples of simple machines, including the inclined plane, wedge, screw, lever, wheel and axle, and pulley. Have your students check it out as a primer for the After Playing: Research and Report.

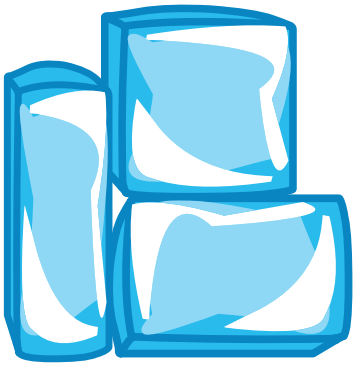
The New Way Things Work, by David Macaulay (Houghton Mifflin Company, 1998, $35.00, ISBN 0-395-93847-3). Readers of all ages will learn something from this book! Fun cartoons accompany explanations of how things work—from simple machines to the latest high-tech inventions. To order, call 1-800-733-2828.

TIP FOR PULLEY POWER (Student Hands-On Activity):
Ask students to bring in a rolling pin from home. If you still don't have enough rolling pins, try this substitute: Straighten a large paperclip and slip it through the center of an empty spool of thread.

ANSWERS
Pulley Power, Worksheet: **(1.** With a pulley. **2.** With a pulley, you pull down, rather than up. So you can use your weight as a counterweight. **3.** Answers will vary.**)**

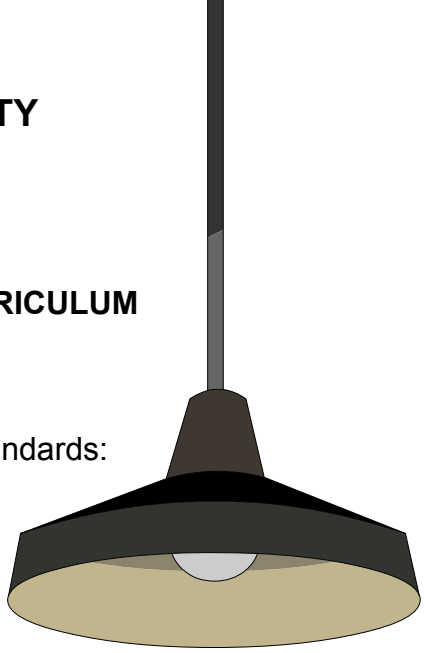
Before Playing, Worksheet: **(1.** 2; **2.** 50; **Do the math:** 2; **3.** 3; **4.** 75; **Do the math:** 3; **5.** 4; **6.** 100; **Do the math:** 4; **Do the math:** 125; **7.** 125; **8.** 150; **9.** Multiplied 6 x 25 to get 150. Or students could have added 25 to their previous answer—125 + 25 = 150; **10.** 250.**)**

After Playing, Worksheet: **(1.** 68; **2.** 51; **3.** 102; **4.** 85; Bonus: 86, 64.5, 129, 107.5**)**



PULLEY ACTIVITY

CONNECT TO YOUR CURRICULUM



This activity can help you meet these National Standards:

Mathematics:

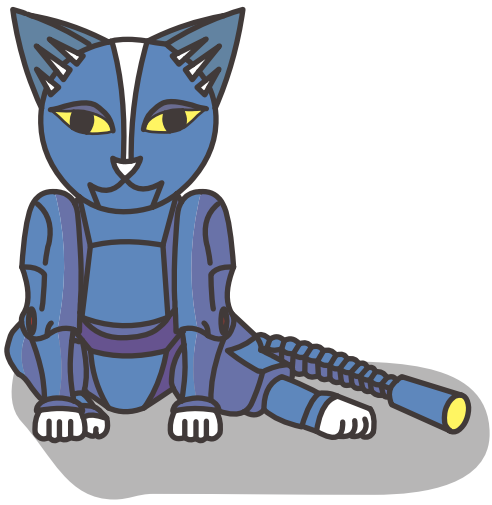
- Understand numbers, ways of representing numbers, relationships among numbers, and number systems
- Compute fluently and make reasonable estimates
- Understand patterns, relations, and functions
- Develop and evaluate inferences and predictions that are based on data

Science:

- Change, constancy, and measurement
- Motions and forces
- Abilities of technological design

CURRICULUM AREAS

Science: simple machines; pulleys; forces; weight.
Scientific Inquiry: testing variables; experimenting; observing; gathering data; drawing conclusions; interpreting results.
Language Arts: library/Internet research; following directions.



PULLEY ACTIVITY
(Student Hands-On Activity)

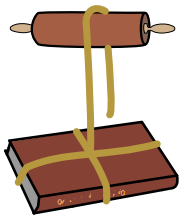
Name:_____

Date:_____

Materials:
Sturdy string
Scissors
Textbook
Rolling pin

Think: Have you ever been unable to lift a heavy object? Why was it hard to lift the object?
Predict: Will a pulley make it harder or easier to lift a heavy object? Explain your answer.

Procedure:
1. Cut a piece of string and tie it around your textbook, as shown.
2. Place the book on the floor and lift the book by pulling up on the string. Note the strength you need to use to lift the book.
3. Now, have your partner hold the rolling pin firmly by its handles.
4. Thread the string over the top of the rolling pin.
5. Pull down on the thread to lift the book. Again, note the strength you need to use to lift the book.



Conclusions:

1. Which requires less strength: lifting the book without a pulley or with a pulley?

_____

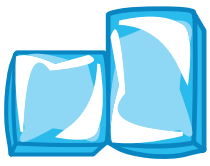
2. How do you explain your answer to #1 above? _____

_____

_____

3. Elevators use a pulley system. What is another pulley system found in everyday life?

_____



PULLEY ACTIVITY
(Before Playing)

Name:_____

Date:_____

Click on the button that says, "close up of pulley."

1. How many wheels does this pulley have? _____

2. How many lbs. can icat lift if Josie uses this pulley? _____

Do the math! (Write your answer in the ☐.)

☐ x 25 = 50

Click on the button that says, "add one pulley wheel."

3. How many wheels does this pulley have? _____

4. How many lbs. can icat lift if Josie uses this pulley? _____

Do the math!

☐ x 25 = 75

Again, click on the button that says, "add one pulley wheel."

5. How many wheels does this pulley have? _____

6. How many lbs. can icat lift if Josie uses this pulley? _____

Do the math!

☐ x 25 = 100

Find the pattern, then predict:
Do the math!

5 x 25 = ☐

7. How many lbs. do you suppose icat can lift if Josie were to use a 5-wheeled pulley? _____ (Check your answer by clicking on "add one pulley wheel.")

8. How many lbs. do you suppose icat could lift if Josie were to use a 6-wheeled pulley? _____

9. Explain how you found the answer to #8. _____

_____

10. How many lbs. do you suppose icat could lift if Josie were to use a 10-wheeled pulley? _____

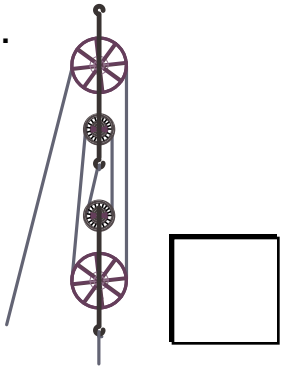
PULLEY ACTIVITY
(After Playing)

Name:_____

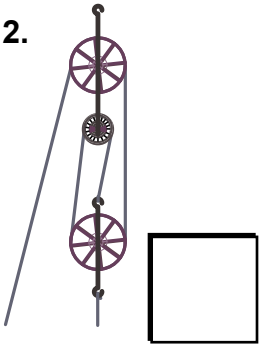
Date:_____

Suppose you could lift 34 lbs. with a two-wheeled pulley. How much weight could you lift with the following pulleys?

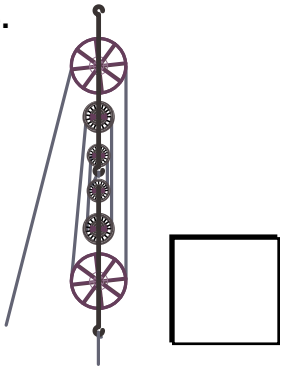
1.



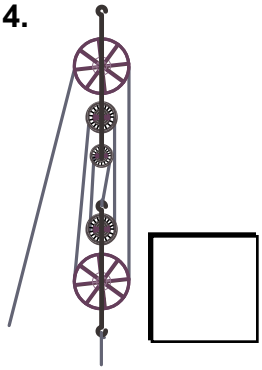
2.



3.



4.



Bonus: Answer questions 1-4 again, this time supposing the two-wheeled pulley could lift 43 lbs.