GALILEO'S DAYDREAM

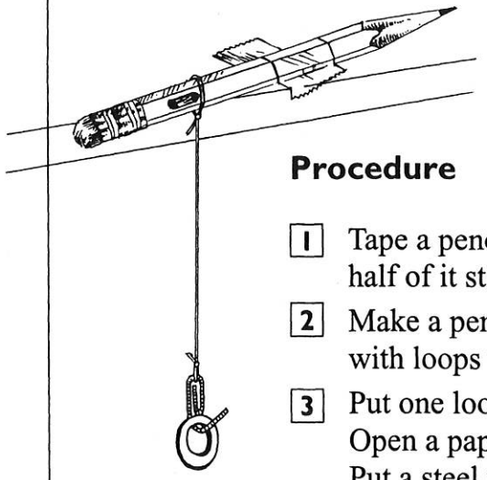
A PENDULUM IS A SWING, TOO!

A pendulum is in fact a falling object, but the string, chain, or rope keeps it from falling straight down. The string puts another force on the pendulum (along with gravity) so that when it swings, it takes a curved path. Galileo studied pendulums when he was a child. As he sat in church, he watched the candelabras swing above his head, suspended by ropes, and started thinking about gravity.

Think about the pendulums that you have seen. What factors do you think influence pendulums? Try a few experiments to learn more.

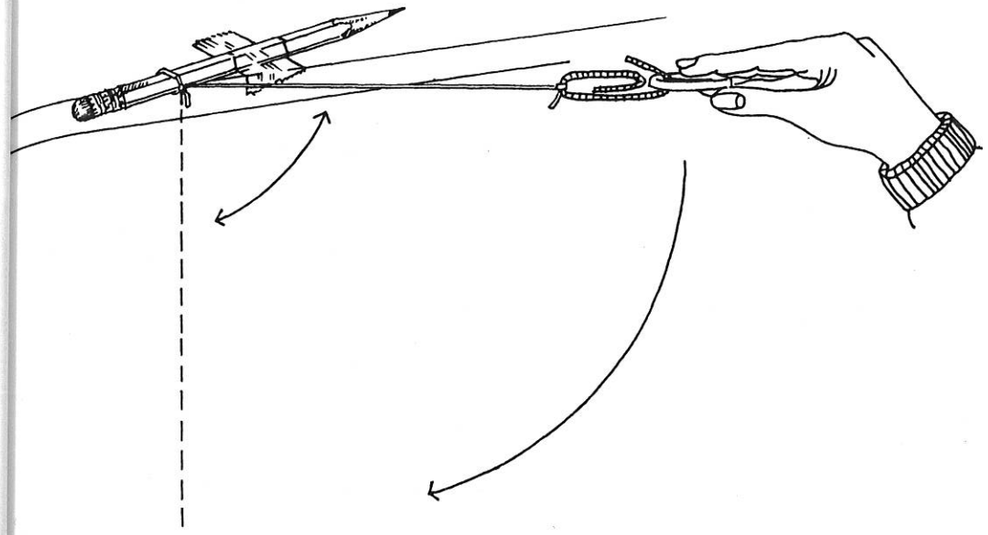
ACTIVITY 1

HOW LONG DOES IT TAKE?



Procedure

1. Tape a pencil to the top of a desk or table so that half of it sticks out over the edge.
2. Make a pendulum string 10 inches (25 cm) long, with loops tied at each end.
3. Put one loop of your pendulum string on the pencil. Open a paper clip and attach it to the other loop. Put a steel washer on the paper clip. The diagram shows the proper setup.
4. Estimate how many times you think your pendulum will swing in 15 seconds. You should count only
5. Hold the washer at a 90° angle—straight out, parallel to the floor, and parallel to the table edge.



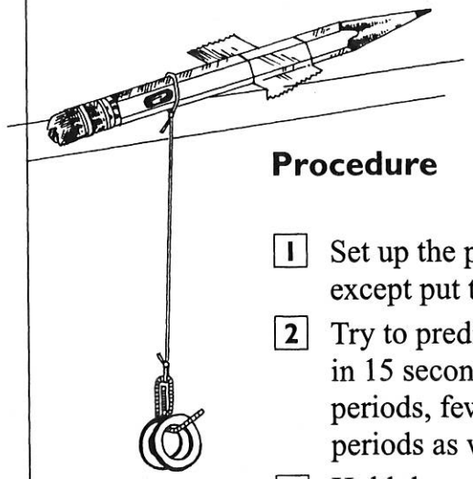
You will probably need a friend to count the 15 seconds for you. At the signal "go," release the pendulum and count the periods until your friend says "stop."

6. Record the number of periods your pendulum made. How close was your estimate?
7. All scientific experiments need to be repeated both by yourself and by others. Repeat the experiment yourself a couple more times, then have a friend do it. Did all the trials give the same results?

Can you think of anything that you can change in the experiment that might affect the outcome of the experiment? Any factor that changes is called a **variable.** With a pendulum, the variables of mass, the angle of swing, and the string length may all have an effect on how long it takes to complete one swing. Try changing these variables and see what happens—but

ACTIVITY 2

ADDING WASHERS



Procedure

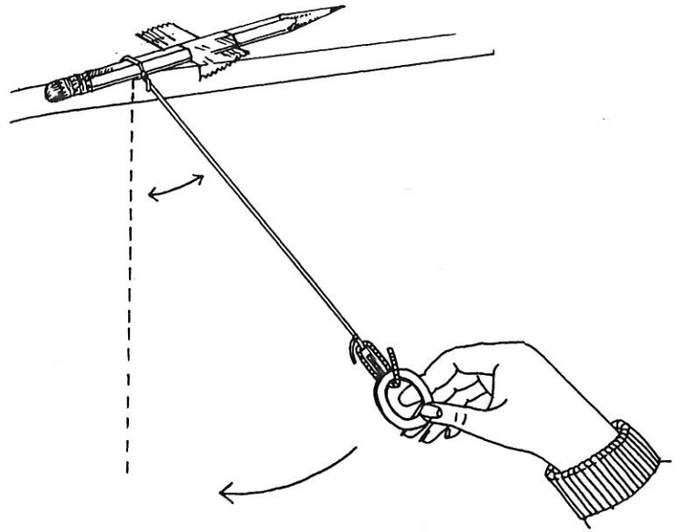
1. Set up the previous activity the same as before, except put two steel washers on the pendulum.
2. Try to predict the periods the pendulum will make in 15 seconds with two washers. Will it make more periods, fewer periods, or the same number of periods as with one washer?
3. Hold the washer parallel to the floor and release it as before. Count the number of complete periods it makes in 15 seconds.
4. Repeat the experiment several times to see if you always get the same results.
5. Repeat the experiment with three steel washers.
6. Does greater mass, that is, more steel washers, affect the number of periods that a pendulum makes in 15 seconds?

ACTIVITY 3

SWING HIGH, SWING LOW

Procedure

1. Set up the pendulum as in Activity 1 on page 12, with only one steel washer.
2. Instead of releasing the washer from a 90° angle (parallel to the floor), release the washer from about



4. Repeat the experiment several times to see if you always get the same results.
5. Does the angle of release affect the period of the pendulum?

ACTIVITY 4

LONG ONES, SHORT ONES

Procedure

1. Set up a pendulum the same as in the previous experiment, only this time use a string of a different length.
2. Use the same procedure as the first experiment, releasing the pendulum from a 90° angle.
3. Repeat the experiment several times to see if you always get the same results.
4. Repeat the experiment at least nine more times, using pendulum strings of different length each time. Try some that are longer and some that are shorter. You will use these pendulums in the "More