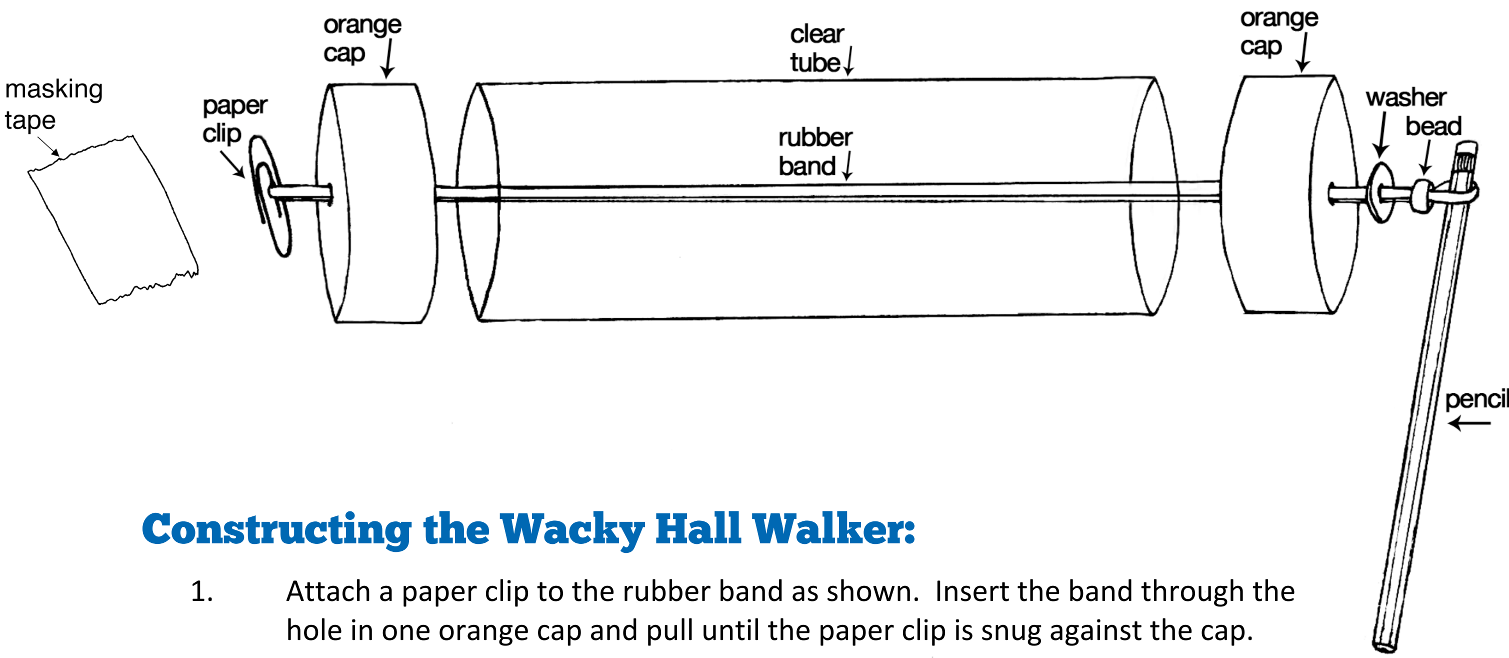
Wacky Hall Walker

WHW-100, WHW-115



Constructing the Wacky Hall Walker:

1. Attach a paper clip to the rubber band as shown. Insert the band through the hole in one orange cap and pull until the paper clip is snug against the cap.

2. Secure the paper clip against the cap with the piece of masking tape.

3. Using the white wire hook, grasp the rubber band inside the clear tube and pull it through the clear tube and the hole of the other orange cap.

4. Grasping the end of the rubber band, insert it through the metal washer and then the bead. *Note: it is sometimes easier to twist the bead over the end of the rubber band.*

5. Secure the end of the rubber band by inserting a pencil through the loop. Slide the pencil through the loop until the band is about 2 cm from the eraser end of the pencil. *Note: make sure the orange caps are secure on the clear tube before use.*

6. Test the walker by winding it up (30-50 turns) and checking that the pencil is able to rotate freely. Test the movement of the walker along the floor. It is best to use a large area such as the gym, lunchroom, or hallway.

5 Francis J. Clarke Circle

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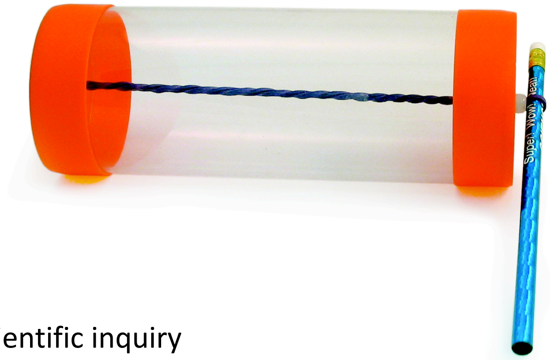
The Wacky Hall Walker



Topic: Energy Transfer

Problem: To control the movement of a wind-up toy.

Process Skills: observing, inferring, predicting, measuring, generalizing, drawing conclusions

NSES Content Standards:

Standard A:	Develop abilities necessary to do scientific inquiry
	Design and conduct a scientific investigation
	Use appropriate tools and techniques to gather, analyze, and interpret data
Standard B:	Develop understanding of motions and forces
	Develop understanding of transfer of energy
Standard C:	Use mathematics in all aspects of scientific inquiry

Performance Objectives:
Students will be able to:

- explain the difference between kinetic and potential energy
- conduct experiments using the Wacky Hall Walker
- apply the law of conservation of energy as it relates to the Wacky Hall Walker
- make predictions based upon collected data
- measure distances in metric units
- construct tables and graphs to display data

Vocabulary: energy, potential energy, kinetic energy, mechanical energy, tension

Background Information:
The law of conservation of energy states that the amount of energy put into a system is equal to the amount of energy leaving the system. The elastic energy stored in the twisted rubber band of the Wacky Hall Walker (WHW) is called *potential energy*. The energy of motion released as the WHW moves is called *kinetic energy*. The number of twists applied to the rubber band mechanism is proportional to the distance the WHW travels.

The motion of the WHW is also influenced by the size and mass of the WHW body, size of the rubber bands used inside the container, type of surface the WHW travels over, size of the pencil, and whether the eraser end of the pencil is dragging along the floor or up in the air.

Materials:
Clear cylinder, 2 plastic end caps with a hole in the center, small round bead, #117 rubber band, metal washer, pencil, paper clip, masking tape, measuring tape

The Wacky Hall Walker

continued

Introducing the Wacky Hall Walker

Show students a WHW with the rubber band already twisted 50 times. Hold the pencil still, and ask students what is in the can. Elicit that the can is filled with energy.

Release the pencil and allow it to spin freely. Define the stored energy in the WHW as *potential energy*. Ask students to predict how the WHW will behave when placed on the floor (when filled with potential energy).

Twist the rubber band and demonstrate how the WHW rolls along the floor. Define the energy of movement as *kinetic energy*.

Experimenting with the Wacky Hall Walker

1. Ask students to find the minimum amount of energy (number of turns) needed to set the pencil in motion so it makes at least one full turn.

2. Each group should have one WHW, measuring tapes, the *Wacky Hall Walker Activity Sheet*, graph paper, and a pencil. Have groups work in the hallway or a large room (i.e. gymnasium, lunchroom).

3. Place a strip of tape on the floor as a starting line. Remind groups to start their WHW from the same position behind the line.

4. Wind the WHW 30 turns, release it, and measure the distance it travels along the floor. Record this data in the bottom table on the *Wacky Hall Walker Activity Sheet*.

5. Continue experimenting by measuring the distances the WHW travels when wound 40, 50, 60, and 70 turns. Record this data. Predictions should be made prior to releasing the WHW after it is wound 50, 60, and 70 turns.

6. Use the data in the table to complete the *Wacky Hall Walker Bar Graph*. Older students can make their own line graphs.

7. Discuss the relationship between the number of turns put into the WHW and the distance it traveled. How accurate were the predictions?

The One Chance Challenge

1. Establish a starting point and target destination in the “WHW test area.”

2. Ask students to predict the number of turns needed (energy input) for the WHW to reach the target distance (energy output). Students should refer to the previously used tables and graphs.

3. Graph paper and pencils should be made available if any groups wish to draw any new graphs.

4. Conduct the challenge and declare the winner. How accurate were the predictions? How helpful were the data tables and graphs?

Extensions:

1. Challenge students to construct a WHW that travels at a faster or slower speed. (Try using different sized containers, rubber bands, and pencil lengths.)

2. Place additional weight (gram weights, fishing weights, metal washers, etc.) inside the WHW. Have students predict the effects (if any) the additional weight will have upon the movement of the WHW.

3. Ask students to discover if the WHW travels differently with the eraser end of the pencil up or down. Why is there a difference? (friction)

4. Measure the distances the WHW is able to travel across different surfaces (carpet, wood, concrete, tile, freshly waxed floor) when wound an equal number of turns. Discuss how friction effects the movement of the WHW.

5. Wind the WHW 50 turns and secure the pencil in place with tape. Put the WHW away for 24 hours or longer. The following day(s) remove the tape and place the WHW on the floor. Measure the distance the WHW travels. Compare this distance with the distance traveled when “freshly” wound 50 turns. Discuss how well (or poorly) the WHW was able to store energy over a period of time. How does this experiment compare with the energy stored in fresh or old batteries?

6. Have students bring assorted wind-up toys or other devices (i.e. clock, watch) into class. Have students describe how they get their energy to work.

7. Challenge students to design and construct original wind-up toys that move.

Wacky Hall Walker
Activity Sheet

Procedure:

1. Tape a length of masking tape on the floor in either a hallway, gym, or lunchroom. Label the tape “START.”
2. Starting with the rubber band *untwisted*, twist the rubber band inside the Wacky Hall Walker 30 times by rotating the pencil.
3. Place the Wacky Hall Walker (with eraser end of the pencil touching the floor) behind the “START” line and release.
4. After the Wacky Hall Walker has stopped rolling, measure the distance traveled. Use an appropriate measuring device or count the number of floor tiles.
5. Untwist the rubber band until all the twists are gone. (This must be done after each test.)
6. Repeat the above procedure, twisting the rubber band 40 times. Record the distances traveled on the chart below.
7. Predict the distance the Wacky Hall Walker will travel when the rubber band is twisted 50 times. Enter your prediction below.
8. Twist the rubber band 50 times, then place your Wacky Hall Walker on the start line, and release it. Measure the distance traveled. Compare your prediction with the actual distance.
9. Predict the distance the Wacky Hall Walker will travel when the rubber band is twisted 60 and then 70 times. Record your predictions and test. How accurate were your predictions?

Number of Turns	Distance Predicted	Distance Traveled
30		
40		
50		
60		
70		

Wacky Hall Walker Activity Sheet

continued

Wacky Hall Walker Bar Graph

10. Color each row of the bar graph below to show the distance the Wacky Hall Walker (WHW) traveled after each number of turns.

Number of Turns	Distance Traveled in Meters																							
30																								
40																								
50																								
60																								
70																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

11. What is the relationship between the number of rubber band turns and the distance the WHW travels? Why?

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To extend your lesson, consider these Educational Innovations products:

Wooden Car Kit (WK-1)
This wooden car is powered by an elastic band. When the potential energy of the stretched elastic is converted into kinetic energy of motion, the car will travel about three meters (10 feet). Students can experiment by varying the method of winding the elastic, the number of turns, and the type of surface used. It is easy to assemble.

Light Up Gyro Wheel (GYR-285)
Here's a new take on a retro "toy" that mesmerizes while it teaches! Demonstrate the conversion of potential energy to kinetic energy and back again. The colorful wheel has a hidden LED light inside. As soon as the magnetic edges of the wheel touch the metal rails, the LED lights up—a perfect demo of open and closed circuits! Simply tip the rail to begin the spinning motion.

Flying Butterfly (AIR-480)
Wind up this clever little device and hide it inside a book or greeting card. When it is set free, the butterfly will spin and fly up to 20 feet in the air! Amazing!

Newton's Cradle (NEW-115)
Wind up this clever little device and hide it inside a book or greeting card. When it is set free, the butterfly will spin and fly up to 20 feet in the air! Amazing!