Speedy Energy

Grade 4: Motion Probe

Aligned with National Standards

ward's science

Single Probes

overview

This is an interactive inquiry where students will investigate the speed of an object and the energy it exerts as it crashes into other objects. Students will understand that the more speed an object has, the more energy it has in a collision.

This activity uses the WARD's Single Motion Probe to collect data, allowing students to focus on the science discovery and leaves more time for learning and developing higher level thinking skills.

time requirement:

This activity can be completed in one session of 20 minutes.

materials required for the activity:

WARD'S Single Motion Probe
Toy car (or ball)
Ramp
Box (open on one end)
Meter stick
Instructions (this guide) and the student worksheet (page 8).

safety precautions

general safety:

- Read all instructions before starting the lab activities. Review safety and lab procedures with students and remind students to ask questions.
- Consider establishing a safety contract that students and their parents must read and sign. This is a good way to identify students with allergies (e.x. latex) so that you (and they) will be reminded of specific lab materials that may pose risks to individuals.

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DIMENSION 1 Science and Engineering Practices

×	Asking questions (for science) and defining problems (for engineering)		Use mathematics and computational thinking
×	Developing and using models		Constructing explanations (for science) and designing solutions (for engineering)
×	Planning and carrying out investigations		Engaging in argument from evidence
×	Analyzing and interpreting data	×	Obtaining, evaluating, and communicating information

DIMENSION 2 Cross Cutting Concepts

×	Patterns		Energy and matter: Flows, cycles, and conservation
×	Cause and effect: Mechanism and explanation	×	Structure and function
	Scale, proportion, and quantity		Stability and change
	Systems and system models		

DIMENSION 3 Core Concepts

Discipline	Core Idea Focus
Physical Sciences	PS2.A: Forces and Motion

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NGSS STANDARDS

Elementary School Standards Covered
4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object. 4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide.

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Content Standards (K-12)			
	Systems, order, and organization		Evolution and equilibrium
×	Evidence, models, and explanation	×	Form and function
×	Constancy, change, and measurement		

Physical Science Standards Elementary School	
×	Position and motion of objects

× Indicates standards covered in activity

prior to class

- Review the basic information about how to use the WARD's Single Motion Probe. The motion probe has three units that it can measure; the units can be changed by touching the "m" to the right of the motion icon and then touch the box showing one of the below units.

m

m	Measures distance in meters
m/s	Measures speed
m/s^2	Measures acceleration

It is recommended for this activity that the probe measure distance.

- Gather materials for a ramp.
- Find a box and cut out one end so the test object can roll into it easily, but not out the other side. A shoebox would be good depending on the size of the car (or ball) you use.
- Make copies of page 8 for students if desired.

objective

Students will learn to relate the speed of an object to its energy. They will also see that the speed and energy of a moving object is impacted when it collides with another object.

background

A moving object covers a specific distance over a period of time. This is called its speed. The speed of an object increases as it covers more distance in a shorter period of time. This also gives the object more kinetic energy, or energy of motion.

The speed of a swinging golf club creates a change of energy in both the ball and the club. Prior to the collision (the club hitting the ball) the club is moving and has energy of motion, while the ball is at rest. After the collision, the ball moves very quickly since the golf club transferred energy to it, and the club comes to rest.

build upon prior knowledge:

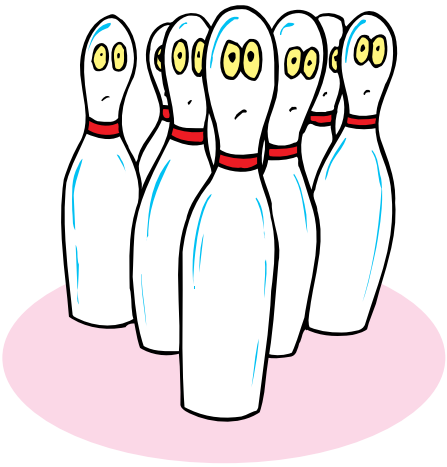
- Ask the students to look at the pictures below and ask the students which golfer would hit a ball that goes faster. Ask them to explain their reasoning. *(Student response: golfer B is swinging his club harder and faster, with more motion and energy, so the ball will go faster and farther.)*

Golfer A

Golfer B

- Ask the students to look at the pictures below and ask the students what happens when the ball hits the pins. How would the results be different if the ball was slowly rolled down the lane compared with if the ball was rolled very fast? *(Student response: The moving bowling ball will knock down the pins. If the ball rolls slowly down the lane, it will not have the speed and energy to knock a lot of pins down. If the ball is rolled very fast, it will knock a lot of pins down because the energy and motion will be transferred to a lot of the pins.)*

Bowling ball



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guiding questions

- What do you think will happen? (Hypothesis)
- What do you expect to learn?
- What tools are needed?
- How can we record our findings?

procedure

1. Set up a ramp for either a car or ball. The motion probe will need to be held at the top of the ramp.

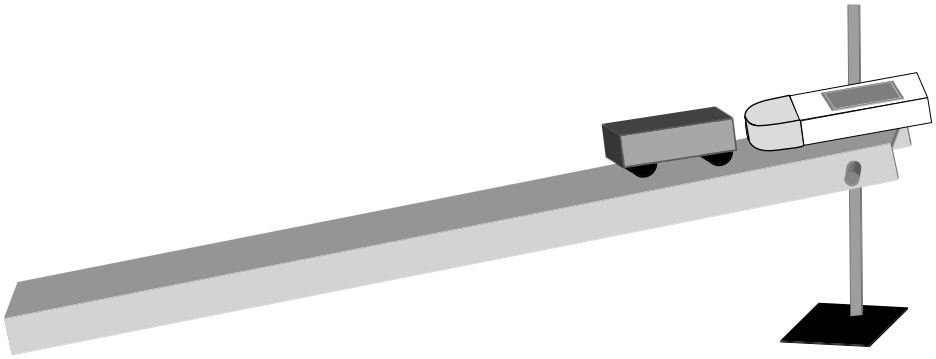

Figure 1

2. The student with the motion probe should hold it steady while recording the distance of the car. Using the graph display makes this easier. The purpose of this is to give the students a graphical picture of the car's motion so they know it changes from one experiment to another.

3. Have the students do a couple trial runs of the car or ball rolling down the ramp and across the floor. Make sure the graph of the motion is consistent from one trial to another. Also make sure there is plenty of room for the car or ball to come to a stop on its own. Make a note of the distance the car or ball travels before it stops. *(#1 on Data Sheet)*

4. Once the students have an average distance recorded, place the open end of a box at the end of the ramp. Do not secure the box. It should be able to slide away easily. The intent is for the box to capture the car or ball and move with the car or ball as one unit.

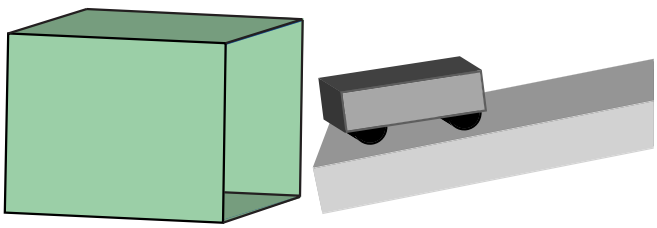

Figure 2

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5. Have the students predict and record what they think will happen to the distance the car (or ball) and box will move once they collide. *(#2 on Data Sheet)*

6. Release the car (or ball) so it collides into the box and both go sliding across the floor. Have the students record the distance it moved. *(#3 on Data Sheet)*

7. Ask the students what they think will happen if the ramp is raised so the car (or ball) is released from a higher position. Have them repeat the experiment to see if they are correct. *(#4 on Data Sheet)*

summarize

Ask the students what they have learned about the speed of an object and its energy to move. (*Student responses may include: the more speed an object has, the more energy it has to move.)*

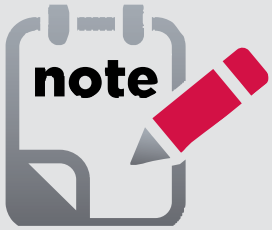
Ask the students what they have learned about what happens to the energy of a moving object when it collides with another object. (*Student responses may include: the energy is transferred from one object to the other and causes motion in the other object.)*

extension

Ask the students what would happen if you placed an object like a shoe on the box and then repeated the experiment. Would the energy of the car (or ball) be enough to move the heavier box?

You can also experiment with the box being on carpet or a strip of wax paper if you want to discuss the effect of friction.

Using the units of m/s can give students a more direct reading of the speed of the moving object.



teacher notes

- The Ward's Single Motion Probe sends out a sonic cone that it uses to determine the distance of an object. The probe will yield better results if held up off the surface.
- Since the motion probe emits a high frequency sound, it is an excellent way to demonstrate to the students how sound waves reflect off different objects. Point the probe at a hard tiled floor and then at a carpet, the carpet will absorb the sound waves.
- Connecting the Single Probe to a computer either through the USB or WiFi may make the graph easier to see. Printing out the graph for each experiment may also be useful.

Data and Results

1. Record the average distance the car (or ball) rolled. _____ m

2. What do you predict the distance will be when the car (or ball) and box collide with each other? _____m

   Explain your answer.

_____

_____

_____

3. Record the average distance the car (or ball) and box moved. _____m

4. What do you predict will happen to the distance the car (or ball) and box will move if you raise the ramp higher?

Car/ball alone _____ Car/ball with Box _____

Explain your answer.

_____

_____

_____

5. What happened to the energy of the car (or ball) after it collided with the box?

_____

_____

_____

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