Activities

Student Activities *continued*

6 Students should stack 3 of the same title of textbook to represent the deck height, or use the inclined plane. Using a large rubber band attached through the hole in the carriage (representing the hot tub), a student should lift the carriage up to the top book or top of the plane, and hold it there. Another student can use the ruler to measure the length of the rubber band as it does this work. Discuss that this length demonstrates the amount of effort exerted. (Advanced students could be asked to come up with what represents each factor in the task on their own.) This measurement should be notated.

7 Next, students should use the ramp on the inclined plane, or create one with another book or notebook, to go from the desk to the top of the incline. This time, using the same size of rubber band as before, a student should pull the carriage up the ramp. Just before reaching the top, so the rubber band is still pulling, another student should measure the length of the rubber band with the ruler. This measurement should be notated.

8 Students should compare the two measurements and discuss which way made the rubber band work harder. (The latter).

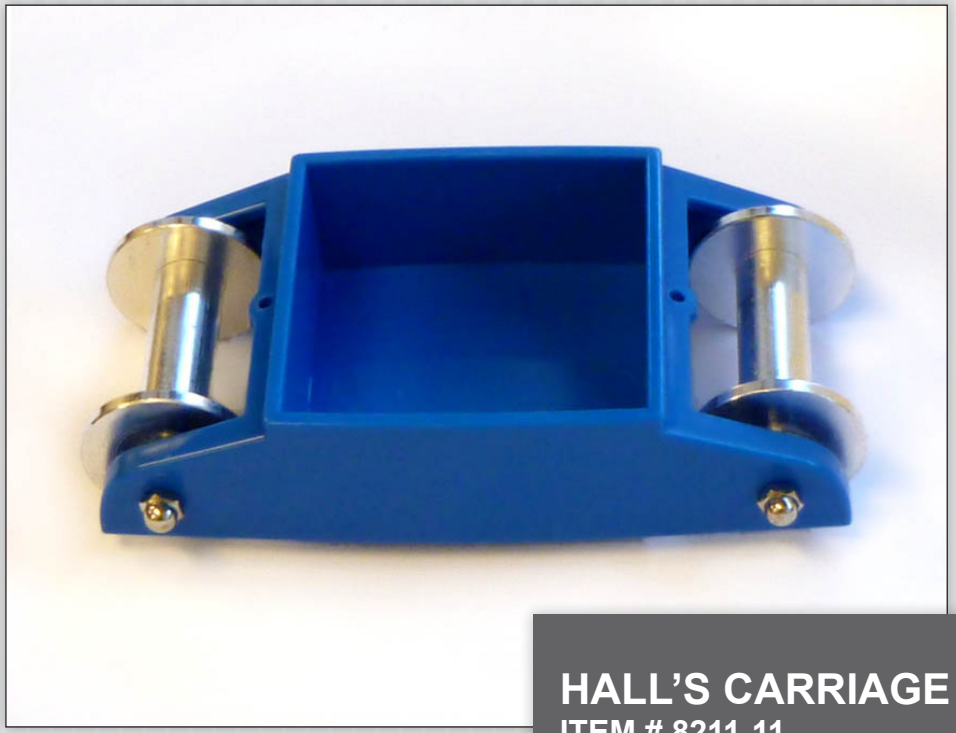
9 To further explain this issue, students should add variables. Students should consider their observations and vocabulary for the experiment to answer these questions: What would change if the carriage didn't have wheels? What would happen if the ramp were shorter? Longer? What if the rubber band were bigger? Smaller?

10 Advanced students can work to discover the mathematical equations which express the effects of angle, distance, force, speed.

Vocabulary List - Key

- Force - strength or effort placed upon an object
- Mass - amount of substance to an object
- Acceleration - increase in speed
- Distance - a measurement of space from point A to point B
- Angle - amount of slope of slant
- Effort - amount of energy applied to an object to achieve a desired result
- Work - what gets accomplished because of effort or force.
- Friction - a resistance to a moving body, causing it to slow or stop.
- Incline - a grade, hill, slope or slant

TEACHERS GUIDE



HALL'S CARRIAGE
ITEM # 8211-11

MECHANICS - DEMONSTRATION DEVICES

- How can I get up the hill more easily on my bicycle?

This frictionless carriage will allow analysis of force needed for work. The Hall's Carriage is made of sturdy plastic and one-piece metal wheels. Hole in one end of the chassis allows for attaching a cord.

Materials

- unit vocabulary
- plastic toy car
- large metal toy truck
- inclined plane
- Hall's carriage
- large rubber bands
- ruler
- topographical map of Appalachian Mountains
- Newton's 3 laws of motion
- pictures of construction tasks or furniture moving that applies
- Student Handout (Quiz and Vocabulary List)

Goals & Objectives

Students will:

- explain how technology responds to people's needs.
- explore the movement of objects and what affects this.

Assessment

Quiz Questions - Answer Key

1. Name Newton's three laws.
   - "A body persists its state of rest or of uniform motion unless acted upon by an external unbalanced force."
   - "Force equals mass times acceleration (F = ma)":
   - "To every action there is an equal and opposite reaction."

2. Which of the three laws does pulling the carriage with the rubber band demonstrate?
   - The first. The carriage didn't move until the rubber band acted upon it.

3. To increase the need for more effort or acceleration in the hot tub situation, you would need to make the ramp **(shorter/ longer).**

4. Decreasing the ramp's distance would increase the **slant/angle/slope**.

5. If carriage (hot tub) had no wheels under it, moving it would create **friction**, which would slow down the work, or create need for more effort or acceleration.

6. The rubber band in the experiment exerted **force** on the carriage.

7. Increasing the rubber band or decreasing the **mass** of the carriage would make the work easier.

8. Use the information in this unit to answer the following question: How can I get up the hill more easily on my bicycle?
   - Answers will vary. They should mention concepts found in the vocabulary. One possible answer would be to make the force propelling the bicycle increase. This could mean changing gears. Another might be to increase the distance by using less slope or angle up the hill.

Activities

1 Show pictures of an Appalachian Mountain range. Ask students how the settlers dealt with this obstacle as they moved west in rude vehicles and no roads.

2 Give students Newton's 3 laws of motion, and demonstrate them by doing the following:

a *First, place Hall's Carriage on a desk and ask students if it can begin moving all by itself. (No) This demonstrates law 1.

"A body persists its state of rest or of uniform motion unless acted upon by an external unbalanced force." Newton's first law is often referred to as the law of inertia.

b *Second, roll the small car to bump the carriage. Measure how far the carriage moves. Then roll the larger truck to bump the carriage. (Attempt to use the same force as before.) Measure how far the carriage moves. It should move farther this time. This demonstrates law 2.

"Force equals mass times acceleration (F = ma)": the net force on an object is equal to the mass of the object multiplied by its acceleration.

c *Third, notice that the impact of the train with the carriage slows or stops the train. This demonstrates law 3.

"To every action there is an equal and opposite reaction."

3 The topics of one and two are related and must be dealt with any time you want to move something to a higher location. This is a common issue in daily construction projects, or moving furniture to an upper story. Show pictures of construction efforts or moving efforts that apply.

4 Pass out a list of vocabulary words they will find useful throughout the unit, and ask them to define each word.

Note
It is always best to DO an experiment ahead of time to be able to best present it to the class.

5 Students are to assume they have a hot tub that needs to be placed on a deck three feet off the ground. Does it take less force to hoist the tub straight up? Does it take less force to pull the tub up a ramp?

continued on page 4

QUIZ

STUDENT HANDOUT

Student Name: _____

Hall's Carriage Quiz

Try to use vocabulary words (on the back of this quiz) as you answer questions, where appropriate.

1. Name Newton's three laws.

2. Which of the three laws does pulling the carriage with the rubber band demonstrate?

3. To increase the need for more effort or acceleration in the hot tub situation, you would need to make the ramp _____ (shorter/longer).

4. Decreasing the ramp's distance would increase the _____.

5. If carriage (hot tub) had no wheels under it, moving it would create _____, which would slow down the work, or create need for more effort or acceleration.

6. The rubber band in the experiment exerted _____on the carriage.

7. Increasing the rubber band or decreasing the _____ of the carriage would make the work easier.

8. Use the information in this unit to answer the following question: How can I get up the hill more easily on my bicycle?

STUDENT HANDOUT

Vocabulary List

1. Force
2. Mass
3. Acceleration
4. Distance
5. Angle
6. Effort
7. Work
8. Friction
9. Incline