

Resources Archive

Chapter 5: Get Moving

Get Me Out of Here

Materials for Testing Your Plan

- Compass or compass phone app
- Helmet with a blackened visor, folded sheet, or coat to put over trapped firefighter's head so this team member can't see where he or she is going but can see the compass
- Blueprint of a room (see, for example, Figure 5.4)

Fastest Beetle

Materials

- Stopwatches or stopwatch phone apps
- Chalk to mark start and finish lines
- Notebook(s) for recording results
- Optional: meter sticks or tape measures for measuring the length of the course

Safety Precaution

Students must wear personal protective equipment (safety glasses or goggles) during the setup, hands-on, and takedown segments of the activity when meter sticks or tape measures are used.

Fastest Human

In racing, the total time can be divided into smaller portions known as splits, the time it takes to cover different portions of the race course. For example, Donovan Bailey covered the third 10 meter split in 1 second. This means that over that stretch, he averaged 10 meters per second (1 meter per second is equal to 2.2 miles per hour). Table 5.2 shows both races divided into splits.

Constantly Moving

Materials

Your lab has the following tools for you to use:

- Self-propelled toy car
- Tape measures or meter sticks
- Roll of paper from an adding machine or receipt tape
- Metronome or metronome phone app
- Stopwatches

- Graph paper
- Calculator
- Safety glasses or safety goggles

Safety Precaution

Students must wear personal protective equipment (safety glasses or goggles) during the setup, hands-on, and takedown segments of the activity.

Good Driver

Version 1

MATERIALS

You have the following tools to test your interpretation of the accelerometer readout:

- Motion detector that can produce distance versus time, speed versus time, and acceleration versus time graphs
- Wooden or plastic building blocks that the motion detector can “see”
- Tape measures or meter sticks
- Stopwatches
- Graph paper
- Calculator
- Safety glasses or safety goggles

SAFETY PRECAUTION

Students must wear personal protective equipment (safety glasses or goggles) during the setup, hands-on, and takedown segments of the activity.

Version 2

There are two ways you can make a simple acceleration detector to experiment with.

MATERIALS FOR ACCELERATION DETECTOR 1

- Disposable water bottle with cap
- A cork that will fit through the opening
- String
- Thumb tack or hot glue gun
- Tape (any type)
- Indirectly vented chemical splash goggles

SAFETY PRECAUTIONS FOR ACCELERATION DETECTOR 1

1. Students must wear personal protective equipment (indirectly vented chemical splash goggles) during the setup, hands-on and takedown segments of the activity.
2. Use caution when working with sharps (tacks), which can puncture or cut skin.
3. Use caution when working with glue guns, which get very hot and can burn skin.
4. Immediately wipe up any water spilled on the floor to avoid a slip or fall hazard.

MATERIALS FOR ACCELERATION DETECTOR 2

- Clear wide-mouthed jar with lid (e.g., a pickle jar)
- Metal nut or washer
- String
- Tape (any type)
- Indirectly vented chemical splash goggles

SAFETY PRECAUTIONS FOR ACCELERATION DETECTOR 2

1. Students must wear personal protective equipment (indirectly vented chemical splash goggles) during the setup, hands-on, and takedown segments of the activity.
2. Immediately wipe up any water spilled on the floor to avoid a slip or fall hazard.
- 3.

Chapter 6: Forces and Motion

Asteroid Field

Materials for Tabletop Model

- Tabletop map of asteroid field made by taping together the 16 pages provided on the Extras page at www.nsta.org/pbl-physicalscience. Alternatively, you could cover the tabletop with a large piece of paper and draw the asteroid field with markers or place weighted objects that can represent asteroids. If using the single page map, you can enlarge the image by 400% to create a poster-sized version.
- Optional: Books to place around the edges of the tabletop map to serve as bumpers to prevent the ball representing the spaceship from rolling off the table
- Carpenter's level or phone app such as Bubble Level, which turns a phone into a level, or a large marble for leveling the tabletop
- Heavy but small ball such as a bouncy ball or large marble to represent the spaceship full of fuel
- Lighter ball, preferably of the same diameter, to represent the empty spaceship (Note: Table tennis balls are too lightweight and move too quickly to be easily controlled by students.)
- Straws to simulate thrusters (one per student)

- Masking tape
- Paper towels
- Safety glasses or safety goggles

Safety Precautions

1. Students must wear personal protective equipment (safety glasses or goggles) during the setup, hands-on, and takedown segments of the activity.
2. Immediately pick up any marbles or small balls that fall on the floor to avoid a slip or fall hazard.
3. Students should not share straws. Have students label their straws with pieces of masking tape on which their initials are written so that the straws won't get mixed up.
4. Students should put their straws down only on clean paper towels.
5. Paper towels and straws should be discarded immediately after the activity is finished.

Materials for Hover Soccer Ball Model

- Map of asteroid field (taped to floor or marked out on floor with tape)
- Cones, bricks, books, or pails placed on map to act as asteroids
- Hover soccer ball
- Hockey sticks or broom handles (4 per group) to act as thrusters
- Safety glasses or safety goggles

Safety Precaution

Students must wear personal protective equipment (safety glasses or safety goggles) during the setup, hands-on, and takedown segments of the activity.

Cartoon Cliff Escape

Materials for Comparing Craters

- 1-inch-diameter steel ball
- Foam bowl full of fine sand placed on a tray
- Ruler for measuring crater diameter
- Safety glasses or safety goggles

Safety Precautions

1. Students must wear personal protective equipment (safety glasses or safety goggles) during the setup, hands-on, and take-down segments of the activity.
2. Make sure there are no fragile materials in the area of the activity.
3. All students should have on closed-toed shoes to prevent injury in case the steel ball is dropped.

Rescue Force

- Simulation for practice adding vectors: <https://phet.colorado.edu/en/simulation/legacy/vector-addition>
- Explanation of adding forces as vectors: www.youtube.com/watch?v=hSQM0hoS6VE

Chapter 7: Engineering Energy Transformations

An Energetic Ride

- Roller coaster energy simulation using PhET's Energy Skate Park: <https://phet.colorado.edu/en/simulation/legacy/energy-skate-park>
- It may be helpful to show students a picture of a skateboarder (Figure 7.3) during the simulation.

Rube Goldberg Machine

The following list includes suggested materials that you can provide for students to choose from to create their Rube Goldberg machine. Figure 7.8 shows some components. You might also ask students to bring some of these items from home. Note: If students wish to use a chemical energy transformation in their design, ask them to run it by you first to make sure the plan is safe.

Materials for a Rube Goldberg Machine

- String
- Used paper
- Tape
- Ring stands
- Old toys, including windup toys, cars, action figures, and blocks
- Springs
- Rulers (the side that is not flat can often be used as a track)
- Pieces of molding
- Marbles of different sizes
- Paper towels and toilet paper
- Weights
- Pulleys
- Modeling clay
- Empty food cans and containers such as yogurt cartons

- Safety glasses or goggles

Safety Precautions

1. Students must wear personal protective equipment (safety glasses or safety goggles) during the setup, hands-on, and takedown segments of the activity.
2. Immediately pick up any marbles that fall on the floor to avoid a slip or fall hazard.
3. All students should have on closed-toed shoes to prevent injury to feet from falling objects.

Keep It Warm, Keep It Chill

- How vacuum flasks work (www.explainthatstuff.com/vacuumflasks.html)

Chapter 8: Engineering Electricity and Magnetism

A Light in the Dark

- Service hours or characteristic discharge times for AA batteries are available on the data sheet at <https://sep.yimg.com/ty/cdn/theshorelinemarket/PC1500.pdf>.

Wiring a Cabin

Materials for Model Building

- 2 topless cardboard boxes per team (alternatively, a team can work from a floor plan or use just 1 box and wall off an end to represent the bedroom)
- Insulated wire and wire cutters. (Note: For younger students, it is easier to have precut lengths of insulated wire with the ends already stripped or with alligator clips on the ends.)
- Flashlight bulbs and bulb holders
- 2 D-cell batteries per team
- Masking tape
- 2 kinds of commercial wall switches (1 of each kind per team): single switches that turn circuits on and off and two-way switches that alternate turning the circuit on and off regardless of which switch is used (see Figure 8.11). Alternatively, students can make switches using card stock, brass brads, and paper clips (see a YouTube video called “Paper Clip Switch” at www.youtube.com/watch?v=IA6aEFoXvFc for complete instructions).
- Safety glasses or safety goggles

Safety Precautions

1. Students must wear personal protective equipment (safety glasses or safety goggles) during the setup, hands-on, and takedown segments of the activity.
2. Use caution in handling sharps such as wire or brads, which can cut or puncture skin.
3. Use caution in working with wire cutters, which can pinch or cut skin.
4. Use caution in handling lighted bulbs, which will get hot and can burn skin.
5. Students should use the minimum number of batteries for each circuit. This is usually two batteries. If they use more than two, the circuit will get very hot.
6. Tell students not to connect one end of a battery directly to the other end without a load such as a bulb. Without a load, a lot of current will flow, the wires will get hot, and the battery will quickly be drained.

Cool It

Materials to Build a Fan

- Flashlight containing 2 D batteries
- Spool of coated wire
- Varied pieces of cardboard
- Duct tape
- Paper cups
- Paper clips
- Sheet of cardstock
- Clay
- Safety glasses or safety goggles

Safety Precautions

1. Students must wear personal protective equipment (safety glasses or safety goggles) during the setup, hands-on, and takedown segments of the activity.
2. Use caution in handling sharps such as wire and paper clips, which can cut or puncture skin.