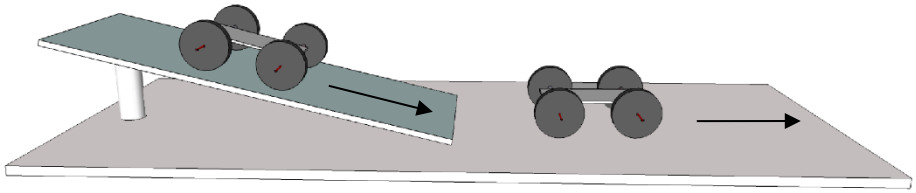
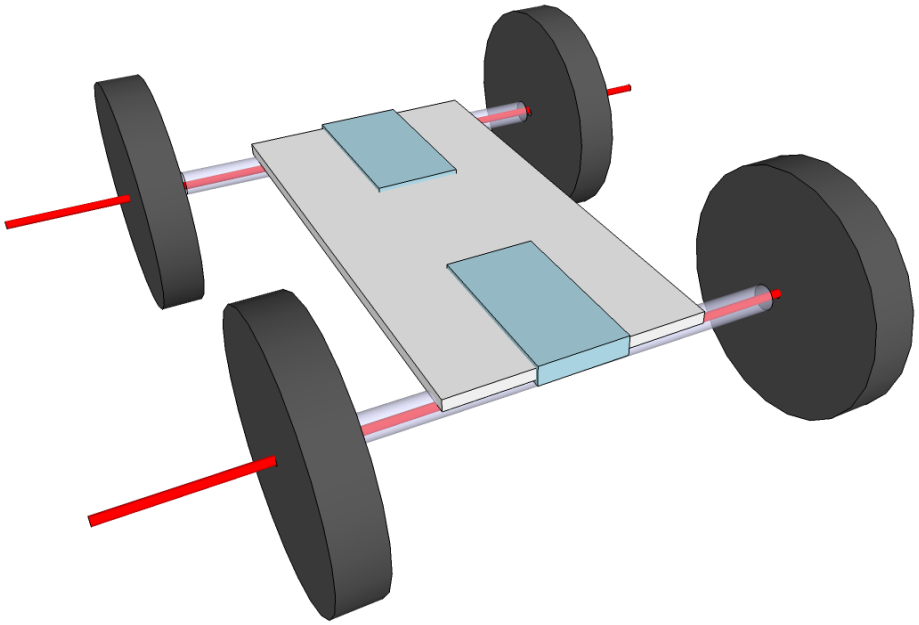
CAR ON A ROLL

A simple car model for motion-based activities



The simple chassis and a straw-based axle system (simple machine) produces minimal friction and allows these cars to roll with little energy input, making them ideal learning tools for all ages.



Curriculum topics

- Energy
- Friction
- Motion
- Momentum
- Simple Machines

Subjects

- Engineering
- Physical Science

Grade range: K – 8

Who we are: Resource Area for Teaching (RAFT) helps transform the learning experience by inspiring joy through hands-on learning.

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Materials

Materials in the kit may vary but generally, this kit contains the following:

- Corrugated plastic sheet or cardboard (1)
- Plastic coffee stirrers (2)
- Clear plastic straw halves (2)
- Foam discs (4)
- Adhesive labels (2)
- Not included/optional: Ramp, ruler/measuring tape

To Do and Notice

1 Secure the clear straw halves on each end of the rectangular sheet (**body/chassis**) centered across the width using an adhesive label or tape (see **A** below).

2 Insert one end of a coffee stirrer (**axle**) through the hole in a foam disc (**wheel**) until the axle sticks out from the other side of the wheel (**B**).

3 Insert the other end of the axle through one clear straw half secured to the chassis (**C**). Slip another wheel onto the axle (**D**).

4 Assemble the remaining wheel and axle on the other end of the car (**E** and **F**). Roll the car on a flat surface to ensure the wheels turn freely.

5 Mark a starting line on a flat surface. From the starting line, roll the car across the surface and note the distance traveled. How might you make the car travel a longer distance?

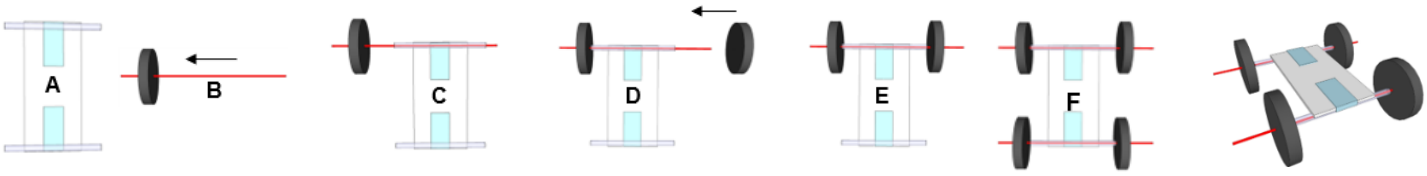
6 Attach binder clips, paperclips, or other items to the car to change its weight. Roll the car as described above. How does changing the weight of the car affect its forward motion, or the amount of push (**force**) to get it moving?

7 Optional: Form a ramp with cardboard or other flat material. Position the ramp so that its base is at the starting line. Roll the car down the ramp and note the distance traveled from the starting line (see page 1). Did the car travel farther from the starting line than before? Why or why not?

8 Optional: Try covering the ramp with different materials. For each material, roll the car down the ramp as before, noting the distance traveled from the starting line. Based on your observations, which material slowed the car the most (produced the most surface friction)?

9 Optional: Adjust the ramp height. Compare your observations for each condition and explain any differences you notice in terms of forces (pushes and pulls), speed and/or weight.

10 **Share** student learning with RAFT! Submit photos/video via email at education@raft.net or on social media (Facebook, Twitter, Instagram).



Core Content Skills:

Science & Engineering (NGSS)

Developing and Using Models, Planning and Conducting Investigations, Forces and Motion, Definitions of Energy, Types of Interactions, Cause and Effect

Social Emotional Learning

- Self-awareness
- Self-management
- Responsible decision-making

The Content Behind the Activity

The **wheel and axle** are one of the six **simple machines**. Machines make work easier by changing the size and/or the direction of an input force. A wheel-axle combination consists of two wheels of different sizes, with the larger wheel turning around the smaller axle. The friction between the wheels and the surface below, plus the friction of the axle rubbing in the axle supports, slows the car. For each rotation, the axle travels a shorter distance around than the wheel. The shorter turning distance and smaller diameter of the axle means less energy is lost as the car moves.

When the car used in this project is at rest on a flat surface and no horizontal force is applied, the car will remain at rest in accordance with Newton's 1st Law. Newton's 2nd Law of Motion, **F** = **ma**, states that the **net force** (sum of forces) acting on an object is the product of its **mass** and **acceleration** (change in speed and/or direction). If all the forces acting on an object are balanced, the object does not move. Newton's 3rd Law of motion says that for every force acting on an object there is an equal and opposite force also acting on the object. Gravity pulls downward on the car and in response to the upward force applied by the surface on the car. This makes sense because the car neither plunges through the surface nor floats in the air! If a horizontal force is applied to the front or rear of the car, it will roll. **Friction** is a force acting opposite the direction of motion and slows the car to a stop.

Releasing the car from the top of a ramp (an **inclined plane**) subjects the car to an additional downward force besides gravity. The strength (**magnitude**) of the additional downward force is a function of the height of the ramp, as is the **potential** (stored) **energy** the car possesses at the top of the ramp. The car accelerates down the ramp and the potential energy it started with gets converted to **kinetic energy** (energy of motion) as it rolls. The higher the ramp, the more kinetic energy the car has as it rolls, and the farther and faster it will roll forward until friction eventually brings it to a stop.

Reuse

This kit uses 100% reusable materials designed for other uses. To continue making a positive impact in reducing waste, reuse these materials in other projects. Additionally, any unused materials can be collected and delivered back to RAFT.

Feedback

Please comment on this kit by taking this short survey: http://bit.ly/RAFTkitsurvey. Let us know of any material concerns (missing, broken, or poorly fitting parts) as well as any suggestions for improvement.

Visit https://raft.net to view related activities!

Retractor Car
Cart the Box
Fender Bender Box Cars

Resources

- Newton's Laws of Motion - https://bit.ly/2RPnV6z
- Khan Academy, Balanced & Unbalanced Forces - https://bit.ly/3a7bElr