



Reinventing the Wheel

Simple Machines, Forces, and Motion

Grades 2-5

Build and test a recycled race car! Combine your understanding of forces, motion and simple machines with recycled and found objects to see how far your car can go with just a push.

Background Information

To help our cars race across the room, we need to consider the forces of gravity and friction. A force is simply a push or a pull. Gravity is a force that pulls objects together. The more mass something has, the stronger the pull. For example, Earth's gravity creates a constant downward pull toward the planet so, when you drop an object, it falls to the ground. Friction is a force that works against movement. It acts when objects touch or rub against each other, pushing back in the opposite direction of motion.

We're going to use these forces to our advantage with two simple machines. A simple machine is a device with few or no moving parts that only needs a single force to do work. The wheel and axle, for example, is a simple machine that helps our car move more freely. Without wheels, we would have to push the car body with enough force to overcome the friction between its bottom surface and the rough floor. With wheels and axles, we only need to overcome the much smaller friction force between the smooth round axle and the wheel. Friction between the wheel and the floor, sometimes called traction, helps the machine work by digging in against the direction of motion, turning the wheel. The size difference between a wheel and an axle creates leverage, acting like a lever to multiply the force you use. This makes a small push from our muscles act like a much bigger push on a car with wheels.

The other simple machine we'll use is an inclined plane, or ramp. An inclined plane makes it easier to raise or lower objects. Less force is needed to move an object with a ramp than lifting an object straight up or lowering it straight down. We can use the inclined plane to take advantage of gravity's pull and speed up our car.



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Materials

Car Parts:

- 1 Car body – a recycled box, carton, or toy - be creative!
- 4 Wheels – circular objects - *e.g. cardboard cut-out circles, lids, bottle caps, toy parts*
- 2 Axles – thin, stick-like objects - *e.g. chopsticks, dowels, straight sticks, pencils, rigid wire*
- 2 Bearings – something the axles can spin freely inside of (usually tube-like) *e.g. straws, toilet paper roll, binder clips, twist ties, holes cut carefully in car body*

Tools:

- Scissors
- Tape

Testing Equipment:

- Ramp (inclined plane) - *e.g. cardboard, board, binder, dirt from backyard*
- Testing Track - a clear, smooth space on the floor, driveway, or yard
- Distance Marker - *e.g. measuring tape, metre stick, ruler*
- Weights - anything non-breakable that you can attach to/place inside the car body

Instructions

1. Attach the centre of your wheel to an axle. Make sure it's secure so that the wheel stays attached.
2. To make sure that your wheels turn freely, we need to use a round, hollow bearing. For example, you can use a pencil as an axle and a toilet paper roll as a bearing. The toilet paper roll will slide over the pencil. Now the pencil and wheels can spin freely inside the toilet paper roll bearing.
3. Attach the centre of your second wheel to the axle. Make sure it's secure so that the wheel stays attached - see diagram on page 3.
4. Attach your bearing to the base of your car body.
5. Make a ramp that runs from a higher point (like the seat of a chair) to the floor
6. Test out your car by pushing it on flat ground, then let it roll down your ramp to see how far it goes!
7. Make changes to your car so that it goes faster or farther.

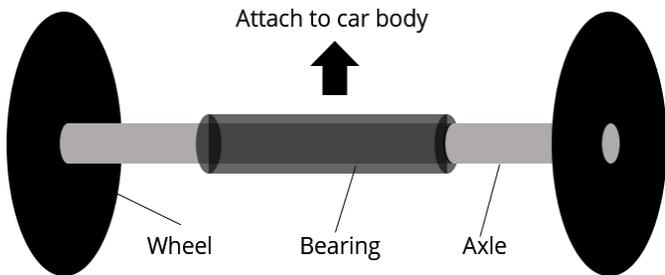


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Diagram



Tips for Success

- Make sure the edges of your wheels are smooth and straight so they roll well.
- Make sure your axles and bearings are smooth, and that the axles can spin freely inside the bearings.
- Make sure your wheels are rolling and not sliding to reduce friction.
- Make sure your axles are parallel to each other so that your car doesn't turn - unless you want it to!
- Make sure your wheels are securely attached so they roll smoothly.

Questions for Reflection & Activity Extensions

- How far does your car travel (cm) when you push it on flat ground?
- How far does your car travel (cm) when you release it on a ramp?
- How far does it travel (cm) when you make your ramp steeper?
- Which method (ramp or push on flat ground) needed the most force to get the car moving?
- Does the size of the wheels affect how far the car travels?
- Does the weight of the car body affect how far the car travels?