Activity Title: How Fast Can You Go? Vehicle Efficiency

Recommended Grades

Kindergarten, Grade 1, Grade 2, Grade 3, Grade 4, Grade 5
Could be expanded to older grades.

Curriculum Connections

Matter
- 1 – analyze properties of objects (measurements - distance)
- 2 – materials used to make objects

Energy
- K – how can objects move
- 1 – how objects move, how movement can be influenced
- 3 – force and movement, simple machines
- 4 – forces and objects
- 5 – thrust and drag

Computer Science
- K – instructions to be followed, have steps
- 1 – instructions to be followed, have steps
- 2 – creativity support design
- 3 – could relate to creativity and relationship to computational thinking (designing instructions)
- 4 – how can design meet needs

Scientific Methods
- 1 – carry out an investigation, data recorded
- 2 – methods and processes used in investigation, data collection
- 3 – data can be used to analyze
- 4 – how can evidence advance knowledge in science, data types
- 5 – variables can be controlled or changed

Time

10-30 minutes

Skills Focused On

- Critical Thinking
- Hypothesizing
- Observation

Materials Needed

- Small toy car
  - a few cars with different shapes/sizes if you want to expand the experiment
- Balloon
- Tape
- Elastic (e.g., a rubber band)
- Books or cardboard

Background Information

Have you ever heard the term efficiency and wondered what it means, or why it's important?

Efficiency is the ratio of how much energy you need to put into a system compared to the amount of useful energy you get out.

Efficiency = output / input

When something is not very efficient, it loses a lot of its energy in a way we don't want. For example, we want a light bulb to give us energy in the form of light. But if the bulb isn't very efficient, a lot of the electricity we put in will transform into a form of energy we *don't* want from a lightbulb, like heat. Making more efficient machines helps save energy!

Today you are going to test the relative efficiency of different methods to propel a toy car - balloons, elastics, and a ramp. The most efficient method should make the car travel the fastest and furthest, since more of our output energy will be converted to kinetic energy (the energy of motion).

Experimental Steps

1. Before you start, make a prediction - which method do you think will make the car go the farthest?
   a. A prediction is when you say what you think is going to happen, based on what you already know about the world.
2. Mark the starting point.
3. Blow up the balloon, pinch the end, attach to the car with a piece of tape. Let go at the starting line.
4. Measure the distance the car travelled.
5. Loop the elastic between 2 fingers and pull it back with your other hand. Line up the elastic behind the car and let go.
6. Measure the distance the car travelled.
7. Build a ramp using the books, place the car at the top and let go. *Optional:* make ramps of different heights.
8. Measure the distance the car travelled.
9. Determine which method was the most efficient energy transfer (Hint: which method made the car travel the farthest?).
10. Repeat with different types of vehicles.

Method	Distance Travelled			
	Round 1	Round 2	Round 3	Average
Balloon				
Elastic				
Ramp				

The table above is an example you can copy on a piece of paper. We did three rounds and then averaged the distance travelled. Calculating the average looks like:

Average = Sum of Rounds / Number of Rounds.

So, for three rounds:

Average = (Round 1 distance + Round 2 distance + Round 3 distance) / 3.

Averaging the results from multiple rounds of the experiment is more accurate than a single round. More rounds are better, so do the experiment as many times as you want!

If you use multiple cars, you should give your cars descriptive names to remember which one is which! (For example, “blue car” or “pointy car”). Here’s another example of what your table might look like:

Method	Distance Travelled			
	Blue Car, Round 1	Blue Car, Round 2	Blue Car, Round 3	Blue Car, Average
Balloon				
Elastic				
Ramp				
Method	**Red Car, Round 1**	**Red Car, Round 2**	**Red Car, Round 3**	**Red Car, Average**
Balloon				
Elastic				
Ramp				

You could also make separate tables for each car.

Optional for older groups: you can combine the forms of energy and see what combinations work best OR build a car and see what building strategies work with each fuel source.

Discussion/Experimental Extensions

What were the challenges and benefits of each method to propel your car?

In addition to your fuel source, what are other ways to improve the efficiency of your vehicle? Consider testing different types of toy cars and see how your results change.

What are different sources of fuel for real cars? Think about this related to climate change and sustainability.

According to the Law of Conservation of Energy, the total amount of energy never disappears - it just changes to another form. Some energy transfers are more efficient than others. The useful energy that moves your car forward is called kinetic energy; the balloon, elastic and ramp are potential energy. When we are trying to figure out what method is the most efficient, consider how far the car went and how much energy is lost to something that doesn't move the car forward (friction, sound, etc.).

Additional Resources

To learn more about EcoCar (a hydrogen cell based car), join Willow Dew, Jade Webster, and Anita Petrovic, members of the University of Alberta EcoCar team, explore vehicle efficiency and learn about their work creating an ecocar https://youtu.be/eGgHMBYAFI4. This can be linked to sustainability. It also provides more information about additional ways to make your car efficient.

This video was produced as part of Future Energy Systems Learning Resources, by Willow Dew, Jade Webster, and Anita Petrovic, members of the University of Alberta EcoCar team.

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Learn more about Future Energy Systems (https://www.futureenergysystems.ca/) and access more learning content, including storytimes, lab tours, ask an experts and more

(https://www.futureenergysystems.ca/engage/learning https://www.youtube.com/channel/UCJr8N9KyFJ6d-t36TPtUlwg).
Check out in Women in STEAM playlist https://www.youtube.com/playlist?list=PLwhyRzP6sRaRPX8yerrVVDfxkbHnqDDgN. Check out the Engineering playlist https://www.youtube.com/playlist?list=PLwhyRzP6sRaQLI-q8geCO7ZwY0FI3AiLx
Check out the Renewable Energy playlist https://www.youtube.com/playlist?list=PLwhyRzP6sRaQnhm1Z2oWSe1HYeX0vxVhl

Learn more about University of Alberta EcoCar http://ualberta-ecocar.ca/.