RUBBER-BAND POWERED CAR
Teachers Notes

Overview

Subject: Science and Technology

Grade: Years 7 – 9

Topics: Conversion of energy (potential to kinetic)
Relationship between speed, distance, and time
Interaction between energy and materials

Curriculum: Physical Sciences

- Energy appears in different forms including movement (kinetic energy), heat, light, chemical energy and potential energy; devices can change energy from one form to another (VCSSU104)
- The description and explanation of the motion of objects involves the interaction of forces and the exchange of energy and can be described and predicted using the laws of physics (VCSSU133)

Science Inquiry Skills

- In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task (VCSIS109)
- Analyse patterns and trends in data, including describing relationships between variables, identifying inconsistencies in data and sources of uncertainty, and drawing conclusions that are consistent with evidence (VCSIS138)
- Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (VCSIS140)

Objectives

1. Construct a car propelled by rubber bands that can travel 2m distance or more.
2. Gain an understanding of energy conversion, energy loss, friction, and use that to improve design and maximise car performance.
3. Construct a range of representations, including tables and graphs, to display data and analyse patterns or relationships.
4. Summarise and draw conclusions based on data found through investigation.

Key Concepts

Energy. The capacity for doing work. It can exist in potential, kinetic, thermal, electrical, chemical, nuclear, or other various forms. (Britannica)

Potential Energy. The stored energy in an object due to its position relative to some zero location. For example, a ball raised high above the ground. When the ball is at rest on the ground there is no stored energy. Elevating the ball can store energy, referred to as **Gravitational Potential Energy**. This lesson looks at **Elastic Potential Energy** where energy is stored because of stretching or compressing elastic materials such as, rubber bands, trampoline springs, bows and arrows. The amount of elastic potential energy stored is correlated to the amount of stretching – more stretch means more elastic potential energy. (Physics Classroom)

Kinetic energy. The work needed to accelerate an object from rest to motion. An object that has any motion, either vertical or horizontal, has kinetic energy. (Physics Classroom)

Friction. A force that impairs or stops the sliding or rolling of one object over another. (Britannica) In this experiment, friction occurs between the wheels and the surface, and all moving parts, including the washers, straws, and skewers.

Additional Resources

https://www.scientificamerican.com/article/bring-science-home-rubber-bands-energy/

https://www.physicsclassroom.com/class/energy/Lesson-1/Potential-Energy

https://www.physicsclassroom.com/class/energy/Lesson-1/Kinetic-Energy

Materials

Milk carton
Drinking straws
Paddle pop sticks
Bamboo skewers
Rubber bands (multiple length and thickness variation where possible)
Toy truck wheels (multiple size variations)
Machine washers 1/8” (or suitable size to fit bamboo skewers)
Textured tape (e.g. duct tape, cloth tape, electrical tape)
Various weights
Tape or Blu-tack

Tools

Ruler or measuring tape
Scissors
Craft knife or blade
Hot glue gun
Extra hot glue gun glue
Stop watch
Safety glasses

Risk Management/Hazards

The main hazard is the hot glue gun, the front part of the gun can get quite hot and the glue itself can cause minor burns. Students are instructed to keep hands away from all hot surfaces/materials.

While cutting the bamboo skewers and paddle pop sticks, sections may fly off unexpectedly. Students must wear safety glasses to prevent any pieces from hitting them in the eyes.

Activity

Students follow the instructions in CONSTRUCTING A RUBBER-BAND POWERED CAR resource. Once the car has been successfully completed the students will make alterations to different parts of the car, including but not limited to, adding and distributing weights, altering the friction coefficient of the wheels, and changing the type of rubber band used.

Students will measure the distance travelled by the car and the time taken for each variation in a table. These results will then be graphed.

Expected Results

The original design of the car will likely not travel far on a surface will low friction levels. The wheels will most likely spin without providing any propulsion. Adding weight will improve the distance travelled although too much weight will slow and ultimately reduce the displacement.
During our investigation, it was found a thicker rubber band required a heavier weight on the car to propel more than 2m. Thinner rubber bands could cause the car to travel a similar distance using less weight. The thickest rubber band tested only produced wheel spin with no propulsion achieved. Over winding the car resulted in ineffective wheel spin with little or no propulsion.

Overall, thinner rubber bands were more effective and posed less risks (see **Difficulties**). The best result in terms of distance travelled was given with a thin rubber band wound 8 times and a weight of 160g.

Difficulties

Having little gap between the wheels and straw is important. A large gap will make the wheels wobble, causing the car to veer left or right and overall reducing the distance travelled. No gap the straw will impede the wheels turning. Extra washers may need to be added to reduce the gap.
Be careful over winding the notch, especially when experimenting with a thicker rubber band as the skewers will break if exposed to too much stress.
Threading the rubber band between the chassis, axle, and frame can be difficult a long thin object (e.g. unfolded paperclip) may be required to help pull the band through.

References

Buddies, S. (2018). *Stretched Rubber Bands Are Loaded with Potential Energy!*. [online] Scientific American. Available at: https://www.scientificamerican.com/article/bring-science-home-rubber-bands-energy/ [Accessed 13 Sep. 2018].

The Physics Classroom. (2018). *Work, Energy, and Power - Lesson 1 - Basic Terminology and Concepts: Potential Energy.* Available online at: https://www.physicsclassroom.com/class/energy/Lesson-1/Potential-Energy. [Accessed 13 September 2018].

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