Balloon Powered Car

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Introduction:

How do rockets leave the earth's gravity? If the burning of gases can provide enough thrust for a rocket to overcome earth's gravity, can air escaping a balloon provide enough thrust to move a toy car forward? Forces and energy cause movement. Energy can be stored or it can be used. Stored energy can be changed into energy of motion or action. For every action there is an equal and opposite reaction, causing movement. The potential energy inside a blown up balloon is converted to energy of motion by the fast-moving air through the opening of the balloon. Because the air is pushed out rapidly backwards, there is a reaction force that pushes the balloon forward (Finio).

Hypothesis: If the amount of air in a balloon is increased, then the car will travel a farther distance.

Newton's third law states, "For every action there is an equal and opposite reaction." In rocket engines, the kinetic energy of the expanding gasses provides enough thrust to break the force of Earth's gravity. On a balloon car when air escapes the balloon it pushes on the air outside the balloon. The equal and opposite reaction is the outside air pushing back on the air in the balloon. This makes the balloon car move forward. If the amount of air inside a balloon is increased, the outside air pushing back will also increase. This larger force will move the balloon car a farther distance.

Acknowledgements:

The only person I would like to thank is my mother. She helped me tape measure the balloon and get the hot wheels car attached to the balloon. I would like to thank God for helping me persevere and not get discouraged with this long project.

Research:

All the energy of the world falls into one of two types, stored energy or energy actively doing something. Energy that is stored is called potential energy, because it has the ability to do something later. (Woodford, p.6). Five categories of potential energy include: positional, electrical, nuclear, chemical, and mechanical (Woodford, p.6). Potential energy is stored energy (Dine, p. 274). Potential energy is due to position. The higher off the ground, the more potential energy (Woodford, p.6). Potential energy can be used for lots of things. As potential energy is used, it is not used up. Instead, it is converted into kinetic energy. (Woodford, p.8). Potential energy is present and ready to go, but not yet active (de Pinna, p. 22). An object has potential energy because of where it is, what it contains, or what has been done to it (de Pinna, p. 26). Gasoline is stored energy with the potential to release a lot of energy if it comes into contact with a match (de Pinna, p. 26).

All moving objects have kinetic energy. Forces put things in motion. Movement often happens when potential energy is released or converted (Green, p. 13). Kinetic energy is in the motion found in atoms, molecules, and electrons. It is found in moving water and wind (de Pinna, p. 22). Things have kinetic energy when they are moving or doing something. Five categories of kinetic energy include: electrical, sound, thermal, light, and the energy of movement. Kinetic energy is energy in motion (Dine, p. 274). Kinetic energy is already happening (de Pinna, p. 22). Kinetic energy is related to speed. The faster something is moving, the more kinetic energy it has (de Pinna, p. 22). Kinetic energy depends on both the object's size and its speed. Very fast moving particles have a tremendous amount of energy (de Pinna, p. 23). An object moves only if some sort of force is applied to it – a push or a pull (de Pinna, p. 26). Kinetic energy is due to motion (Green, p. 12).

British scientist James Joule conducted experiments proving that energy did not disappear but was converted into different forms (Green, p. 44). Energy may be converted from one form to another to another, but the total amount is conserved (Green, p. 34). Mechanical engines convert the potential chemical energy of fuel into kinetic energy (Green, p. 40).

Newton's Laws of Motion are used to calculate quantities of energy (Dine, p. 274). Newton's First Law states that an object that is not in motion will remain still unless a force acts on it (Parker p. 8). Newton's First Law continues that once in motion, an object will continue moving unless a force makes it slow down or stop (Parker p. 8). The more mass an object has, the more force needed to get it moving. Also, the longer a force is applied, the faster an object will move (Parker p. 10). Speeding up is acceleration; slowing down is deceleration (Parker p. 12). Newton's Second Law states that the change in speed of an object over a given time is proportional to the force exerted on it (Goodstein, p. 11). In other words, a freight train is harder to accelerate than a car, but once moving the train is harder to stop.

Newton's Third Law states, "For every action there is an equal and opposite reaction" (Parker, p. 12). In rocket engines, the kinetic energy of the expanding gasses provides enough thrust to break the force of Earth's gravity (Green, p. 41). When air escapes a balloon it pushes on the air outside the balloon. The equal and opposite reaction is the outside air pushing back on the air in the balloon. This makes the balloon move forward (Robinson, p. 57).

The skin of a balloon is made from an elastic material. When inflated, the balloon skin stretches. The stretched skin stores energy. When the balloon deflates, the stored energy is released. The strong elastic force from the stretched balloon pressurizes the air trapped inside. When the pressurized air is allowed to escape, it rushes from the balloon's nozzle. This is a demonstration of Newton's third law of motion, "for every action, there is an opposite and equal reaction" (Dispezio, p. 153). The action is the air escaping from the balloon nozzle. The reaction is the balloon moving in the opposite direction from the released air. If the amount of air inside the balloon is increased, the stored energy of the stretched balloon skin also increases. Because the force is larger, the balloon car will move faster and as a result travel a farther distance.

When forces are at work, both size and direction must be considered (Goodstein, p. 44). Friction exerts an opposing force that slows the car (Goodstein, p. 47). Friction is caused by molecular attractions (Goodstein, p. 44). Rolling friction is kinetic friction (Goodstein, p. 47). Air resistance is the force air exerts opposing any object moving in it (Goodstein, p. 95). As the car moves through the air, it is hit by more molecules in front of it than in back of it, causing it to slow down (Goodstein, p. 95).

Materials:

- Light weight car
- 9” balloon
- Bendy straw
- Rubber band
- Tape
- Flexible measuring tape
- 50 ft measuring tape
- Note book or table and pencil

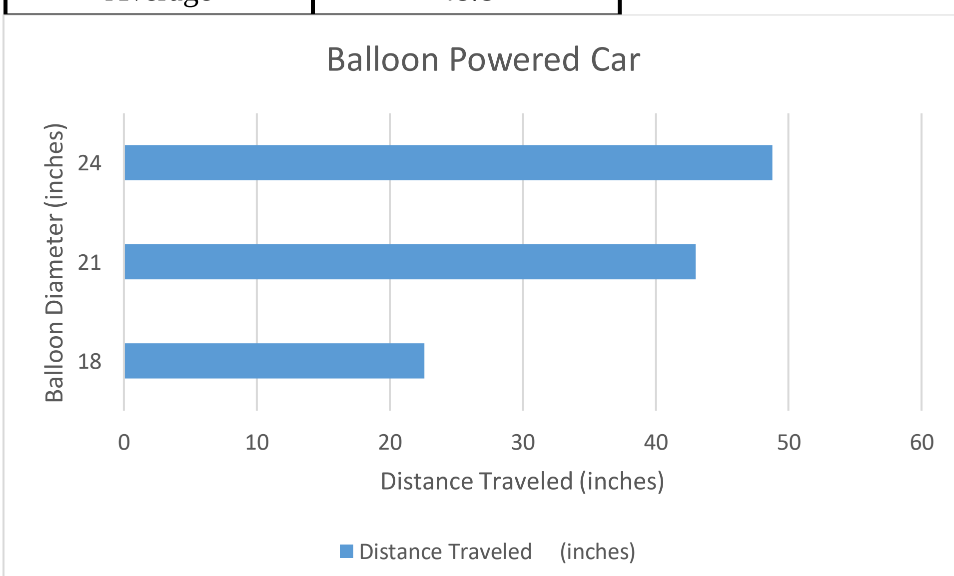
Experimental Procedure:

1. Design and build a light weight car. The car can be made of a small plastic bottle or a cardboard paper towel holder. The wheels can be made of bottle tops or of CDs.
2. Attach a bendy straw to the car with tape. The bendy end should be at the front of the car.
3. Attach a 9” balloon to the bendy end of the straw with a rubber band.
4. Place a flexible tape measure around the balloon and blow up the balloon (by blowing through end of straw) to a diameter of 18”. Hold the balloon neck closed, keeping the air in the balloon, while you position car at start line.
5. Place the car such that the front wheels just touch the start line.
6. Let go of the neck of the balloon.
7. Measure from the start line to the front of the wheels on the car.
8. Record both diameter of balloon and distance car traveled in a table.
9. Repeat steps 4 – 8 with balloon diameters of 18”, 21”, and 24”.
10. Five trials with each diameter should be performed and recorded.

Data and Results:

The balloon powered car traveled an average 22.6" with air filling an 18" diameter balloon, an average of 43" with air filling a 22" diameter balloon, and an average of 48.8" with air filling a 24" diameter balloon.

Balloon Diameter (inches)	Distance Traveled (inches)
18	22
	20
	22
	24
	25
Average	22.6
21	32
	45
	36
	55
	47
Average	43
24	79
	40
	39
	47
	39
Average	48.8



Conclusions and Real Life Application:

This data clearly demonstrates that more air in the balloon causes the car to travel farther. This supports the hypothesis which stated, "If the amount of air in a balloon is increased, then the car will travel a farther distance." The expanding gases passing through the straw provided a force to move the car forward. The larger the force provided from the larger balloon propelled the car a farther distance. This clearly demonstrates Newton's third law states, "For every action there is an equal and opposite reaction."

A real life application of Newton's third law is a rocket. The kinetic energy of the expanding gasses provides enough thrust to propel the rocket forward. Faster rockets release more gases. The military uses smart bombs to bomb terrorists. Smart bombs are rockets. Rockets need fins for guidance but not wings for lift. The expanding gases provide the thrust to move the rockets to go faster.

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