Contact and Non-Contact Forces	Grade 3: Forces Causing Movement

Lesson Plan

Safety Notes

Students might need help with cutting skewers or cardboard safely. Do not swallow magnets.

Description

In this lesson, students will learn about contact and non-contact forces by building a toy car and moving it with different forces.

Materials

All of these materials are suggestions of what you could use, you do not need everything on this list. You will need 4 wheels, a body, axles, and a motor. Use what you have and be creative!

Toy Car

- Tools
  - Tape
  - Scissors
  - Pencil
- 4 Wheels
  - cardboard
  - Pop bottle lids
- Body
  - craft stick
  - foam tray
  - cardboard
- Axles
  - Straw
  - Skewers
  - toothpicks (round)
- Motors
  - Sheet of paper
  - Skewer
  - Magnets (stronger the better)
  - Balloon
  - Plastic straw

Science Background

A force is a push or pull caused by objects interacting. Forces are acting on objects all the time. Right now, the force of gravity is pulling you down yet you have not fallen through the floor. What you are sitting on is pushing you up, this is called a normal force. These forces are balanced, so you do not feel or think about them all that much. We notice forces more when they are not balanced which results in objects moving by changing speed or direction.

Think of a ball that is sitting in a field. Like us, gravity is pulling it down and the ground is pushing it up. If the ball was kicked, the forces are unbalanced and it goes flying! A kick is a big pushing force that only lasts as long as the contact between the ball and the foot. But the ball does not travel forever. This is because there are other forces acting on the ball. Air resistance and friction eventually slow down and stop the ball.

Air resistance is the force of the air particles the ball has to push through. Air resistance is very important for things that fly or go very fast, like planes and race cars. Friction is the force that pulls backwards when objects rub against each other. The friction between ice and shoes is low, making the

ice slippery. The friction between wood and sandpaper is very high. Pushing wood harder into the sandpaper also increases friction. Heavy objects experience more friction because of gravity pulling it down. The friction between the grass and the ball will eventually make the ball stop moving completely.

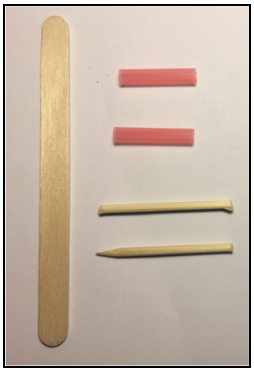
Forces are always between objects. Contact forces are when the objects touch each other and non-contact forces are when they do not touch each other. The kick between foot and ball, air resistance, the friction between the grass and the ball and you sitting in a chair are all contact forces. Most of the forces we encounter everyday are contact forces.

Non-contact forces are harder to spot but are also important in everyday life. A fun one to play with is magnetic force. Magnets can push and pull each other without touching. Another one you might have played with is electrical force, this includes static electricity. If you have ever played with a balloon and made your hair stand up, that static electricity acts as a non-contact force. The biggest non-contact force is gravity. Even if you jump, gravity pulls us back down. Gravity from the Earth even keeps our moon in place, all without touching.

In this lesson you'll be creating a toy car that uses these contact and non-contact forces.

Activity Procedure

Build the Car



1. Choose a body for the car. A craft stick or a piece of cardboard will work well.
2. Cut 2 lengths of straw that are a bit wider than the width of the car body. These will hold the axles to let the wheels spin.
3. Tape the straw pieces to the bottom of the car body, make sure that both ends of the straws are not covered in tape. Tape one towards the front and one towards the back of the car.
4. Find 4 wheels, bottle caps, buttons, container lids, cardboard or any round object would work for wheels.

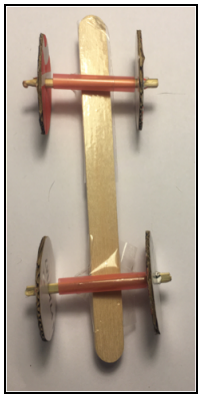
   To make cardboard wheels:

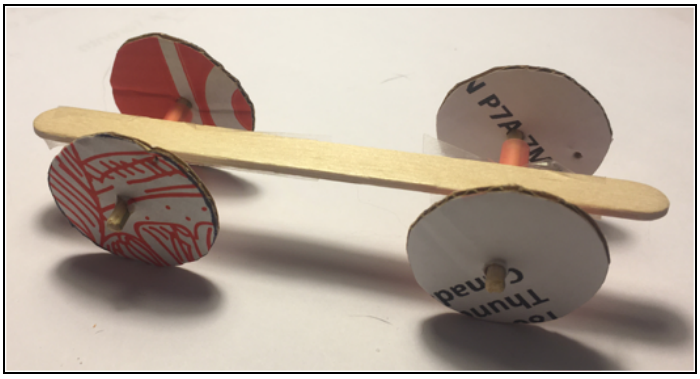
   i. Find a circle to trace (a round bottle cap).
   ii. Cut out 4 cardboard squares that are a bit bigger than your circle.
   iii. Trace the circle onto each square.
   iv. Cut out each circle by cutting off the corners of the square, making it smaller and smaller until you can cut out a smooth circle.

5. *You might need adult help for this step!*

To make axles, cut 2 pieces of skewers to be longer than the axle holder straws attached to the car body. An easy way to cut the skewers is to score them with scissors (make an indent where you want to cut them) and then break them at the score mark.

6. *You might need adult help for this step!*
   Attach the centre of one wheel onto one end of an axle. Put the other end of that axle through the axle holder and tape on another wheel. You can use tape or poke a hole in the wheel to attach it to the axle. Ask for an adult's help if you poke holes into the wheels.
7. Repeat with the other set of wheels and axle.
   The picture to the right shows the bottom of a car!
8. Congratulations! You have a basic car! Test it out to make sure the wheels work!
9. When testing your car, is this a contact or non-contact force?





Troubleshooting

If your car does not work well here are some things you try to make it work:

- Can both sets of wheels spin? Check for tape touching the wheels
- Do the wheels rub on the axle holders? Check for making the axles longer.
- Wheels not really turning on the ground? Check for how round the wheels are and that the axle is attached to the centre of the wheel
- Not all the wheels touching the ground? Maybe add some weight to the middle of the car, we need more friction in this case!

Motors

The three different types of motors shown here can go onto three different cars or onto one car that gets modified several times. It is up to you and the materials you have!

Sail Motor

1. Make a mast by taping a skewer or pencil to the centre of the car body, so that it is standing straight up.

2. Add the sail by poking the bottom of a piece of paper and then the top of the paper onto the skewer mast.
3. Blow on the mast to test out your sail!
4. Is this a contact or non-contact force?
5. Challenge: try to make the mast more stable or try to engineer the mast so that you can make the car turn!

Magnet Motor

1. Take the strongest magnets you can find, stack half of them together and tape them to the body of the car.
2. Hold the other half of the magnets near the car and see if you can push or pull the car.
3. Try flipping the magnets to get different effects.
4. Is this a contact or non-contact force?
5. Challenge: how fast can you make the car go? Is it smoother to push or pull the magnet car? What happens if you use more magnets? Fewer magnets?

Balloon Motor

1. Blow up a balloon and let all the air out.
2. Put a straw into the balloon and take them together so that air can still be blown into the balloon, without air leaking.
3. Tape the straw to the body of the car, do not get tape onto the body of the balloon.
4. Blow up the balloon and hold the straw closed.
5. Place the car onto the ground and let it go!
6. Is this a contact or non-contact force?
7. Challenge: Change the car so that it goes further or goes straighter.

Extra Challenges

- Come up with another motor to make the car move!
- Come up with a way to make the car move with a different non-contact force!
- How far can the car go on different surfaces? Try tile, carpet, concrete, sand, and any others you can think of! Which do you think it would travel farthest on? Why? What force is responsible?
- Modify and decorate the car!

Debrief

The toy car needs a force to make it move. Using your hands is a contact force because you are touching the car. The different kinds of motors also use different forces. With all the motors, the car slows down because of a combination of friction and air resistance. Since the toy car is fairly small and slow, friction between the wheels and the ground will be the main cause for the car slowing down.

Sail Motor

The sail catches air. The air pushes on the sail and propels the car forward. This is a contact force because the air is touching the sail to push it. Even though we cannot see the air, we can feel it's push. Think of the wind blowing away a hat, the air touches the hat and pushes it away!

Magnet Motor

The magnets on the car and in your hand either attract or repel each other. This happens when the magnets are not touching, making this a non-contact force. Maglev trains use magnets to make the train float. This means the maglev is very smooth and very fast!

Balloon Motor

This motor is similar to the sail, it is powered by your breath. The air in the balloon pushes against the air behind the car, propelling itself forward. Because the fast moving air is pushing and touching the still air, this is a contact force.

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Handout

1. Sort contact force vs non contact force:

Action	Contact or Non-Contact
Kicking a ball 	
A magnet pulling a coin 	
The balloon you just rubbed through your hair makes your hair stand up. 	
Throwing a ball 	
Dropping an orange 	
Pushing a swing 	

2. What force is pulling on you right now?

3. There are two types of forces. What are they?

Contact and Non-Contact Forces — Grade 3: Forces Causing Movement

Handout Answers

1. Sort contact force vs non contact force:

Action	Contact or Non-Contact
Kicking a ball 	***contact***
A magnet pulling a coin 	***non-contact***
The balloon you just rubbed through your hair makes your hair stand up. 	***non-contact***
Throwing a ball 	***contact***
Dropping an orange 	***non-contact***
Pushing a swing 	***contact***

2. What force is pulling on you right now? ***Gravity***

3. There are two types of forces. What are they? ***Pushing and pulling forces***