COACH ART connect | starlight children's foundation

In partnership with

Engineering Part 1 of 2

ages 11-18

Captain Starlight, here!

I just landed on Earth with some exciting news:

Starlight Children's Foundation has partnered with the organization **CoachArt** to work together to add fun STEAM (Science, Technology, Engineering, Art, Math) lessons into all the activities! How cool is that?!

Over the next few weeks, I will lead you and your student through four action-packed lessons using these nifty curriculum guides!

Did you know kids learn best when they are having fun? That's why I have thoughtfully sprinkled in a **STEAM** learning moment into each exciting lesson. Make sure you highlight those as you work your way through this curriculum guide.

If you have any questions throughout your mission, check out the Coach Corner website or email ***match@coachart.org.***

Now, buckle up and get ready to blast off in *3...2...1!*

Action and Reaction: Lesson 1

Build a Catapult

- Skill Level: Beginner
- S.T.E.A.M.: Engineering
- Adult Helper Required: As needed
- Recommended, ages 11-18

Preparation: 20 minutes / Experiment: 10 minutes / Coaches Notes: 10 minutes

If you were a builder, and had no modern machines or electricity or gas, and you needed to move a stone from one place to another, how would you do it? Today you will learn how to make a device that has been used for thousands of years.

Learning Objective:

- Students will learn the concept of Newton's Third Law of Motion.

At the end of this module, students will be able to:

- Demonstrate an understanding of actions and reactions.

What you need:

- 7 craft sticks
- Rubber bands
- Milk cap
- Various projectiles (objects to launch)
- Glue

SHARE YOUR EXPERIENCE
Enjoy your time together, and email your photos & stories to photos@coachart.org at "original" (maximum) size.

What to do:

A catapult is a device used for launching objects. Catapults have been used for thousands of years and come in all shapes and sizes. We'll make ours with a Y-shaped stick and a piece of elastic tied between the two parts.

1. Stack 5 craft sticks together to make a crossbar, and place rubber bands around the ends.
2. Stack 2 craft sticks together and wrap a rubber band around one end.
3. Separate the 2 craft sticks at the end without the rubber band.
4. Place the crossbar between the 2 craft sticks at a perpendicular angle.
5. Wrap a rubber band around all the craft sticks to hold the catapult together.
6. Glue a milk cap to the top craft stick (the "lever") to serve as a launching platform.
7. Push down on the lever and release it to launch an object from the milk cap.

The Experiment

- Launch various projectiles (objects) from the catapult and measure how far each one travels.

Launch the following projectiles:

- Cotton ball
- Scrap of paper
- Bottle cap
- Bouncy ball

Bonus:

- Now that you understand how the catapult works, can you think of ways to change the design of the catapult so it makes the projectiles travel farther? Try it and see.

Coaches Notes – Laws of Motion

S.T.E.A.M. Science Question of the Week:
What is Newton's Third Law of Motion?

Sir Isaac Newton was one of the most influential scientists who ever lived. In 1687, he published three "laws of motion" that describe the relationship between the motion of an object and the forces acting on it. Newton's Third Law of Motion says that for every action, there is an equal and opposite reaction. In this lesson, pushing down the lever is the action, and launching the projectile is the reaction.

S.T.E.A.M. Science Word of the Week:
Projectile: An object that's thrown, thrust, or propelled by an external force.

Force and Momentum: Lesson 2

Egg Drop

- Skill Level: Beginner
- S.T.E.A.M.: Engineering
- Adult Helper Required: As needed
- Recommended, ages 11-18

Activity: 30 minutes / Launch: 15 minutes/ Coach Corner: 10 minutes

Learning Objective:

- Students will learn how force and momentum work.

At the end of this module, students will be able to:

- Create a structure to support an egg when dropped from a high area.

Have you ever wondered why an egg doesn't break if you drop it on a pillow? Today we are combining science and engineering and testing Newton's Laws of Motion.

What you need:

- 6-12 Raw Eggs
- Various containers
- Padding, i.e., bubble wrap, cotton balls, trash bags etc.
- Tape, string

Activity 1: Welcome to the Egg Drop Challenge!

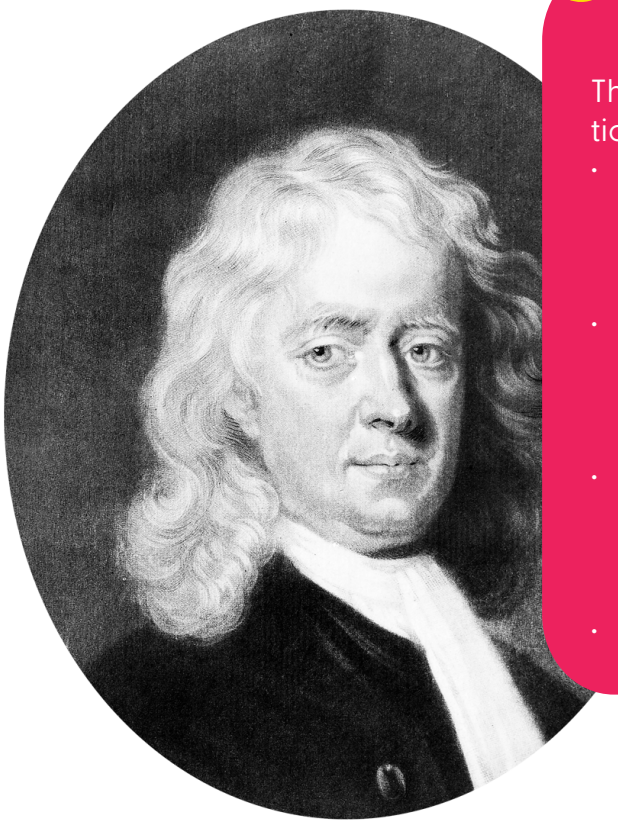
The objective of the egg drop experiment is to keep the egg from breaking as it decelerates.

Here are the basic guidelines:

- Your container must be under 10 inches in size.
- Your container can be made from any material.

Bonus Challenge

Test your design from various **SAFE** heights.



The Man Behind the Motion

There's more to Sir Isaac Newton than the Laws of Motion. Did you know:

- He had to leave his studies at Cambridge from 1665 to 1667 because of the Great Plague. He spent these two years in study and isolation. Perhaps this time led him to some of his incredible discoveries.
- He invented a whole new type of math that he called "fluxions." Today we call this "calculus" and it is an important type of math used in advanced engineering and science.
- In 1668 he invented the reflecting telescope. This kind of telescope uses mirrors to reflect light and form an image. Almost all of the major telescopes used in astronomy today are reflecting telescopes.
- In 1705 the queen of England made him a knight.

Coaches Notes – Force and Momentum

S.T.E.A.M. Science Question of the Week:
What are force and momentum?

A force is a push or pull acting upon an object as a result of its interaction with another object. When there is an interaction between two objects, there is a force upon each of the objects. Forces only exist because of an interaction.

Momentum is "mass in motion." All objects have mass; so, if an object is moving, then it has momentum - it has its mass in motion. The amount of momentum that an object has is dependent upon two variables: how much stuff is moving and how fast the stuff is moving.

S.T.E.A.M. Science Learning Term of the Week:
Newton's Second Law of Motion: Force equals mass times acceleration. In the egg drop experiment in order to minimize the force experienced by the egg at impact, you are designing an egg container that must increase the time over which the egg is brought to rest or decrease the egg's velocity at time of impact.

Land Sailing: Lesson 3

Wind-Powered Car

- Skill Level: Beginner
- S.T.E.A.M.: Engineering
- Adult Helper: As needed
- Recommended, ages 11-18

Is it a sail, a boat, a car... a kite? What is it? It's a wind-powered car! Today you will learn how wind can power something.

Activity: 30 minutes / Lesson: 10 minutes / Coaches Notes: 10 minutes

Learning Objective:

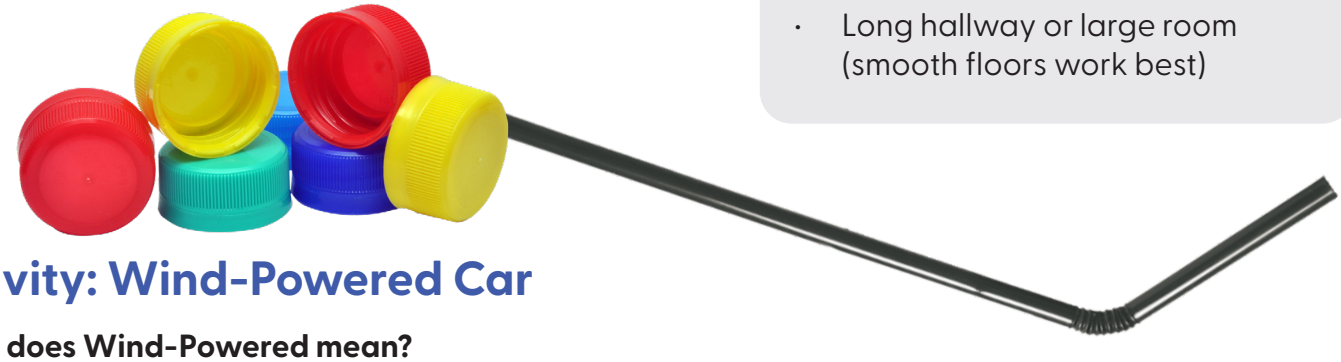
- Students will learn how wind can power an object and affect its speed.

At the end of this module, students will be able to:

- Demonstrate how wind can be used as a source of energy.

What you need:

- Corrugated cardboard
- Construction paper or cardstock
- Three wooden skewers
- Two plastic straws
- Four plastic bottle caps
- Tape
- Scissors
- Hobby knife
- Electric fan
- Coins
- Long hallway or large room (smooth floors work best)



Activity: Wind-Powered Car

What does Wind-Powered mean?

Wind-powered means that instead of being powered by electricity or gas, something is powered solely by wind. Your car will harness the power of the wind the way a sailboat does, by using a mast and a sail.

What to do:

1. Carefully cut out a piece of cardboard in a rectangular shape to create the body of your car. For this project, your car is flat, like a skateboard.
2. Tape two straws across the bottom of your car, one at each end. Make sure the straws are parallel. These will hold your axles.
3. Adult Helper assistance required: Use the hobby knife to carefully poke a "+" shaped hole in the middles of the bottle caps.

4. Push a wooden skewer through the hole in one of the bottle caps. Remember, always push it away from your face!
5. Thread the other end of the skewer through one of the straws.
6. Push a bottle cap onto the end of the skewer opposite the first bottle cap.
7. Cut off the ends of the skewer.

You just made an axle with two wheels for your car!

Repeat these steps to make the other axle.

Make sure the axles can spin and the car can roll smoothly without getting stuck. If needed, adjust the wheels so they are not too wobbly.

Use the hobby knife to carefully poke a small hole in the middle of the cardboard.

Insert a wooden skewer upright into the hole to form a mast for your car's sail. Secure it at the base with plenty of tape. If it is still too wobbly, you can build a diagonal support out of a piece of cardboard.

Make at least three sails that are all the same shape but different sizes.

For example, for rectangular sails, you could use a whole sheet of paper, a half sheet of paper, and a quarter of sheet of paper.

Now you have a sail car and sails that are ready to test out!

The Test

Attach the smallest sail to the mast. You can just poke the mast through the top and bottom of the sail. Or use tape -- just keep in mind that you'll remove the sail from the mast later.

- Place your fan on the floor at one end of a long hallway or large room.
- Place your car in front of the fan and turn the fan on.
- How far does your car go before it stops?

The Experiment

- Change the sail to the next size up, sail your car again, and see how far it goes.
- Now try with your largest sail. Does the car go farther? As far as you expected?
- Put coins on your car to make it heavier. Now how far does it go?
- Try again with more coins.

Bonus

- Try making more sails that are different shapes.
- What shape works the best?
- If you're able to adjust the speed of the fan, try sailing at different fan settings.
- How does the fan speed affect how far or how fast your car goes?

Coaches Notes – Why Wind?

S.T.E.A.M. Science Question of the Week: Why is wind power important?

Wind power is an alternative energy source. It means that the power of wind can replace other sources of energy, like coal, oil, and gas. It's renewable (meaning we won't run out of wind) and it's clean (powering something with wind doesn't create pollution).

S.T.E.A.M. Science Learning Term of the Week:
Wind Speed: The speed of the weather-related air movement from one place to the next.

Wind Speed: Lesson 4

Airfoils

- Skill Level: Beginner
- S.T.E.A.M.: Engineering
- Adult Helper: As needed
- Recommended, ages 11-18

Activity: 40 minutes / Lesson: 10 minutes / Coaches Notes: 10 minutes

For a plane or bird to fly, its wings must produce enough lift to equal its weight. Most wings used in flight are a special shape called "airfoils." This shape helps to generate lift.

Learning Objective:

- Students will learn how different shapes affect the flow of air.

At the end of this module, students will be able to:

- Understand what an airfoil is and how it works.

What you need:

- Several sheets of standard copy paper (8.5" x 11")
- Textbook
- Sharp pencil
- Tape
- Drinking straw
- String
- Hair dryer
- Scissors
- Ruler

Activity: Make and Test Airfoils

What Is an Airfoil?

An airfoil is a structure with curved surfaces designed to give the most favorable ratio of lift to drag in flight, and is used as the basic form of the wings, fins, and horizontal stabilizer of most aircraft.

Place a sheet of paper in the top part of a textbook so that it hangs out and down. Blow over the top of the paper – the paper will lift upwards.

Why do you think this happens?

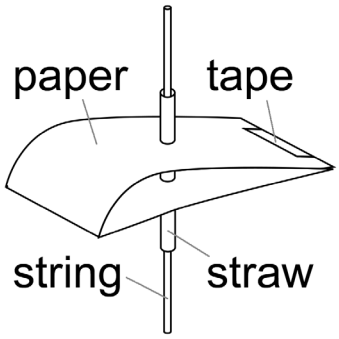
Airfoil One: Make a Paper Airplane with Airfoil Wings
See diagrams for each step at http://hilaroad.com/camp/projects/paperplane/paperplane.html

1. Fold a standard (8.5" x 11") piece of paper 2.75" from one end.
2. Fold the paper down the center.
3. Fold two outer corners to the center and tape in place.
4. Fold both wings down on a line 3/4" from the bottom of the fuselage.

5. Fold both wings up on a line about 3/8" from the top of the fuselage.
6. Cut both wings, as shown, on the dotted line.
7. Hold the wings up out of the way and cut the fuselage on the dotted lines.
8. A = 3/4", B = 1-3/16".
9. Push tail up to top of fuselage. Fold sharp point of nose back in. Wrap tape around shoulder at front. Tape the fuselage together along the top.

Airfoil Two:

1. To make your flying wing, cut a piece of paper to a size of 4" x 6". Fold the paper in two, leaving an overlap of 3/8".
2. Push the overlapping ends together. This will make one side of the folded paper curved. Tape it in place.
3. Use a sharp pencil to pierce holes through the wing (top and bottom).
4. Carefully push a drinking straw through the holes.
5. Thread a long piece of string through the straw.
6. Pull the string tight and fix it straight between the floor and a table, so the wing can slide up and down freely.
7. Lift the wing up a little and aim a hairdryer straight at the folded edge. Turn it on and watch the wing lift.



The Experiment

Have students make both airfoils and compare which flies better and longer.

Coaches Notes – Why Shape Matters

S.T.E.A.M. Science Question of the Week: How do airfoils work?

The basic shape of wings – whether it's a bird's wing or a plane's wing – is a curved shape called an airfoil. The airfoil shape helps birds and planes overcome weight, which is the effect of gravity pulling them down towards the Earth. The airfoil shape helps give lift when it is moving through the air. The airfoil shape of the wing causes air to move downwards following the shape. If the wing is at the right angle of attack, the air is deflected downwards both over and under the wing. The air blown over the paper is deflected downwards by the curve of the paper. The action of the air being forced down results in a reaction: lift. Also, the air pressure is lowered over the paper because the air is 'stretched' out over the curve, resulting in lift by the higher pressure beneath the paper.

S.T.E.A.M. Science Learning Term of the Week:
Bernoulli Principle: Within a horizontal flow of fluid, points of higher fluid speed will have less pressure than points of slower fluid speed.

Additional Resource:
https://www.sciencelearn.org.nz/resources/300-wings-and-lift

COACH ART connect | starlight children's foundation

In partnership with