COACH ART connect

In partnership with

starlight children's foundation

Engineering Part 2 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!*

Compression and Suspension: Lesson 5

Design a Bridge

- Skill Level: Beginner
- S.T.E.A.M.: Physical Science
- Adult Helper Required: As needed
- Recommended: Ages 11-18

Activity 1: 4 minutes / Activity 2: 30 minutes / Lesson: 10 minutes / Coaches Notes: 10 minutes

If you were a builder, and had no modern machines or electricity or gas, and you needed a way for people and animals to safely cross a river, how would you do it? Today you are going to learn how to make a structure that has been used for thousands of years.

Learning Objective:

- Students will learn what types of materials are used to build bridges and what makes bridges strong.

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

- Identify at least one geometric shape used in bridge design.

What you need:

- Plastic drinking straws (not the bendy type)
- Scotch tape
- Scissors
- Measuring stick or ruler
- Rubber bands
- Heavy item such as a can of food, book, or wooden blocks

Activity 1: What Makes Bridges Strong?

Bridges are structures made from different types of materials that provide important links between places. There are many different types of bridges, including beam, truss, arch, suspension, and cable-stayed. Watch this video to see what makes them strong:

Topic: What makes bridges Strong- SCI Kids
Length: 3 Minutes and 44 Seconds
Link: https://youtu.be/oVOnRPefcno

Activity 2: Design a Bridge

Here is what you do:

Have students design and build a bridge based on the types of bridges that were shown in the video. Students can make any design. The key things to remember are that the bridge must:

- Have a span of 20 inches
- Support the weight of a canned good
- Remember: some shapes support loads better

Think:

- Would bunching straws together make them stronger?
- What about string?

Coaches Notes – Civil Engineering

S.T.E.A.M. Science Question of the Week: What type of engineers build bridges?

Civil engineers are responsible for building infrastructure. They are the ones who create the roads, bridges, dams, and buildings in your city. Everything from water systems to subways has been touched by a civil engineer at some point in time.

S.T.E.A.M. Science Learning Term of the Week:
Compression: A force that acts to squeeze or shorten the thing it is acting on.
Tension is a force that acts to expand or lengthen the thing it is acting on.

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

Windy City: Lesson 6

Wind-Resistant Construction

- Skill Level: Beginner
- S.T.E.A.M.: Visual Arts
- Adult Helper Required: As needed
- Recommended: Ages 11-18

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

Why do you think the little pig with the brick house stood up to the wolf's huffing and puffing, but the straw house and the house of sticks could not?

Learning Objective:

- Students will make a paper tower that can withstand as much wind as possible, without sliding or falling.

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

- Build a paper tower that can withstand wind.

What you need:

- 2" diameter metal washers (between 1.5 and 2 oz)
- Rulers or yardsticks
- A multi-speed fan with at least 12" diameter blade
- Scissors
- A tape measure of at least 12' length
- 12" x 18" drawing paper
- ¾" masking tape
- Notebook paper and pencil for design planning

Activity: Design and Build a Tower

Here is what you do:

Have students build a tower using no more than 3 sheets of paper.
It must support a weight at least 9 inches above the surface of a table or floor.

The Experiment

- Set up a fan and mark off 1-foot intervals for 6 feet.
- Set the fan on low, put the structure at the 6-foot mark and see if it survives.
- Move it closer to the fan in 1-foot intervals until it blows over.

How close could you get it?

Bonus:

- What were the results of the first test?
- Would you make any changes? If so, why?
- Can you redesign the tower to withstand more wind?
- What about a redesign to hold more weight?
- How did you go about planning your tower?
- What factors did you consider as you designed your tower?

Coaches Notes – Preventing Wind Damage

S.T.E.A.M. Science Question of the Week: What is a Wind Engineer?

A wind engineer studies and analyzes the effects of the wind in natural building environments. A wind engineer is a kind of mechanical engineer. Wind engineers are responsible for studying any damage that wind may cause to buildings and structures. Only the strongest, most wind-proof structures can escape damage from tornados, hurricanes, and heavy storms.

S.T.E.A.M. Science Learning Term of the Week:
Wind Load: The force of wind as it pushes and pulls on a building.

The Science of Floating: Lesson 7

The Penny Boat

- Skill Level: Beginner
- S.T.E.A.M.: Science
- Adult Helper Required: Yes
- Recommended: Ages 11-18

Have you ever wondered how a ship made of steel can float? How can a steel ship carry a heavy load without sinking? What do you think determines if an object sinks or floats?

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

Learning Objective:

- Students will learn how density affects an object's ability to sink or float.

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

- Build a boat that will float and hold pennies.
- Define density.

What you need:

- Aluminum foil
- Ruler
- Tape
- Calculator
- Scrap piece of paper and pen or pencil
- Bucket, tub, sink or dishpan
- Water
- Pennies (10-100, depending on the size and shape of the boats you make)
- Rag or paper towels
- Dry rice and measuring cup (optional)

Activity: Penny Boat

What determines whether an object can sink or float?

We'll conduct an experiment that helps us understand one reason why a boat might sink. In this experiment, we'll increase the density of two boats.

What to do:

1. Cut two squares of aluminum foil. The dimensions of one square should be twice as big as the dimensions of the other square.
2. Fold the two aluminum foil squares into two different boat hulls. Try to make them the same shape. Add any finishing touches to your boats.
3. Make sure your boats don't have any leaks. Use a little tape to make them stronger, if needed.
4. Flatten the hull bottoms.
5. Try to make sure the rim is the same height going all around the hull edges. Why do you think this is important?
6. Fill a bowl with water. Make sure the container is large enough to completely submerge the boat.

The Test

- Add the boats to the water.
- Gently add one penny at a time to each boat. To prevent the boats from tipping, carefully balance the load as you add pennies.
- Continue to add pennies until the boats finally sink.
- Carefully take out the sunken hulls and place them and the pennies on a rag or paper towels. Dump any excess water back into the container.

The Experiment

- Compare the two boats that you made. Did you get the same results?

Bonus:

- Try making a wider range of boat shapes and sizes, and compare them. Did you get the same results?

Coaches Notes – Density

S.T.E.A.M. Science Question of the Week: How can a steel ship carry a heavy load without sinking?

The shape of a steel-hulled ship is what determines how the ship will float, as well as how much load it can carry. The density of an empty ship is equal to the sum of the mass of the steel hull and the mass of the enclosed air. All the hull's volume is divided.

So why does it float? The ship floats because its density is less than the density of water. If too much weight is added, the ship's density becomes greater than that of the water, and it sinks.

S.T.E.A.M. Science Learning Term of the Week:
Density: The mass of a unit volume of a material substance.

Simple Machines: Lesson 8

Rube Goldberg Machine

- Skill Level: Beginner
- S.T.E.A.M.: Science
- Adult Helper Required: Yes
- Recommended: Ages 11-18

Activity: 30 minutes / Lesson: 20 minutes / Coaches Notes: 10 minutes

Have you ever wished there was a machine that would empty the trash or feed your dog? You may be surprised at the power you have to make your own machines using the power of chain reactions!

Learning Objective:

- Students will learn how simple machines can work together to solve a problem.

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

- Build a simple machine to solve a problem.

What you need:

- Rube Goldberg Inspired Supply List: https://tinkerlab.com/wp-content/uploads/2015/03/Rube-Goldberg-Activity-List.pdf

Activity: Build Your Machine

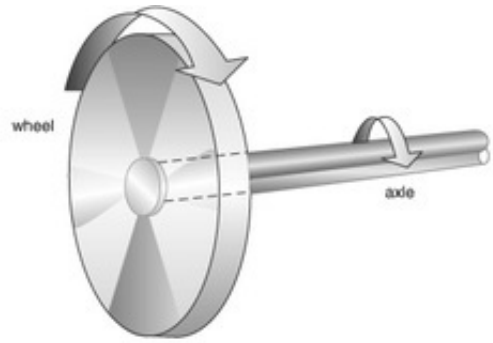
What Is a Rube Goldberg Machine?

Rube Goldberg was an American cartoonist, sculptor, author, engineer, and inventor. He is known for creating popular cartoons that showed complicated gadgets performing simple tasks in indirect and sometime strange and funny ways.

What is a simple machine?

To create a Rube Goldberg machine, you must first understand what a simple machine is. There are six different types of simple machines:

- Incline Plane
- Lever
- Pulley
- Screw
- Wedge
- Wheel and Axle

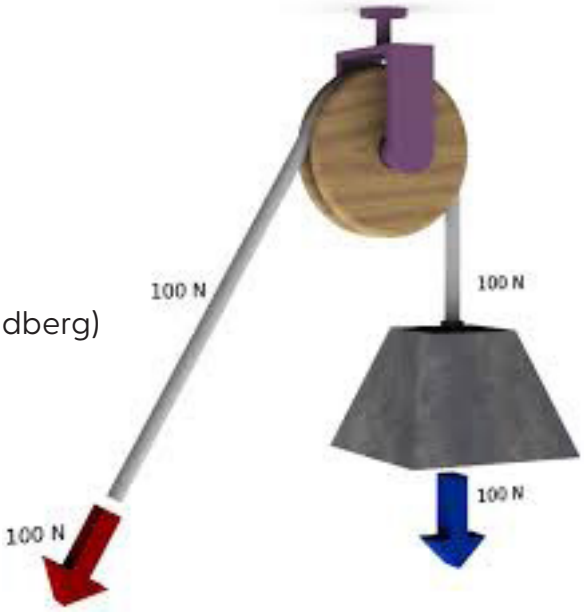


Engineering ages 11-18

STEP 1: Watch this video to see some simple machines:

Topic: Simple Machines
Length: 7 minutes and 1 second
Link: https://youtu.be/LSfNYpCprw4

Now that you have a better understanding of a simple machine, the best way to start your Rube Goldberg machine is to get a little inspiration.



STEP 2: Watch these videos to get inspired:

Topic: Sesame Street Rube Goldberg Compilation
Length: 14 minutes and 5 seconds
Link: https://youtu.be/pMpmit5YMcg

Topic: Ok Go (one of the best representations of Rube Goldberg)
Length: 3 minutes and 54 seconds
Link: https://youtu.be/qybUFnY7Y8w

Now that you are inspired, it is time for the next step.

STEP 3: Solve a Problem

Think of a simple problem you would like to solve. Maybe you want a better way to:

- Empty the trash
- Ring a bell
- Feed the dog
- Get a snack

Once you have your idea, it's time to make your plan. Have the student think of how large or small they want their contraption to be. Smaller and simpler is easier! Once they have designed how they will solve a problem, it is time to gather supplies.

STEP 4: Gather Supplies

When you are gathering your supplies, use what you already have available at home rather than what you'd have to buy at a store. Think of things that:

- Move
- Roll
- Can be used as a ramp
- Everyday household items

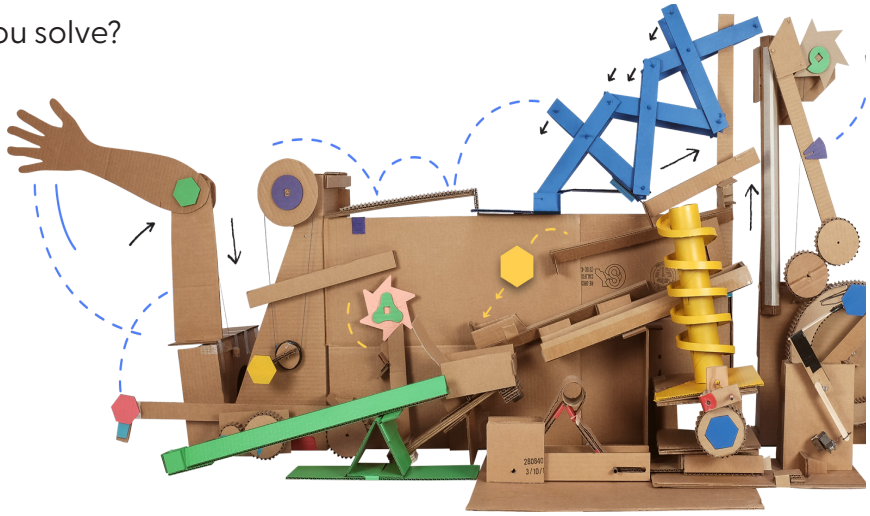
Hint: A toybox is probably full of items you can use.

STEP 5: Build Your Machine

The Ok Go video might have given you many ideas, but the things they built are too complex and advanced for someone who's just starting out. So put on your thinking cap. Think of a simple chain reaction that could solve the problem.

STEP 6: The Results

- What other simple problems could you solve?
- What materials could you use?
- What didn't work?
- What would you change to solve the problem?



Coaches Notes – It's Complicated!

S.T.E.A.M. Science Question of the Week: Why are Rube Goldberg machines so interesting?

Simple and compound machines are designed to make work easier. But sometimes when a machine is not well designed, it can make a task more complicated. Rube Gold berg noticed this and began to draw cartoons that illustrated this fact in a funny way.

When engineers design machines, they are concerned with how the machines will fit in with someone's lifestyle and what benefit it will provide for them. Most often, a machine must be practical for it to be used.

Can you think of any machines we use today that remind you of a Rube Goldberg machine?

S.T.E.A.M. Science Learning Term of the Week:
Chain Reaction: A sequence of reactions where a reactive product or by-product causes additional reactions to take place.

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