Rising Grade 5
Science Practice
Review Your Skills
YOUR CHALLENGE

Design and build a boat out of straws and plastic wrap that can hold 25 pennies for at least ten seconds before sinking.

BRAINSTORM & DESIGN

Look at your materials and think about the questions below. Then sketch your ideas on a piece of paper or in your design notebook.

1. How will you make a boat that floats well enough to support a heavy load without sinking?
2. Should your boat be a platform (e.g., a raft or barge) or an open boat (e.g., a rowboat or canoe)?
3. What's the best way to make your boat waterproof?
4. How big do you need to make your boat to hold 25 pennies?

BUILD, TEST, EVALUATE & REDESIGN

Use the materials to build your boat. Then test it by floating it in a container of water and adding pennies, one at a time. When you test, your design may not work as planned. When engineers solve a problem, they try different ideas, learn from mistakes, and try again. The steps they use to arrive at a solution is called the design process. Study the problems and then redesign. For example, if the boat:

- sinks easily—Increase its ability to float. When you set your boat in water, notice how it sinks down a bit, pushing aside some water. The water pushes right back, pressing on the boat’s bottom and sides. The force from these pushes is called buoyancy. To change your boat’s buoyancy, experiment with the boat’s width and the height of its sides.
- leaks a lot—See if the straws are filling with water or if the plastic wrap is separating.
- tips easily—Check how near the weights are to each other. A boat can get tippy when one part is heavier than another.

MATERIALS (per person)
- container filled with water (e.g., bucket, sink, plastic tub)
- duct tape
- paper cups (8-ounce or larger)
- 10-inch strip of plastic wrap
- 10 straws
- towels (paper or cloth)
- 25 pennies (or 15 standard, flat steel washers, at least 1 inch in diameter)
TAKE IT TO THE NEXT LEVEL

• Ready for some heavy lifting? Change your boat so it holds 50 pennies for at least ten seconds before sinking.

• Less is more! Build another boat that can hold 25 pennies, but use only half the amount of materials that you used for your first boat.

ENGINEERING IN ACTION

Windsurf across an ocean? In 2006, Raphaëla le Gouvello windsurfed 3,541 miles across the Indian Ocean—a record-setting first! Raphaëla first discovered windsurfing while on a family vacation. Soon, the idea of windsurfing across an entire ocean caught her imagination. To turn her dream into reality, she teamed up with engineer Guy Saillard. His challenge was to make her a sailboard she could live on. For years, Guy had experimented with new ways to use durable hi-tech materials such as epoxy resin, carbon fiber, and foams. For Raphaëla, he designed a strong, lightweight, 25-foot-long sailboard. It has a sleeping compartment, a shower, and its own satellite communication system—all the comforts of home.

Or not! The cabin was only 8 feet long, 20 inches wide, and 31 inches high (slightly bigger than a coffin). If an engineer could build you the boat of your dreams, would you want to take a trip like Raphaëla’s? Here’s a snapshot:

• **Length of trip:** Two months.
• **Time sailed each day:** Seven hours.
• **Time spent sleeping:** Seven hours.
• **Weight of her first-aid kit:** 26 pounds.
• **Other things she did each day:** Send e-mail, check her course, get weather reports, talk to her support team by radio, relax, and make and eat meals.

• **Amount of water she used per shower:** A half gallon. The average shower in the US uses 18 gallons! Her boat only holds five gallons, but it has a solar-powered device that makes fresh water by taking the salt out of seawater.

Watch the DESIGN SQUAD PVC Kayak episode on PBS or online at pbs.org/designsquad.
YOUR CHALLENGE
Design and build something that can carry a Ping-Pong ball from the top of a zip line string to the bottom in four seconds (or less!).

BRAINSTORM & DESIGN
Look at your materials and think about the questions below. Then sketch your ideas on a piece of paper or in your design notebook.

1. Using these materials, what can you design that can carry a Ping-Pong ball down a zip line?
2. How will your Ping-Pong ball carrier stay on the zip line as it goes from the top to the bottom?
3. What kinds of materials should be in contact with the zip line so that the carrier slides quickly?

BUILD, TEST, EVALUATE & REDESIGN
Use the materials to build your Ping-Pong ball carrier. Then make a zip line. Run the line between the back of a chair and a stack of books. Make sure the high end is about two feet above the low end. Test the carrier by putting it on the line. When you test, your design may not work as planned. The design process is all about “if at first you don’t succeed, then try, try again.” On Design Squad, we say, “Fail fast—succeed sooner!” Study the problems and then redesign. For example, if your Ping-Pong ball carrier:

- keeps dropping the ball—Check that it has a big enough place to hold the ball.
- stops partway down—Make sure there’s nothing blocking your carrier where it touches the line.
- doesn’t balance well—Adjust the weights. Add weights or move them so they are farther below the zip line. Doing this changes the carrier’s center of gravity, the point within an object where all parts are in balance with one another. See how changing the numbers and positions of washers affects the carrier’s balance.
- takes longer than four seconds to travel the zip line—Find ways to reduce friction. Yes, there’s friction—the force that resists motion—even when you’re dealing with something as smooth as fishing line. You’ll find friction anytime things rub together. Experiment with different materials to see if you can reduce friction and speed up the Ping-Pong ball carrier.

MATERIALS (per person)
- chipboard (from a cereal box or back of a notepad)
- 2–4 small paper cups (i.e., 3-ounce)
- Ping-Pong ball
- 4 plastic straws
- scissors
- single-hole hole punch
- 4 feet of smooth line (e.g., fishing line or unwaxed dental floss)
- tape (duct or masking)
- 4 standard, flat steel washers (1 inch in diameter or larger)
- 4 wooden skewers
TAKE IT TO THE NEXT LEVEL

• Slow down! Build a carrier that takes ten seconds to travel the length of the zip line.

• Piggyback time. Make a carrier that can hold several Ping-Pong balls at the same time.

• Blast off! Find a way to launch the Ping-Pong ball when the carrier gets to the end of the zip line.

• On your mark. Get set. Go! Set up two zip lines and race different ball carriers.

ENGINEERING IN ACTION

Ever want to zip up the side of a building like Batman or Spiderman? Now this superpower can be yours, thanks to engineer Nate Ball, host of Design Squad, and his friends. For a contest, they designed and built a climbing device that could carry a person 50 feet up the side of a building in less than five seconds. After months of work, the team tested their climber by lifting a 150-pound load of tires. Nate recalls, “After a few seconds, there was an awful sound. The gearbox exploded. The tires smashed to the ground with a huge crash.” After analyzing the ruined climber, they made lots of changes and ended up winning third prize in the contest. Ultimately, they patented the climber and started a company to sell it. Today, soldiers, firefighters, and rescue workers around the world use the team’s climber to fly up buildings. Now, those are real superheroes.

MAKE IT ONLINE

Travel by blimp, anyone? Build a jet-propelled blimp that can travel across a large room. Make it out of 2 balloons, 2 straws, and some clay and tape. See how on Make Magazine’s project page at makezine.com/designsquad.

Watch the DESIGN SQUAD Backyard Thrill Ride episode on PBS or online at pbs.org/designsquad.
Have some fun at home with these science activities from Science Sparks and the Primary Science Teaching Trust.

**BEFORE YOU START!** Please read through this with an adult:

- Make sure you have read the 'IMPORTANT NOTICE' on the back of this page.
- If you have a space outside that you can use safely, then you can do the 'Try this outdoors' activity outside. Don’t worry if not as you could still do it indoors.
- Talk to your adult about sharing the science you have done and if they want to share on social media, please tag @ScienceSparks and @pstt_whyhow and use #ScienceFromHome.

**SINK OR SWIM?**

**TRY THIS INDOORS ....**

Fill a large bowl or container with water. One at a time, put the different things you have chosen to test into the water and watch to see which of them floats and which of them sinks.

Put the orange in the water. Does it float or sink? What happens when you peel the orange and put it back into the water? Does the orange float or sink? What about the peel?

**WHAT DO YOU NOTICE?**

**Things to talk about …**

What are your ideas about why some things float and others sink? Can you predict which things will float or sink? Why does an orange float with its skin on, but sink with its skin peeled off? Do other fruit or vegetables float or sink? What happens if you take off the skin?

**You will need**

- Large bowl or container
- Water
- Selection of things to test, e.g. small toy, pencil, coin, cork, elastic band, candle, empty plastic bottle ....
- A small orange
- Paper, lollipop sticks, card, foil, sponge, playdough or plasticine
- Lego pieces, coins or other small items
2 TRY THIS OUTDOORS …. MAKE A BOAT

Fill a large container with water. Make boats or rafts out of different materials, e.g. lollipop sticks, playdough, paper, sponge or aluminium foil. Float the boats in the water. Choose coins or pieces of lego and add these one at a time to each boat until the boat sinks. Count how many coins or lego pieces it took to sink each boat.

WHAT DO YOU NOTICE?
Things to talk about …

Which material was best for making a boat? Why do you think this is? Which type of boat held the greatest number of coins/lego before it sank? Why does a ball of playdough or piece of foil sink, but will float when you make it into a boat? Why do big, heavy ships float?

WHAT IS THE SCIENCE?

Whether something floats or sinks depends on its density. If something has a lower density than water, it will float, and if it has a higher density than water it will sink. Density is how tightly packed the material inside an object is. Just because something is heavy does not necessarily mean it will sink. For example, a ship might be very heavy but if it is less dense than water, it will still float.

The orange peel has tiny air pockets in it which make the peel less dense than water, so it will float. The orange on without the peel is denser than water, and so it will sink. But when the peel is still attached to the orange it makes the orange less dense overall, so it will float.

4 MORE ACTIVITIES YOU COULD TRY

MAKE A SALT VOLCANO  https://wowscience.co.uk/resource/salt-volcano/

MAKE A DENSITY JAR AND LEARN MORE ABOUT FLOATING LIQUIDS
https://www.science-sparks.com/floating-and-density/

MAKE A PAPER CLIP FLOAT ON WATER! https://spark.iop.org/paperclip-afloat

TAKE A SCIENCE SELFIE! Maybe you could show other people what you have been doing?
Before you start! Please read through this with an adult:

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Salty Science

Try this indoors…. Crystals

Put about half a litre of warm water into the jug. Stir in a large spoon of salt until you can no longer see all the grains of salt which means they have dissolved. Keep on stirring in salt, a spoon at a time, until you reach the point where no more salt will dissolve. Then pour a small amount onto a flat coloured plate or tray and leave the plate somewhere warm.

What do you notice?

Things to talk about …

Over the next few days have a close look at what is happening on the plate. What do you notice? Where do you think the water is going? Can you see the salt again? Does it look the same as the salt that you started with? What is the same about it? What is different about it?
TRY THIS OUTDOORS .... EVAPORATING WATER

Take the rest of your salty water and put a small amount into each of your different shaped and sized containers. Try to put the same amount of salty water into each container. Find a sunny place to put the containers close together, or you can find a warm place indoors. Over the next few days, watch to see what happens.

WHAT DO YOU NOTICE?
Things to talk about ...

What do you notice is happening to the levels of the salty water? Can you see any salt crystals appearing? Which containers do you see salt in first, the tall and thin or the shallow and wide ones?

WHAT IS THE SCIENCE?

Salt dissolves in water. It might look as though it has disappeared but it has actually become mixed in with the water to form a transparent (see-through) solution. When the salt solution is left in a container and it dries up to leave new salt crystals, it is because the water has evaporated. This happens when some of the water gets enough energy to change from being liquid to a vapour (a gas). The water vapour mixes with the air above the water. If it is warm or windy, evaporation happens faster: think about a puddle on a sunny day. Evaporation also happens faster when there is a bigger surface area next to the air, so the water in a shallow, wide container will evaporate faster than the same amount of water in a tall, thin container.

MORE ACTIVITIES YOU COULD TRY

FIND OUT MORE ABOUT WHICH SOLIDS WILL DISSOLVE IN WATER https://www.science-sparks.com/exploring-which-solids-dissolve-in-water/

GROW YOUR OWN SUGAR CRYSTALS https://www.science-sparks.com/how-to-grow-sugar-crystals/

Join in with THE GREAT SCIENCE SHARE - register for this year’s event and take a look at these question maker tools to SHARE YOUR SCIENTIFIC QUESTIONS!
This easy rain gauge is a super simple way to practice recording data and learn about rainfall patterns.

Materials!
- Empty plastic bottle
- Permanent marker
- Tape (optional)
- Ruler
- C bottle

Method!
- Cut the top off the plastic bottle.
- Place the top upside down inside the other half of the bottle.
- Measure and mark in cm from the bottom upwards.
- Place in the ground and you are ready to go!

Discuss!
- Don’t forget to empty the bottle once you’ve recorded your data.

Extension Tasks...
- Record rainfall daily
- Draw a table to display your results. What does the sky look like on rainy days?
Can you cross the river?

Can you build 3 boats using different materials to help the Gingerbread Man cross the river? Your boat must be able to carry a small load so he can build a bridge to get back to the other side.

Here’s what you will need

- Lemons, oranges or limes, cut in half with the flesh removed
- Playdough
- Lolly sticks and cocktail sticks
- Cardboard
- Jam jar lids
- Sponges
- Egg cartons
- Corks
- Aluminium foil
- Water tray
- Small figures or objects

Here’s what you can do

1. Build three boats using different materials each time. If you build three you can decide which one is best.

2. Place the boats in a filled water tray to see if they float. If they float, add small objects or figures to find out how well the boats float.
Questions to think and talk about

Do all the boats float? Which boat floats best?

Does it matter where in the boat you put the extra weight?

Does it make a difference if the water is deeper?

Which materials are the most waterproof?

What do you notice about materials that float? Do they have any properties in common?

Extra Activities

Does the shape of the boat affect how it floats?

Can you make the boats move across the water? How many different ways can you do this?

How else could the Gingerbread Man cross the river? Can you think of three more ideas?

Links with English

Can you write an alternative ending to the Gingerbread Man story where he builds a boat and escapes across the river?

How might the Gingerbread Man send a signal to ask for help? Who or what might come to his rescue?

Links with Maths

How much weight can you add before each boat sinks? What is the maximum weight a boat can hold?

How far does each boat travel if you blow it?

Opportunities for learning

- Understanding more about why some objects sink and some float.
- Understanding how different materials can be used to make a boat more buoyant.
- Using key vocabulary including sink, float, light, heavy, buoyancy, density.
- Calculating how much objects weigh.
- Comparing different solutions to a problem.
The Transparent Egg

**Concept:** Chemistry, Acids and Bases

**Materials:**
- raw chicken egg
- white vinegar
- bowl

**Thinking and Predicting Question:**
What will happen if the egg shell is dissolved?

**What to do:**
Place a chicken egg in the bowl. Pour enough vinegar into the bowl to completely cover the egg.

After 24 hours, you will notice the shell is starting to dissolve. There will be some floating particles on top of the bowl. Carefully pour out the old vinegar, and replace it with fresh vinegar.

After 24 more hours have gone by, you will notice that the egg shell will have completely dissolved. Take it out of the bowl and observe.

**What will happen and why:**
The vinegar dissolves the eggshell, leaving just a rubbery egg. You can even see the yellow yolk inside! Turn the egg and you can see the yolk move around. The egg will even bounce if you drop it a few inches off of the table.

**Vocabulary:**
dissolve – to chemically break down and seemingly disappear
Name: __________________________

**Transparent Egg**

**Materials:**
- raw chicken egg
- white vinegar
- bowl

**What to do:**

Place the egg in the bowl. Pour enough vinegar into the bowl to completely cover the egg.

After 24 hours, you will notice the shell is starting to dissolve. There will be some floating particles on top of the bowl. Carefully pour out the old vinegar, and replace it with fresh vinegar.

After 24 more hours have gone by, you will notice that the egg shell will have completely dissolved. Take it out of the bowl and observe.

What caused the egg shell to dissolve?

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Describe the egg after the shell was fully dissolved.

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
Producers and Consumers

A **producer** is a living thing that makes its own food from sunlight, air, and soil. Green plants are producers who make food in their leaves.

A **consumer** is a living thing that cannot make its own food. Consumers get their energy by eating food. All animals are consumers.

A **decomposer** is a living thing that gets energy by breaking down dead plants and animals. Fungi and bacteria are the most common decomposers.

Tell whether each living thing below is a **producer**, **consumer**, or **decomposer**.

a. apple tree - __________________________

b. hawk - _____________________________

c. mushroom -________________________

d. carrot - _____________________________

e. dragonfly - _________________________

f. bamboo - ____________________________

g. cougar - ____________________________

h. bacteria - __________________________

i. daffodil - __________________________

j. pigeon - _____________________________

k. snake - _____________________________

l. catfish - ____________________________
A paleontologist uses fossils to understand the story of Earth’s history. This story includes the plants and animals that once lived on Earth. Evidence of this past life is found by paleontologists within sedimentary rocks. These rocks are made of the broken pieces of other rocks called sediment that have become compacted or cemented together over time.

Sediment can be clay, sand, or gravel. Rocks can form on land or in water. An ancient beach might leave behind sand which forms into sandstone. Ocean sediments could develop into marine shale made of clay, or limestone from broken down shells. If the remains of an animal or plant, like bones or leaves, are covered by sediments, a fossil may become preserved in the rock formed from these sediments.

Now it is your turn to hunt for fossil-bearing rocks and the stories they hold!

Find the underlined words in the text above in the word search. Words may go up, down, or diagonally.

When you finish, write down the unused letters in order in the spaces below to reveal a hidden message!

Vertebrate Fossils
Animals with backbones (vertebrae) are known as vertebrates. Mammal, fish, and dinosaur bones or teeth are all examples of vertebrate fossils.

Invertebrate Fossils
Animals without backbones are known as invertebrates. Shells and exoskeletons help organisms like clams and corals to be preserved.

Plant Fossils
Fossil plant remains include petrified wood, leaves, cones, seeds, pollen, and sometimes even flowers. Amber is tree sap and can preserve other organisms.

Trace Fossils
Trace fossils—tracks, burrows, and coprolites (ancient poop!)—are evidence of organisms interacting with their environment.

Paleontology vs. Archeology
PALEONTOLOGISTS and ARCHEOLOGISTS are scientists who dig and study old things from the ground. They both use the same tools and techniques to look for things in sedimentary rocks, but there are some big differences too.

ARCHEOLOGISTS study the remains of human history, culture and civilizations. PALEONTOLOGISTS study the remains of past animals and plants and how they have changed.
Paleontologist’s Scrapbook (#4)

Paleontologists are scientists who study what life was like on Earth a very long time ago. They do this by “reading” fossils and rocks for clues about past environments and life. Look at the pictures below and fill in the missing word to find out some of what paleontologists do.

WORD BANK
Applying    Digging    Sealing    Looking    Brushing

Imagine yourself as a paleontologist. Draw a picture of yourself at work and write a caption to describe it.

Find the Fossil (#6)

Find the Fossil (#6)

It is not always easy to see fossils in rocks. Search the pictures below carefully and circle your 9 fossil finds.

Paleontologists use many tools to find and clean fossils. Draw lines to match the images to what they are used for.

Toilet Paper:
- Wipe away sediment from fossils
- Move large amounts of sediment
- Wrap up fossil material before applying plaster
- Pick grains of sediment out of cracks
- Break open fossil-bearing rocks
- Take notes on fossil collection site

Rock Hammer:

Dental Picks:

Brush:

Notebook:

Shovel:

The Right Stuff (#5)

Toilet Paper

Rock Hammer

Dental Picks

Brush

Notebook

Shovel

Imagine yourself as a paleontologist. Draw a picture of yourself at work and write a caption to describe it.

For every hour they spend in the field, paleontologists spend at least three hours in the lab. Imagine that for every hour you spent playing outside you then had three hours of homework!
At Grand Canyon National Park, Arizona, the rocks form neat layers. You can see their different colors in this picture. These layers can help paleontologists find out the age of a fossil by using relative age dating.

Relative age dating is a way to compare the age of different fossils in a section of rock based upon their position. This gives a general idea of what is older or younger.

To get exact ages, paleontologists use absolute age dating techniques like testing the minerals of volcanic rocks.

Grand Canyon National Park is home to a great collection of Paleozoic fossils. They’re hiding in these layers!

Using the rock column to the left and the rules found above, compare the ages of the fossils and answer some questions.

(HINT: Use the timeline on page 9 to help you!)

From 4.6 billion years ago until 541 million years ago was a time period called the Precambrian.

If we made this timeline to scale the red bar would take up 4 pages!