

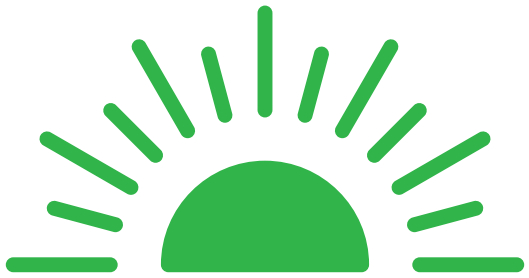


National Inventors
Hall of Fame®
EDUCATION PROGRAMS

Step Outside and STEM



Your guide to outdoor
exploration and
creative problem solving



Let's Explore the Outdoors!

With the help of this handbook, uncover awesome STEM (science, technology, engineering and mathematics) adventures in your own backyard. In this guide, you'll find exciting hands-on activities designed to bring out your creativity while you investigate the natural world around you.

Before you get started, identify useful resources that will help as you make your way through this guide. Here are a few basic tips as you're setting up:

1. Gather supplies

Once you select an activity, use the "Materials Needed" section to collect your necessary supplies. Basic items are often all that you need to develop big ideas!

2. Start an Inventor Log

Keep a notebook and pencil handy to record observations, make sketches and jot down ideas while you work through every activity. Keeping a record of discoveries is a fun way to track your thoughts and designs.

3. Create a makerspace

Think about what kind of atmosphere in or around your home might spark imagination. Consider a space outside in your backyard or nearby green space appropriate for each activity. Assemble your supplies here and let the environment inspire your creativity!

Happy hands-on creating!

Your National Inventors Hall of Fame® team



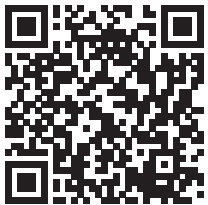
Make Space to Grow

What are we learning?

National Inventors Hall of Fame Inductee George Washington Carver overcame great personal hardship to become a world-famous chemist whose discoveries revolutionized agriculture. His research would prove life-changing for farmers whose cotton crops drained the soil of its nutrients. He discovered that peanuts and sweet potatoes could reintroduce nitrogen, an element essential to plant growth, back into the ground.

As Carver demonstrated, the world can be changed through perseverance and care. The biggest ideas can grow from the smallest seeds, so keep planting!

Learn more about George Washington Carver here:



Materials needed:

- Cup
- Dried beans or peas
- Napkin or paper towel
- Paper
- Pens or pencils
- Recyclables
- Soil (seed starter, potting soil or dirt)

Instructions:

1. Research and explore the life of George Washington Carver, the agricultural chemist who developed new methods of planting crops and discovered hundreds of new uses for crops like peanuts and sweet potatoes.
2. Using your research as motivation, design your own mini greenhouse space by:
 - a. Choosing a sunny area, like a windowsill.
 - b. Looking through your recycling bin for items to house your plant, like a milk jug, an egg carton or a plastic container.
3. Select your choice of beans or peas to grow.
4. Fold a napkin or piece of paper towel into a square shape so it will fit into a cup, then soak the napkin or paper towel in water.
5. Wrap a few dry beans or peas in the wet paper and let them soak until you start to see roots growing out of the paper towel (this could take a few days).
6. After roots have begun to grow, fill your chosen recyclable container or a small cup three-quarters of the way with soil.
7. Remove the beans or peas from the napkin and place them with their roots facing upward in your container.
8. Completely cover the beans with additional soil and place the container in the warm, well-lit area you had selected.
9. Add water to the soil periodically over the course of about three days. Using a small spray bottle can be a fun and easy way to water plants!
10. Find inspiration in Carver, who often illustrated the plants he worked with, and draw a sketch of your sprouting seeds.
11. Watch your plant sprout and start dreaming up your next green project!





Protect Clean Water

What are we learning?

There are many ways that we can clean up and help protect clean water! National Inventors Hall of Fame Inductee Ashok Gadgil invented a water-disinfecting technology that is used to provide clean and inexpensive drinking water to millions of people throughout India and Africa. As he was fascinated with science and loved tinkering, Gadgil's parents encouraged his passion and allowed him to have his very own lab. By supporting children's STEM interests, we can make a lasting impact on caring for this big blue (and green) planet!

Learn more about Ashok Gadgil here:



Materials needed:

- Paper
- Pencil, pens or markers
- Shaving cream
- Small buckets or containers (two)
- Small tables, desks or TV trays (two)
- Squirter or squirt/spray bottle
- Towel or drop cloth
- Water

Instructions:

Activity One: Prototype a Water-Cleaning Device

1. Make a list or have a conversation about the ways you use water every day.
2. Do an internet-safe search to find three challenges that are connected to water — like removing garbage or pollution from rivers, lakes and oceans, or making sure everyone has access to clean drinking water.
3. Decide which water challenge will be your focus.
4. Explore inventors, like Inductee Ashok Gadgil, and inventions that have helped with water-related challenges.
5. Design and sketch your own invention to address your water challenge.
6. Share your idea with your family and friends to keep the fun and inspiration going!

Activity Two: Blob Fish

1. Ask a family member or friend(s) to play an ocean cleanup game called Blob Fish!
2. Fill two small buckets or containers about halfway with water.
3. Place a towel on the floor (or choose to play this game outdoors).
4. Place two small tables or desks on top of the drop cloth or towel, about 2 feet apart from one another.
5. Place a bucket of water and a squirter or spray bottle near each table or desk.
6. Have one person (or one pair or group) stand near each bucket.
7. Place a large blob of shaving cream on top of each desk or table to represent water pollution.
8. Explain that the goal is to use the squirters to remove the shaving cream from the opposite desk or table, and that the buckets of water can be used to refill the squirters.
9. Share that the person or team who removes all of the shaving cream blob first is the pollution cleanup champion!
10. Congratulate each other on a great game of Blob Fish. Everyone wins when we clean up and protect water!



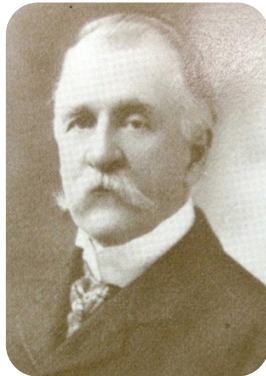
Investigate Geological Features

What are we learning?

Limestone is a type of sedimentary rock that contains calcium carbonate. This compound chemically reacts with acids, such as those found in white vinegar. When the calcium carbonate and vinegar react, they release carbon dioxide, the same gas that makes bubbles in carbonated beverages! You can see the carbon dioxide as it forms on the surface of the limestone and releases as bubbles into the liquid.

Thanks to National Inventors Hall of Fame Inductee William Painter, our carbonated beverages stay contained and sealed with the bottle cap he invented.

Learn more about William Painter here:



Materials needed:

- Bucket
- Gardening gloves
- Notebook
- Pen or pencil
- Small plastic bowl
- Small shovel
- White distilled vinegar

Instructions:

1. With adult supervision or permission, search in your backyard or nearby park for rocks with different colors, shapes and sizes. Collect your samples in a bucket and be sure to wear a pair of gardening gloves to protect your hands. If a rock is stuck in the ground, a trowel or shovel might help excavate it. Consider wearing safety glasses to protect your eyes.



Be on the lookout for these three types of rocks:

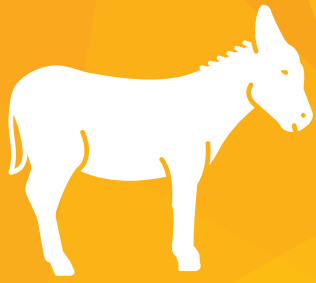
Igneous rocks are formed from melted rock (like lava or magma) deep beneath the Earth's crust.

Sedimentary rocks are made from many layers of sand, small rocks, and dead plant and animal material that are compacted underground over time.

Metamorphic rocks are igneous or sedimentary rocks that have been transformed (metamorphosed) through intense underground heat and pressure.

Remember — all kinds of rocks might not be present in areas!

2. Once you've finished collecting your samples, take out your notebook. Tear out small pieces of paper and label each of your samples with a number (sample 1, sample 2, etc.). Then, write these numbers in your notebook.
3. Examine each rock, noticing its color, texture and features. In your notebook, take notes on the features of each sample. Predict which rocks contain limestone by writing a big letter "L" next to the sample number. Helpful hint: Limestone can be yellow, white and gray in color, is generally a hard rock, and can contain fragments of other rocks and even shells.
4. One at a time, place each rock in a small plastic bowl and pour white distilled vinegar over it. Make sure to cover the rock.
5. After a few minutes, use your observation skills to identify if bubbles are beginning to form. If bubbles form on the surface of the rock, it contains limestone!
6. Return to your notebook and count how many of your predictions were correct!



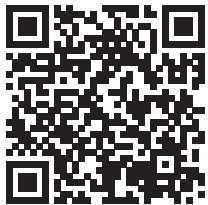
Engineer Hybrid Creatures

What are we learning?

Inventors often combine two or more familiar inventions or their features to make something new and unique. National Inventors Hall of Fame Inductee Elmer Ambrose Sperry studied the properties of gyroscopes and compasses, patenting the gyroscopic compass that can serve as an automatic pilot to help guide ships and airplanes.

Thanks to Inductees Steve Sasson, inventor of the digital camera, and Eric R. Fossum, inventor of the CMOS active pixel image sensor camera-on-a-chip, manufacturers can produce camera phones! Some inventions are brand-new creations, while others take existing products and processes, and adapt them in subtle ways that improve their use and function.

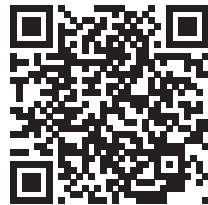
Learn more about Elmer Ambrose Sperry here:



Learn more about Steve Sasson here:



Learn more about Eric R. Fossum here:



Materials needed:

- Animal pictures
- Clay
- Copy paper
- Cotton balls
- Craft sticks
- Feathers
- Felt
- Googly eyes
- Markers
- Masking tape
- Pipe cleaners
- Pompoms

Instructions:

1. Do an internet-safe search to find and then print the following animals: dog, cat, monkey, elephant, bear, hamster, flamingo, jellyfish, seal, turtle, crab, frog, owl, ant, ladybug, seahorse, snake and rabbit.
2. Then, find and print images of the following hybrid animals from the internet: mule, wholphin, liger, zorse and grolar bear.
3. Select a room to be used for a presentation and set out your needed supplies on a table.
4. Tell your family or friends the following story:

There was a sunny island in the middle of the Pacific Ocean where the waters flowed clean and clear, gentle breezes glided through the trees and the animal sounds created a symphony that brought the land to life. There were thousands of animals living in harmony. There were even animals that weren't typically known to live on islands.

5. Look at pictures of some of the animals that live on this island. Examining each photo, identify which features or special characteristics you notice about each photo.
6. Turn off the lights. Continue the story:

One night, the animals watched a severe electrical storm approach the island. They scurried around the island, trying to find shelter and protection. The storm lasted throughout the night.

7. Turn on the lights. Continue the story:

As the sun began to rise the next morning and the animals began to emerge from their hiding spots, they noticed that something very strange had happened. Everyone looked like they were a mix of more than one animal. Where there were feathers, there were now scales. Where there were once spots, there were now stripes!

8. Based on the description from the story, determine what the animals on the island looked like now.
9. Examine the photos of real animals that are a mix of two different animals – known as hybrids – including the mule, wholphin, liger, zorse and grolar bear.
10. Using your supplies, build models of fantasy hybrid animals using any combination of animal photos.





Create a Rainbow

What are we learning?

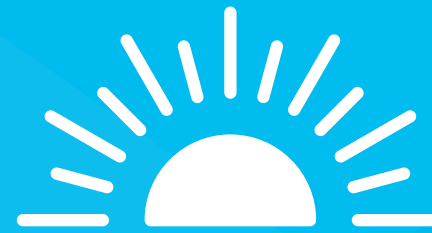
When light passes from one medium (like air) through another medium of a different density (like water), it refracts, meaning the rays of light bend. When white light passes through water and separates into individual colors it's composed of, it creates a rainbow! When we conduct experiments of this nature, we are exploring more than just science concepts — we are exploring mindset, an important aspect of invention.

Materials needed:

- Dark room
- Clear glass vase, container or cup
- Flashlight with batteries
- Mirror, compact or back of a CD/DVD (must fit inside of the glass)
- Water

Instructions:

1. Fill a glass of water and set it on a table.
2. Place a mirror (or CD/DVD) inside of the glass at an angle, reflective side up.
3. Turn off the lights in the room and use curtains to darken the room, if necessary.
4. Turn on your flashlight.
5. Aim your flashlight at the submerged mirror and admire your rainbow.
6. Try changing the angle of the flashlight, as well as the distance of the light to the glass, and see how it changes the shape and direction of the rainbow!



Watch your Shadow

What are we learning?

When the sun is at its highest in the sky, you'll notice that the shadows of objects around you, like your toy figure, are the shortest they will be. Look down and you'll see this is true for your own shadow, too!

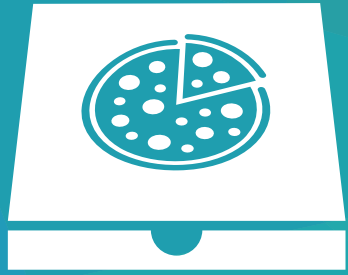
Many inventors have used the sun to make discoveries, including National Inventors Hall of Fame Inductees Daryl Chapin, Calvin Fuller, and Gerald Pearson, who co-invented the silicon solar cell that has powered everything from the space program to the internet.

Materials needed:

- Paper
- Toy figure or small object
- Pencil, marker or sidewalk chalk

Instructions:

1. Find a toy figure or small object and place it on a piece of paper, either outside or in a window.
2. If needed, you can tape your object to a piece of paper to keep it from moving during the day.
3. Using a pencil or marker, make a mark where the top of the shadow lands on the paper. Then, label the mark with the time of day.
4. If your object is outside, you could use sidewalk chalk instead.
5. Throughout the day, check your object's shadow and mark where it lands. Be sure to label the time on each mark.
6. At the end of the day, consider if and how your object's shadow changed ... or maybe didn't!
7. Share your observations of the sun on the summer solstice with family or friends.
8. As a bonus, you might consider saving your object and piece of paper for the winter solstice, so you can see how the shadows might be similar or different.



Construct a Solar Oven

What are we learning?

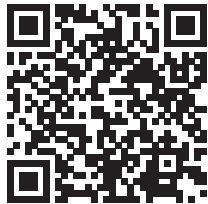
Your solar oven works by reflecting rays of sunlight off the aluminum foil and into the box through the plastic window, heating the air inside the box and melting the chocolate.

Many inventors have found ways to harness and use the sun's rays, like National Inventors Hall of Fame Inductee Mária Telkes, who invented solar thermal storage systems that can put the sun's energy to use, like in solar ovens.

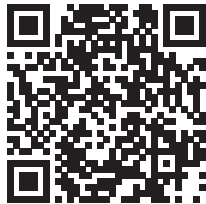
Thanks to Inductee Mary Engle Pennington's significant advancements in refrigeration, you can place your chocolate in the refrigerator to solidify quickly.



Learn more about Mária Telkes here:



Learn more about Mary Engle Pennington here:



Materials needed:

- Aluminum foil
- Black paper
- Bowl or dish
- Chocolate bar or pieces
- Chocolate molding trays
- Clear plastic wrap
- Oven mitt
- Pencil or ruler
- Pizza box (clean)
- Tape
- Scissors

Instructions:

1. Research different types of solar ovens by doing an internet-safe search online.
2. Using your scissors, safely cut a flap in the lid of your pizza box. Be sure to leave space on the sides of the box.
3. Fold the flap upward so it stands on its own and exposes the interior of the pizza box.
4. Wrap a piece of aluminum foil around the flap of your pizza box so it covers the portion that is directed at the inside of the box. Secure the aluminum foil with tape to the backside of the flap.
5. Open the pizza box and tape clear plastic wrap tightly over the hole in the lid to seal out air.
6. Next, line the bottom of the inside of the pizza box with aluminum foil, securing it to the box with tape.
7. Tape black paper on top of the aluminum foil to absorb heat from the sunlight.
8. Then, put your chocolate bar or chocolate pieces in a bowl or dish that is shallow enough to fit inside the pizza box when it is closed.

Place it on the black paper and close the lid of the pizza box.
9. Use a ruler or pencil to prop open the flap of your pizza box, and leave the box outside in the sun. Be sure to angle the box so that the sunlight is reflecting off the aluminum foil and onto the plastic wrap.
10. Once the chocolate has melted, use oven mitts to take it out of your solar oven.
11. If you'd prefer to eat some chocolate while it's still warm, try pouring it over ice cream or salty snacks!
12. To make a cool treat, carefully pour your chocolate into molding trays of your choosing.
13. Place the molding trays inside your refrigerator to cool down.
14. After about 30 minutes in the refrigerator, the chocolate will have hardened, and you can remove the pieces from your mold to enjoy another sweet treat!

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