National Inventors Hall of Fame®

EDUCATION PROGRAMS

Invention Education in Action!

Your guide to applying the I Can Invent® Mindset in the classroom

Help Transform Students Into Innovators

We invite you to use this handbook to give your students the opportunity to practice the skills and attributes used and promoted by some of the world's greatest inventors. In this guide, you will find nine engaging hands-on STEM (science, technology, engineering and mathematics) activities crafted to highlight a specific component of the I Can Invent Mindset.

I CAN INVENT® MINDSET.

Below are a few strategies you can use in advance to ensure successful implementation:

1 Gather supplies

After selecting an activity for your students, use the "Materials Needed" section to collect the necessary supplies. Each experience has been designed to be as accessible as possible, and requires items that are often easy to gather and obtain.

2 Encourage the use of an Inventor Log

While conducting these activities, encourage your students to keep a notebook and pencil to record observations, draw sketches and jot down ideas. Not only is using an Inventor Log something that many National Inventors Hall of Fame® Inductees do, but keeping a record of discoveries is also a fun way for participants to track their progress and improve their designs over time.

3 Create a makerspace

Consider creating an area inside of your classroom dedicated to containing different materials students can use to enjoy these activities. Invention materials are often hiding in plain sight and can include:

- Small or medium boxes
- Paper towel tubes
- Canisters and containers
- Cups and lids
- Bubble wrap
- Foam trays
- Rubber bands
- Miscellaneous paper (construction, magazines, newspapers, etc.)
- Balls and sporting goods (no golf clubs or bats)
- Pulleys
- Springs
- Strainers
- Washers
- Unwanted toys (building blocks, car/train tracks, game parts, pinwheels, plastic figurines, toy vehicles, etc.)
- Unwanted DVDs, tapes and cases

DESIGN THINKING:

Wildlife Engineering Design Challenge

Design a new park where people can have fun and animals can thrive!

What are we learning?

When engineers create a new design, they have to think through problems from various perspectives and identify the best solutions. They also need to employ empathy, or the ability to put yourself in someone else's shoes, as they are creating solutions. Children often feel strong empathy toward animals and nature. National Inventors Hall of Fame Inductee Chieko Asakawa, inventor of the Home Page Reader (which gives people who are blind or visually impaired access to the internet), highlights the importance of empathy in designing products that best fit the end user.

To learn more about Chieko Asakawa, check out this video!

Materials needed

- Aluminum foil
- Craft items (clay, construction paper, craft sticks)
- Markers or pencil
- Paper
- Recyclable materials (boxes, cardboard tubes, packaging materials)
- Small plastic or stuffed toy animals
- Toothpicks

Instructions

1. Imagine that you need to design and build a park where wild animals can safely live and people also can enjoy the environment.

2. Make a list of the types of animals you hope to attract.

3 Begin by identifying potential challenges and thinking through what you can do to help.

4. Consider the following:
   - What types of habitats will suit the animals you hope to attract?
   - What types of pathways might be useful for people?
   - Might there be other features, like bridges or gates?
   - What inventions might be needed to ensure there is enough water or energy available?

5. Design a prototype (model) of your park and test your design using stuffed or plastic toy animals.

6. Ask for feedback and improve upon your design to make it even better!

INTELLECTUAL PROPERTY:

Flag Day

In this activity, students will design their very own flag while learning about logos and trademarks!

What are we learning?

Celebrated on June 14, Flag Day commemorates the Flag Resolution of 1777 that adopted the Stars and Stripes as the official flag of the United States. Just as flags distinguish countries and states from one another, logos are often used on products and packaging to help differentiate one business or product from another. For a logo to be successful, it should communicate information about the company or product through its font, color palette and imagery. Logos can be protected with either a trademark (TM) or a registered trademark (®) symbol if the owner is able to demonstrate that the logo can identify or distinguish the source of goods and services. For more information on trademarks and other forms of intellectual property, visit USPTO.gov.

Materials needed

- Craft items (e.g., foam sheets, patterned tape, stickers)
- Dowel or stick
- Glue
- Markers (or other drawing utensils)
- Paper or fabric
- Tape

Instructions

1. Consider how flags often have colors and symbols that tell a story. The United States flag, for example, has 13 horizontal stripes that alternate red and white. The stripes represent the original 13 colonies and the stars represent the 50 states.

2. Think about how products and companies also have a special design that represents them and tells their story. These special designs are called logos.

3. Grab paper and markers (or other drawing utensils) and design a logo that represents you! Logos can be made of letters, words, symbols, colors and other details. While you are designing your logo, consider some of the following questions:
   - What is your favorite way to spend time together?
   - What are some unique or special features about you?
   - Do you have a favorite shared food, hobby or activity?
   - What colors or patterns best represent you?
   - What are your special talents?
   - When people think about you, what comes to mind?
   - How might you represent your important values, like kindness or patience?

4. If it is challenging to get started, consider using a shape, such as a circle, square or oval, as your base.

5. Once you have designed your logo, create a flag that features the logo as the main symbol. You can draw it on copy paper and tape it to a dowel (or stick). Alternatively, put your crafting skills to the test by drawing your logo on a piece of fabric and attaching it to a piece of rope or string.

6. Place your flag in a prominent place and let it remind you of the special connections that you share.

INNOVATION:

Creativity is PHENOMENAL

Explore the use of phenomena to make creative connections!

What are we learning?

Scientists often build ideas based on direct observations in order to explain and predict phenomena. Many inventors share the power of observation as they gather data to identify challenges and opportunities to pursue, and gaps to close. Many inventors engineer solutions to problems they identified through observations they made in the world, and then sought to better understand the hows and whys behind those observations, ultimately resulting in novel and useful solutions.

Materials needed

- Paper, sketchbook or journal
- Observation tools, if available (binoculars, magnifying glass)
- Pencil

Instructions

PART ONE

Many inventors share that invention often begins with observing a problem. Observable events or processes that happen in the natural world are known as phenomena. Exploring phenomena will help you build your observation skills on your invention pathway!

1. Find a sketchbook, journal or just a blank piece of paper, and head outside or look around your classroom to observe your surroundings.

2. Look around and see what you notice. Perhaps you observe a shadow of an object on the ground, or tracks in the dirt made by a small bug crawling by. Phenomena can be anything that piques interest or gets you to ask “Why?” or “How does that happen?” or say “I wonder …”!

3. In your journal or on your paper, sketch, draw or jot down some notes about what you have observed.

4. Now, think about three things your observations make you wonder (e.g., do you wonder how a shadow is made or how the angle of sunlight changes an object’s shadow?).

5. Next, investigate some of your wonderings. Click here for wonder inspiration from National Inventors Hall of Fame® (NIHF) Inductee and NASA scientist Jacqueline Quinn before starting your quest.

6. What did you discover through investigating your wonder questions? Add your discoveries to your notes.

PART TWO

Forced Connections is a creative thinking tool where you pair seemingly unrelated ideas to make new connections. Try it out!

Take one of the phenomena you observed, or a fun fact you discovered through your research, and use it to form a question that can help you generate ideas. For example, say a phenomenon you observed was a tree’s shadow. If you used this to inspire your brainstorming related to the question “What might be a fun theme for a party?” it could lead you to ideas like:

- Putting on a puppet show
- Making shadow art
- Inviting everyone in your family tree

ENTREPRENEURSHIP:

Sweet Decision-Making

Satisfy your sweet tooth as you set up your very own candy shop! You can learn about the power of decision-making and entrepreneurship as you have fun with your class.

What are we learning?

Responsible decision-making is an authentic life skill that children can develop through play. During children's developmental years, many choices are made for them, such as going to school or the dentist, and this is important for structure and establishing good habits. When decision-making is handed over to the child, however, they are empowered to make own their selections, establishing confidence, agency and capability.

With every decision, there is an outcome. The more opportunities a child is given to make decisions, the more they will understand the consequences of their decisions, both good and bad. Responsible decision-making develops through age, experience and practice, like buying a car, making purchases with a credit card or launching an entrepreneurial venture. In low-risk activities like buying sweet treats, the stakes are low, the play is fun and the outcome is delicious!

Materials needed

- Cups (small ones if possible)
- Markers
- Play money or tokens
- Poster board, or a piece of paper or cardboard
- Sweet treats (pieces of candy, bubble gum, etc.)
- Trays or other flat containers for carrying cups

Instructions

1. Place one to three pieces of your candy or other sweet treats into 10 to 15 different small cups.
2. Arrange and display the cups on a table or counter as if in a candy shop.
3. Select a form of money or tokens. You can use play money, but small items like marbles, blocks or other trinkets can be used as a form of currency as well.
4. Use your imagination and your poster board, paper or cardboard to make fun, colorful signage for your shop. Consider giving your business a name and using your markers to create a unique logo!
5. Price your sweets according to how much currency is available, and give your family or friends each the same amount of "money" (the items you have chosen as your currency).
6. For example, you could set a price for each of the cups between $5 to $10 and give each person a total of $50.
7. Offer each person a tray for collecting their sweet treat cups, and let the shopping and decision-making begin!
8. Enjoy your treats together.

COLLABORATION:

Friendship Day

This activity demonstrates the importance of teamwork and celebrates the many inventors who have collaborated on patenting their inventions!

What are we learning?

When people team up, they bring different knowledge, skills and experiences together. A key rule of brainstorming is to build upon others' ideas. While collaborating in person is fun and useful, it also can be successful from a distance. For example, NIHF Inductees Elizabeth Lee Hazen and Rachel Brown created the first useful antifungal antibiotic while living over 300 miles apart! They developed their invention (which has been used to treat human infection, help diseased trees and restore water-damaged art) through a long-distance scientific collaboration. This is especially impressive because it was before the development of the internet or texting! They relied on the postal service to share their discoveries and observations.

Materials needed

- Post-it® Notes*
- Craft items such as beads, pipe cleaners and glitter
- Large sheets of paper
- Markers
- Recyclables
- Scissors
- Tape

Learn more about Elizabeth Lee Hazen.

Learn more about Rachel Brown.

Instructions

1. Pair up classmates to brainstorm fun inventions! It is often people with different perspectives than yours who make great teammates and co-inventors.
2. Brainstorm invention ideas.
3. Use the thought starter "Wouldn't it be great if …" to help you generate ideas together.
4. If you have adhesive notes available, write or draw your ideas on individual notes and then stick them on a big piece of paper or a wall.
5. Watch this video featuring National Inventors Hall of Fame® (NIHF) Inductees Art Fry and Spencer Silver, co-inventors of the Post-it® Note, for inspiration!
6. After you have brainstormed at least 10 ideas, select one idea that sounds most exciting to you and your co-inventor. Make a star or place a sticker on that idea.
7. Now, work together to build a prototype (a model) of your invention!

CREATIVE PROBLEM SOLVING:

Waking Up to Invention

Invent the perfect morning routine!

What are we learning?

In this STEM activity, students gain valuable hands-on experience using creative problem-solving skills to imagine improvements to their everyday lives. Every great invention first began as a seed of an idea, and for inventors of all ages, recording solutions on paper is a crucial step in the innovation process. Once on the page, students then are able to improve their design over time by creating different prototypes of the same device.

Inspiration

National Inventors Hall of Fame Inductees Joseph Muhler and William Nebergall invented a cavity-preventing product using stannous fluoride that is still used today. Muhler researched more than 150 fluoride compounds before discovering that stannous fluoride was the best option for strengthening tooth enamel. In 1956, Crest® was introduced nationally and became the first toothpaste to be recognized by the American Dental Association as an effective decay-preventing agent.

Learn more about Joseph Muhler.

Learn more about William Nebergall.

Materials needed

- Notebook
- Pencil

Instructions

1. In addition to brushing their teeth, have students consider some of their other morning tasks.

2. Think about some of the pesky challenges that might get in their way or opportunities to improve their morning routine.
   - What if your bed made itself?
   - Would you enjoy a hot, delicious breakfast that could be ready with just the push of a button?
   - Would you like using a cereal bowl that played cartoons?

3. Consider the possibilities and then design an invention to make the morning a breeze!

4. Sketch ideas in a notebook. Jot down notes about its design and how it works.

5. Have your students try their inventions the next morning to see if the inventions jumpstart their day!

EDUCATORS: Make this a group activity to build collaboration skills!
Using a white board or chart paper, have your class brainstorm out loud the inventions they come across in their morning routines. Then, ask them to think of tasks, challenges or wishes that could be addressed to make their mornings better. Consider splitting students into teams, encouraging each to pick one of these challenges or ideas and design an invention that will help start their day with creativity and innovation!

CONFIDENCE:

Creating With Confidence

Ready to get creative? Follow the steps below to help your students use their imagination and build their confidence as an awesome, creative problem solver!

What are we learning?

Supporting children in inventing is an effective and meaningful way to help them build confidence in their ideas and their creative process, as well as their academic skills! In fact, recent research conducted by Learning Heroes shows more than two-thirds of parents seek out-of-school programs to help their children gain exposure to new experiences, ideas and perspectives; find their passion, purpose and voice; and gain the confidence they need to excel.

At NIHF, we're proud that parents of children who join our Camp Invention® program report that the experience has meaningfully impacted their child's creativity, interest in STEM fields, and teamwork and collaboration. We love to help kids discover their passions, and one of the best ways to do this is to introduce them to relatable inventors, like Hall of Famer Rebecca Richards-Kortum. She shows kids how they too can use the power of imagination, design engineering and problem-solving skills to have a positive effect on the lives of others.

To learn more about Rebecca Richards-Kortum, check out this video!

Materials needed

- Clay or dough

ALTERNATE MATERIALS

- Aluminum foil
- Pencil and paper

Instructions

1. Ask your students the following questions:
   - Can you think of a time you solved a problem?
   - How did you solve it?
   - Did you use creativity to solve the problem? If yes, in what ways?
2. Next, using clay or dough, ask them to shape an object that represents how they like to use their creativity (e.g., perhaps a pen for writing, a dance shoe for dancing or a pot for cooking).
3. Give them a moment to shape their object and tell them you would like to guess what they made.
4. After their object is shaped, fill in the blanks of the following statement, "I think you shaped a _____ because you like to express your creativity through _____."
5. Invite your students to share more about where and how they feel creative. Support them in their answers.
6. Feel free to ask others to participate, and then ask everyone to describe what they shaped.
7. Share that while creativity is often connected to art, it also can be part of everyday choices, science, business and other subject areas.
8. Watch the inspirational video featuring National Inventors Hall of Fame (NIHF) Inductee and engineer Rebecca Richards-Kortum to see how she applies her creativity and problem-solving skills to design low-cost, high-performance medical devices for low-resource settings.
9. Practice thinking up solutions to everyday challenges by selecting one of the following prompts and then shaping an invention for it out of your clay or dough:
   - What might be the ultimate piece of playground equipment?
   - How might you create a doorstop that also plays music?
   - What might a device look like that could help clean up the planet?
10. Make up some of your own prompts and questions!
11. As you shape new ideas and solutions, check in on your student's confidence and help them celebrate the power of their creative thinking, as well as your own!

STEM:

Tower Power

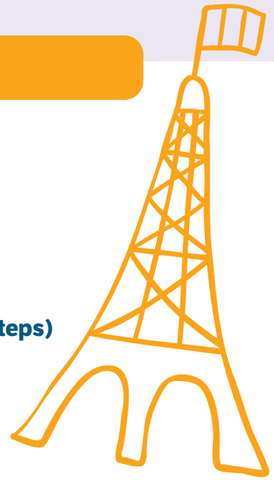
In this hands-on STEM activity, your students are challenged to build the strongest structure possible as they develop their design thinking skills.

What are we learning?

Any structure – from spider webs to bridges to tall buildings – must be strong in both tension and compression. Tension refers to the pulling or stretching of materials. As more and more materials are added to elongate a structure, these materials must stretch without breaking – much like a rubber band. Compressions refer to the pushing force that occurs when weight is added to a structure. For example, if you sit on a marshmallow, it will compress. Materials used for building must have the ability to hold weight as they are added to the structure.

Materials needed

- Medium washers
- Miniature marshmallows
- Paper plates
- Round toothpicks



PREPARATION (An adult should handle each of the following steps)

1. Prepare marshmallows ahead of time. Open the marshmallow bag, put marshmallows in an open container and allow them to sit uncovered for two days.
2. Create one or two structures to use as examples for those participating in the activity. Place a marshmallow at each end of a toothpick. Add a second toothpick by sticking it into one marshmallow. Add a marshmallow at the end of this toothpick. Continue adding toothpicks and marshmallows, experimenting with different shapes to create various structure components (squares, triangles and rectangles).

Instructions

1. Provide containers of marshmallows and toothpicks for your students to use.
2. Give a set amount of time for your student to use the marshmallows and toothpicks to create different towers with various shapes and sizes.
3. Have your student test their structure. Place a paper plate at the very top of each one, then slowly add metal washers on the plate until the structure begins to buckle.
4. Keep a running count of the number of washers each structure can hold.
5. Point out the different shapes your student used in their structures. Ask them why they used the shapes they did and if they think one is stronger than another.
6. Explain that the triangle is the strongest building shape because it evenly distributes weight. It is used in the construction of bridges, roofs and buildings.

EDUCATORS: Make this a group activity to build collaboration skills!
Divide your class into construction teams and have them work together to first design and then build different types of towers. Incentivize your students by creating different categories (tallest tower, strongest tower, tower with only 10 marshmallows, etc.) and rewarding the teams that can build the strongest versions within these parameters. Give each group the opportunity to revise their building based on how it performs during the stress test. By adapting to each new situation, your students are developing valuable creative problem-solving and design thinking skills!

PERSISTENCE:

Creative Coasters

In this hands-on STEM activity, students explore Isaac Newton's first law of motion by building their very own roller coaster!

What are we learning?

According to Newton's first law of motion, an object in motion will stay in motion in a straight line unless acted on by an outside force. In the design of a roller coaster, the loops and turns of the track act as outside forces, channeling the roller coaster in directions other than a straight line.

Materials needed

- Duct tape
- Foam pipe insulation
- Chart paper
- Marbles
- Masking tape
- Scissors

PLAN AHEAD

Cut the foam pipe insulation lengthwise to form two pieces of track. Cut these same pieces widthwise so that each team has four pieces of track for their marble to travel across.

Instructions

1. Divide your class into equal groups and announce that their challenge is to construct a roller coaster that's tall, fast and steep, but also safe.

2. Explain that each group will create one roller coaster that meets the following criteria:
   - The coaster must have a starting point and an ending point
   - The car (marble) must stay on the track
   - The coaster must have a lift hill
   - The coaster must incorporate at least two of the following: a curve, a loop and/or a hill

3. Give each group two sheets of chart paper (to protect the walls), masking tape, scissors and four pieces of foam pipe insulation. Have duct tape available for those groups that wish to use it.

4. Have groups determine where to hang the two sheets of large paper. One sheet should be taped to the wall approximately 1 foot higher than the other sheet of paper. This will give teams ample room to create a track that contains hills and dips.

5. Have groups begin construction of their coasters using masking tape to secure the track (foam pipe insulation) to the sheets of paper.

6. Inform groups that testing and retesting is a crucial part of the design and construction of coasters. Using the marble, they should test and retest their coasters and make changes when needed.

7. Once the groups have completed their coasters, initiate a discussion using the following questions:
   - What elements (lift hill, banked turns, loops) are you using in your design?
   - What is the relationship between the lift hill and all other coaster track elements? (The lift hill should provide momentum for the rest of the ride.)
   - What changes did you make to your coaster to keep the marble on the track?

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