FOREWORD

Introduced in 1990, National Inventors Hall of Fame® programs have encouraged students to explore their creativity and innovation through Science, Technology, Engineering, and Mathematics (STEM) activities and real-world challenges, fostering a lifelong interest in inventive thinking.

The National Inventors Hall of Fame's® Education Programs are inspired by the Inductees, who are integrated throughout the curricula. In collaboration with the United States Patent and Trademark Office, Camp Invention® gives children the opportunity to take risks, use creative problem solving, and develop an entrepreneurial mindset.

To date, the National Inventors Hall of Fame® has impacted over two million children, teachers, parents, college students, and inventors through education and recognition programs. Please visit invent.org to learn more.

The National Inventors Hall of Fame® makes no warranty, explicit or implied, as to the safety or suitability of our activities. We urge you to always use proper safety equipment and precautions. Before using the National Inventors Hall of Fame's® Education Programs, it is essential that all Instructors carefully read and understand the Safety and Hygiene guidelines. Our programs are designed for educational purposes, and safety precautions must be strictly followed to ensure a safer learning experience.

National Inventors Hall of Fame®
EDUCATION PROGRAMS

SAFETY AND HYGIENE

- The activities in this module are intended for use under adult supervision. Instructors should guide participants through the activities to ensure proper safety measures are followed.
- Some materials in this program may pose risks if mishandled. Do not allow participants to use the hot glue gun as it may cause burns. Only Leaders and Instructors should use the glue gun. Practice caution when handling the glue gun. It is hot, even though it is a low-temperature glue gun. Leaders and Instructors should always monitor the glue gun while it is plugged in and hot.
- Ensure all workspaces are clean, well-ventilated, and free of clutter.
- For the safety and hygiene of participants, please be sure all children wash their hands thoroughly with soap and water after each hands-on session, especially after using recyclables and before eating snacks and meals.
- Be sure to follow all local and state fire and safety regulations.
- Demonstrate to the children how to properly hold and use scissors. Do not allow anyone to run with scissors.
- Make sure children do not put materials in or near their eyes, mouth, nose, or ears.
- If any participant has an allergy or a sensitivity, ensure that handled materials are nonallergenic.
- Remind children to safely handle objects with a point, such as pipe cleaners. Do not allow children to poke each other with them.

Session Two

OVERVIEW

In Session Two, children continue to explore claws and grabbers so that they can figure out how to build their own Claw Arcade and rescue NIHFty Bot! They reverse engineer a mini grabber to check out its inner workings and mechanics, and investigate the functionality of each push, pull, and spring. Guided by curiosity and fueled by imagination, they use paper cups to create a new type of grabbing device. Through this hands-on experience, they transform ordinary objects, like cups, into a new contraption capable of grasping and grabbing—prompting them to consider new engineering and design ideas!

ACTIVITY ONE | GRABBER TAKE APART

- ☐ Have participants take apart a mini grabber to explore its inner workings.
- ☐ Ask participants to share the parts and continue to explore how grabbers work.
- ☐ Have participants explore nature's grabbers.

ACTIVITY TWO| CUP GRABBER

- ☐ Play the "Mechanical Marvels" video, and have participants follow along step-by-step to build a cup grabber.
- ☐ Ask participants to explore the functions of a cup grabber.
- ☐ Have participants pick up a pom-pom using the cup grabber and compare the cup grabber's features to the spring-loaded grabber.
- ☐ Have participants compare and contrast the grabbers.
- ☐ Have children build the Cardboard Case for their Claw Arcade.

PLAN AHEAD

For Activity One

- Explore how to take apart a mini grabber before instructing the participants.

For Activity Two

- Gather the materials to build the cup grabbers:
  - Duct tape
  - Markers
  - Paper cups
  - Paper straws
  - Scissors
  - Screwdriver
- Prepare the materials for the cup grabbers as follows **(see Figure 3)**:
  - Poke a hole in the center of the bottom of all the cups using the tip of a screwdriver. Multiple cups can be stacked and punctured at once for efficiency.
  - Precut 1-inch pieces of duct tape so that there are enough for each participant to have a piece. Hang them on a table's edge.
  - On the lip of one cup, make eight evenly spaced marks.
  - Stack the remaining cups and place the marked cup on top.
  - Draw lines down the stack of cups using the top cup as the guide.

Figure 3. Cup Grabber Markings

✓ The lines will rub off after the participants use them as a guide for cutting.

✓ Have a Leader assist with the cup grabber preparation.

Cup Grabber Assembly Tips

- Do not allow participants to place the straws in their mouth.
- Ensure that the participants are cutting the cup up to the base. If it is not cut far enough, the grabber will not work correctly.

- If the marks on the cup rub off, reassure the children that they are just a guide. Encourage them to aim for eight evenly spaced cuts, but let them know that it is okay if they make more cuts, fewer cuts, or uneven cuts. The cup grabber will still function.
- It may be helpful to remind Primary participants that when folding the cup, the green part should touch the opposite green part. Emphasize “green to green” to ensure they align it correctly.
- If the interior cup is pulled out too far, it must be carefully guided back into the exterior cup.
- The cup grabbers allow children to explore different varieties of grabbers. However, since they are made of paper, they will lose functionality over multiple uses. Encourage participants to repair them if they break or rip. It is okay if they only last for one session and need to be discarded. If they are discarded, please remove the tape and recycle them.

✔ At the end of the program, participants will take home their Inventor Log, featuring the cup grabber instructions for future cup grabber building.

Activity One: Grabber Take Apart
(Approximately 30 minutes)

Participants take apart a spring-loaded, mini grabber.

MATERIALS

- ☐ Mini grabbers

INTRODUCTION

1. Open the provided *Claw Arcade* interactive online at invent.org/curriculum-videos.

➔ Navigate to **Slide 14**.

Play the background music. Allow it to play as participants enter.

Slide 14. Background Music

2. Say the following:

Welcome back to Claw Arcade!

Let's jump right in and complete your first hands-on, claws-on activity. You are going to take apart a spring-loaded, mini grabber!

3. Hold up a mini grabber.
4. Ask the following:

? *What do you notice about how the grabber works?*

5. Tell participants to pinch an object with their fingers and notice the pivot points on their knuckles and wrists.
6. Say the following:

When you open and close your fingers, they act like a grabber. The bones in your palm act as the hinge.

? *What do you think the hinge is inside of the plastic grabber?*

💬 *Discuss what you think is inside with a partner.*

PART ONE ACTIVITY INSTRUCTIONS

1. Explain to them that they are going to open the mini grabber to see what is inside and to observe more about how it works.
2. Tell them that once the grabber is taken apart, it will not likely go back together again.
3. Explain to Intermediate participants that it might be possible to put the pieces back together, so they should notice how the parts are put together.

✔ Skip having Primary participants put the pieces back together.

4. Distribute a grabber to each participant.
5. Say the following:

💬 *Let's take apart the grabber to see what is inside.*

? *Have you ever taken an item apart?*

? *How might we open this grabber?*

6. Give participants time to explore taking the grabber apart, letting them make their own discoveries.

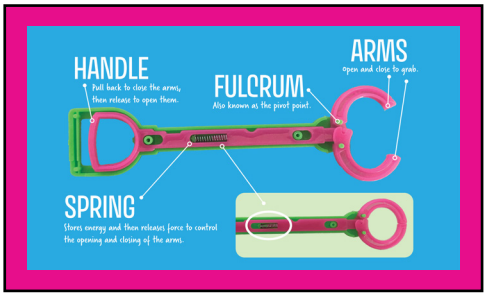
➔ Navigate to **Slide 15**.

✔ Highlight the parts of the grabber shown on the slides.

7. After children have taken apart the grabber, ask the following:

? *How does the claw work?*

? *What do you notice about the spring when the claw is open compared to when the claw is closed?*



Slide 15. Anatomy of a Grabber Image

? *What do you notice about how the springs compress?*

8. Allow the participants to explore the grabber parts.

✔ Have a Leader collect the grabber parts for use in Session Three.

PART TWO NATURE GRABBERS

1. Say the following:

💬 *Now that you know how a few different types of grabbers work, let's think some more about grabbers found in nature.*

? *What kind of grabbers do animals use?*

Slide 16. Nature's Grabbers Inventor Log Pages

➔ Navigate to **Slide 16**.

2. Have participants open their Inventor Log to pages 2–3, "Nature's Grabbers," in the pink *Claw Arcade* section.

3. Say the following:

💬 *Notice how these animals use "grabbers."*

💬 *I'm going to play a video where you can see some more animal grabbers in action.*

Slide 17. Background Music

➔ Navigate to **Slide 17**.

🎞 Play the background music.

4. Select and discuss some of the additional animals from the list below:

   - Wolverine: Climbing, digging, and catching prey.
   - Crab: Burrowing into sand or mud, grabbing, and manipulating food.
   - Sloth: Hanging from trees, climbing, and grasping branches.
   - Komodo dragon: Capturing and holding on to prey.
   - Mole: Digging tunnels and burrowing in soil.

- Kangaroo: Powerful hind limb claws for grooming and self-defense.
- Tiger: Retractable claws, as well as a dewclaw on each front foot, used for grasping prey and climbing.
- Aardvark: Digging burrows and feeding on ants and termites.
- Eagle: Capturing and carrying prey while in flight.
- Velociraptor (extinct): Slashing at prey.
- Frog: Webbed claws aid in climbing and holding on to surfaces.
- Honey badger: Digging for food, creating shelter, and self-defense.
- Sea urchin: The sea urchin's toothed mouth, known as Aristotle's Lantern, is found on the center underside and is used for scraping and grabbing bits of algae.

5. Say the following:

> *Watching how animals interact and use grabbers opens up a world of possibilities for innovation, challenging us to think creatively about how we might engineer tools and create new inventions.*

? *What is your favorite animal that grabs, and how might it inspire you?*

✔ Spend no more than 2–3 minutes discussing the animals.

GUIDING QUESTIONS AND DISCUSSION

PRIMARY GUIDING QUESTIONS

- What surprised you about the way animals use grabbers?
- What is your favorite nature grabber?
- How might you make a grabber that helps you complete a different task? What would it do?

INTERMEDIATE GUIDING QUESTIONS

- How are the mini grabbers similar to animal claws and pincers?
- How might animal claws and pincers inspire new technologies or tools for human use?
- If you were to design a new grabber, what features would you incorporate, and what problem would your grabber solve?

PRIMARY DISCUSSION

Nature can offer many inspirations for solutions. Watching animals complete tasks by grabbing or gripping can spark inventive solutions in our everyday lives. Whether it's bird beaks, eagle talons, or the flexible trunks of elephants, animals have amazing grabbing mechanisms that might inspire us to create new innovations. By studying nature's grabbers, we can be inspired to think of solutions we have not yet considered.

INTERMEDIATE DISCUSSION

Biomechanics is the study of how mechanical principles are often inspired by nature. Take some animals, for instance, whose tendons function like springs, allowing animals to make precise grabbing movements like opening and closing their claws. Just as machines use springs to mimic this natural mechanism, observing nature can inspire us to invent new solutions. Studying nature's grabbers can inspire us to create new advancements in robotics where efficiency and flexibility can be very important.