GALILEO MAKERS: TOYS
CAMP GALILEO
2016 SUPERNova SCIENCE
(For rising 3rd-5th grade campers)

This curriculum was developed by Galileo Learning in collaboration with the Maker Education Initiative.

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About Galileo Learning

Galileo Learning (Galileo) creates and operates Innovation Camps for kids. Their mission is “to develop innovators who envision and create a better world” and this mission comes to life each summer at nearly 60 imagination-sparking locations (40 in the Bay Area, 15 in SoCal locations and 4 in Chicagoland.) They also train and employ more than 2100 educators and aspiring educators as summer staff. Galileo’s programs serve campers from pre-K through 8th grade.

In all of Galileo’s programs, the curricula focuses on helping campers (and staff) develop 21st Century skills and mindsets through understanding and applying the Galileo Innovation Approach (GIA). The GIA is inspired by the Stanford d.school’s design thinking process and mindsets and fine tuned for 5-14 year old campers who are especially open to absorbing new ways to think, explore and create. Click here for more information about Galileo Learning.
The Galileo Innovation Approach

The Galileo Innovation Approach (GIA) is our unique approach to teach and learning. It is designed to develop Galileo Innovators – campers and staff who imagine and create a better world. Galileo Innovators approach their work with an Innovator’s Mindset, do their work with an Innovator’s Process, and seek/leverage Innovator’s Knowledge.

Galileo Innovator’s Mindset
Galileo Innovators have dispositions that support breakthrough thinking and creative work. The Galileo Innovator’s Mindset has five elements:

BE VISIONARY
• I envision a better world.
• I imagine things that don’t yet exist.
• I believe that it is my place to turn ideas into reality.

BE COURAGEOUS
• I freely share my creative thoughts.
• I stretch myself to try new things.
• I embrace challenges.

BE COLLABORATIVE
• I value the unique perspectives of others.
• I build on the ideas of others.
• I use my strengths to support the work of others.

BE DETERMINED
• I persevere until I achieve my goal.
• I recognize setbacks as opportunities to learn.
• I know that innovation and mastery require effort.

BE REFLECTIVE
• I take time to think about what is and isn’t working in my design.
• I think about how my work impacts other people and the world.
• I seek feedback to improve myself and my work.
Galileo Innovator’s Process
Galileo Innovators learn and practice an iterative process to bring the best ideas to fruition. The following diagram illustrates the Galileo Innovator’s Process:

Galileo Innovator’s Knowledge
Galileo Innovators require subject-specific knowledge to creatively solve problems and make their visions a reality. Galileo Innovator’s Knowledge lies in the following four categories:

CONCEPTS AND FACTS
Galileo Innovators understand the big ideas, principles, and facts relevant to their work. Examples: Adding more tension to a rubber band creates a higher pitch when it’s plucked

HISTORICAL CONTEXT
Galileo Innovators understand the contributions, objectives, and processes of relevant movements, artists, scientists, designers, and other experts who came before them. Examples: Kandinsky uses a variety of brushstrokes and line types to represent music visually

SKILLS AND TECHNIQUES
Galileo Innovators understand how to use relevant materials, tools, and technology so they can effectively build, test, and share their ideas. Examples: Manipulating cardboard by cutting, curling, bending, folding, scoring, tabbing, and fastening; taping techniques; watercolor resist

AUDIENCE AND ENVIRONMENT
Galileo Innovators understand the needs, beliefs, and circumstances of their users and the physical context in which their work will be received. Examples: Engineers need to design buildings in a specific way when constructing in an earthquake prone area
Galileo Innovation Approach and the Curriculum

Our curriculum is designed to support you in teaching the Galileo Innovation Approach and nurturing Galileo Innovators. Below are some ways in which the curriculum fosters your development as an Innovation Educator.

First, you’ll find that the components of the GIA literally leap off the page.
• The GIA terms are emphasized throughout the curriculum in ALL CAPS to help you easily identify opportunities to integrate the GIA.
• An overview of the key Innovator’s Knowledge, Process, and Mindset for each lesson appears on the “Secret Sauce” page. This page clearly spells out the key ingredients that transform each project into an innovation-based Galileo lesson.

Second, the curriculum includes a daily Innovator’s Mindset Challenge. The Mindset Challenge helps campers focus on developing a different part of the Innovator’s Mindset each day and shows how practicing this element can help them develop as innovators. Detailed facilitation notes about how to introduce and support the Mindset Challenge are included as a core part of each lesson.

Third, each day concludes with a Lesson Wrap Up that provides a forum for you to go deep on innovation themes with campers. Prompts are provided to support project sharing, reviewing key Innovator’s Knowledge and debriefing the day’s Mindset Challenge. Use this time to help campers solidify what they learned, notice how practicing the mindset helped them with their project and recognize the innovator in themselves and in others. Familiarize yourself with the discussion questions before each lesson so you can best guide campers to develop as innovators throughout the rotation.

Additionally, these general practices can help you to bring the GIA to life:
• Think about what it means to you to be an Innovation Educator and find ways to realize that vision.
• Pace your class to allow time for campers to engage with each project, giving ample time for the TEST, EVALUATE and REDESIGN phase so that campers can thoughtfully evaluate how they can improve their designs, and then implement the modifications.
• Model the Mindset in your teaching. When you make a mistake, celebrate it! Tell the campers that your teaching or the project didn’t go as planned, and that you’ll learn from that and try it a different way in the next rotation.
• Help campers understand what it means to be a Galileo Innovator and strive to shape their self-images as such.
• Recognize campers as they exhibit the Innovator’s Mindset as relevant throughout the day—in addition to this focus during the Wrap Up. (E.g., I see that you’re BEING REFLECTIVE, thinking about what is and isn’t working with prosthetic hand design. That’s a great way to start developing an innovative solution!)
• Refer to the steps of the Innovator’s Process (and your Galileo Innovator’s Process Poster) as you describe the day’s activities and as campers work.

Finally, the curriculum supports your own innovations for how to integrate the GIA in your classroom. Please apply the Innovator’s Mindset and Process to this end and SHARE your learning with your colleagues!
Day 1: Pinball Machine, Part 1 of 5

Pinball machines are classic arcade games that have tons of room for creativity and hours of play. Today’s maker inspiration comes from Cardboard Teck Instantute and their DIY PinBox 3000.

Today: Building the Foundation
Campers focus on making the foundation for a pinball machine, which will set them up for more interesting components later in the week. The pinball machine must:

- Have two working flippers
- Not be wobbly

What’s Next
Tomorrow (Day 2) campers will add a plunger and custom bumpers. On Day 3 they will add an electronic element. Day 4 is dedicated to creating custom interactive elements, and Day 5 is focused on adding elements that give the pinball machine a unique theme.
Today’s Project: At-A-Glance

Assemble the cardboard pegboard box

The pegboard box will allow campers to easily rearrange their pinball components.

Cut out perforated holes for the flippers

Making a perforated hole first makes it easier to cut out with scissors.

Create two flippers with a rubber band reset

The flippers are automatically reset with rubber bands.

Glue legs onto the pinball machine

Short legs glued in in front to allow the pinball to roll down toward the flippers
Test by trying to hit the ball with the flippers

Marble dropped into the playing field and hit with flippers

Adjust the rubber bands or the height of the legs

A piece of cardboard added to the bottom of a leg to fix uneven legs

Rubber band being moved to adjust flipper tension
Teaching the Lesson: Overview

OUR SECRET SAUCE: THE G.I.A.

KNOWLEDGE FOCUS

SKILLS AND TECHNIQUES: Cardboard Cutting (Perforated Cutouts)
Campers learn how to use an awl to punch many holes into a piece of cardboard to create perforations, and then cut out the shape with scissors.

Why? – Cutting large holes into cardboard is challenging. This technique allows campers to cut holes of any shape and size into a piece of cardboard with relative ease. This technique will also be useful later in the week and for other future cardboard projects.

SKILLS AND TECHNIQUES: Hot Gluing Techniques (Globs vs. Lines)
Campers learn how to apply small globs of hot glue to attach the cardboard tubes to the pegboard box.

Why? – Campers’ tendency when gluing tubes is to apply a continuous line of glue around the edge, which often dries before they can stick the tube to the surface. Teaching campers how to use several globs instead of a thin line will prevent this problem and lead to sturdier supports for their pinball machines.

MINDSET FOCUS

BE DETERMINED – I know innovation and mastery require effort.
Campers work carefully during each part of today’s project and put in the time and effort necessary to ensure the box is solid, the flippers are built with precision, and the legs are attached evenly.

Why? – Campers may be tempted to rush through today’s steps in order to start playing with their machines and it may be hard for them to see the importance of precision at such an early stage of the project. Today’s Mindset helps ensure campers construct a machine that will set them up for success later in the week, and as they build on this foundation they’ll be able to reflect on the value of putting in their full effort on this first day.

Remember to include these special ingredients to transform today’s project into a Galileo, innovation-based lesson. Bam!
Lesson Breakdown & Camper Goals

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcome to Science</td>
<td>10 min</td>
</tr>
<tr>
<td>Introduction</td>
<td>5 min</td>
</tr>
<tr>
<td>Demo &amp; Discussion: How to Begin Building the Pinball Machine</td>
<td>15 min</td>
</tr>
<tr>
<td>- Demo how to assemble the cardboard pegboard box</td>
<td></td>
</tr>
<tr>
<td>- Discuss awl and hot glue safety</td>
<td></td>
</tr>
<tr>
<td>- Demo how to make a perforated cutout</td>
<td></td>
</tr>
<tr>
<td>- Demo how to make and install a flipper</td>
<td></td>
</tr>
<tr>
<td>- Demo how to attach the legs with globs of glue</td>
<td></td>
</tr>
<tr>
<td>Independent Work Time: Creating the Box, Flippers &amp; Legs</td>
<td>30 min</td>
</tr>
<tr>
<td>- Assemble the pegboard box</td>
<td></td>
</tr>
<tr>
<td>- Create a perforated cutout using an awl and scissors</td>
<td></td>
</tr>
<tr>
<td>- Create and attach a pair of flippers</td>
<td></td>
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<tr>
<td>- Attach four legs to the bottom of the pegboard box</td>
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</tr>
<tr>
<td>- Test the pinball machine by trying to hit a marble; the pinball machine must:</td>
<td></td>
</tr>
<tr>
<td>- Have two working flippers</td>
<td></td>
</tr>
<tr>
<td>- Not be wobbly</td>
<td></td>
</tr>
<tr>
<td>Clean Up</td>
<td>5 min</td>
</tr>
<tr>
<td>Wrap Up</td>
<td>5 min</td>
</tr>
</tbody>
</table>

Timing Notes
Campers are on track so long as everyone assembles the box and builds two flippers.

If campers or groups are behind
- It’s okay. They can finish tomorrow instead of making the bumpers. Also, Day 5 is a buffer day (Day 5 activities are not crucial to finishing the project), so campers won’t run into problems if some of the goals for today get pushed to the following day.

If campers or groups are ahead
- They can play with the pinball machine and/or experiment with different positions for the flippers.
# Teaching the Lesson: Play-by-Play

## Welcome to Science (10 min)

<table>
<thead>
<tr>
<th>Welcome campers, introduce the theme, and make a quick story connection</th>
<th>Ex: I hear ToyFest is coming up and Lucy and Finn have run into some trouble with their toy. Why don’t we inspire them to keep on making by doing some making ourselves? Let’s get the ball rolling by building some super-innovative toys!</th>
</tr>
</thead>
</table>
| Set expectations about the space and materials | Important to set clear expectations for the whole week. Go over daily procedures you’ll want campers to be familiar with; some ideas:  
  - What they do when they first come in  
  - What materials they can and can’t touch  
  - How they treat plastic (leave it on; don’t poke holes in it!)  
  - How they treat materials  
  Where they put finished projects |
| Set expectations about behavior in the classroom | Come up with agreements about  
  - How everyone can stay safe  
  - How campers can make sure they all have fun  
  Emphasize respecting you, other staff, and each other |
| Introduce the GIA | Introduce the idea of being an innovator  
  - Ex: We’ll be learning about science all week, and we’ll also be practicing being innovators. Being an innovator is a really important job. Innovators think of really great ideas and can make those ideas real!  
  Point out your Innovator’s Process poster and quickly intro the Process  
    - Don’t go over each step in detail now  
    - Ex: These are the steps that good innovators follow to help them make amazing creations. They come up with a lot of ideas, test them out, and redesign to make them better.  
  Point out your Innovator’s Mindset poster and intro the Mindset  
    - Again don’t go over each Mindset element in detail now  
    - Ex: This is how good innovators think and act. They try new ideas, they work together, and they don’t give up!  
  Ask campers if they’re ready to innovate! |

## Introduction (5 min)

| Introduce the idea of makers and making | Announce this week is all about makers  
  Makers are people who make things themselves  
    - There are all kinds of makers  
    - Game makers, tool makers, clothes makers, food makers, etc.  
  This week campers will be toy makers who make their own toys!  
  Makers know they don’t have to go to a toy store to get toys or be part of a big toy company; anyone can be a toy maker! |
Give context for today's project: Introduce pinball machines

Show Pinball Machines pp. 1-4 color copies

Explain the basic idea of how a pinball machine works
- Players launch a small ball into the playfield
- The playfield is on a slope, so the pinball always ends up rolling downward
- Flippers hit the ball back up into the playfield
- Try to score points by hitting targets with the pinball

Build excitement and give an overview of today's project

Announce creating their own pinball machine toys this whole week!

Today there are 3 things to construct:
- Pegboard box
- Flippers
- Legs

Will test machine by playing it once all components are constructed

Show campers your prepared pinball machine with flippers and legs
- Show how the flippers work
- Rubber bands reset flippers
- Flippers have a gap between them
- Legs give the playing field an angle and elevate the pinball machine

Tomorrow campers will add more cool features, and by the end of the week they’ll have an awesome DIY toy!

★ Introduce the Innovator’s Mindset: BE DETERMINED

Point to this on your Innovator’s Mindset poster

Define the Mindset element in the context of today’s lesson
- Today we’re going to focus on being determined – I know that innovation and mastery require effort. This means we’re going to build the foundational parts of our pinball machines carefully and to the best of our ability.

Introduce campers to makers who created their own version of today’s project

Show today’s Maker Connection color copy for inspiration

Read the maker information and quickly describe the project
Pick one of the Q&A’s and share it with campers now

- Explain these are things the makers wanted to share with campers to inspire them as they make toys all week
- If necessary rephrase or sum up in age-appropriate language
- You can read the other Q&A as campers work or if you have extra time later in the week

Have campers give a thumbs-up if they’re psyched to make their own toys like these makers!

Demo & Discussion

How to Begin Building the Pinball Machine (15 min)

★ Introduce the opportunity to practice BEING DETERMINED when assembling all parts of the pinball machine

Point out campers might be tempted to rush through certain steps

- These steps may not seem like the most exciting part
- May want to play as soon as possible
- Step might be tricky or time-consuming

Call out as an opportunity to choose:

- Not practicing determination – rushing to get to the end; not caring if things are falling off or not working ideally
- Practicing determination – working slowly and deliberately; making sure everything is built well; measuring, double-checking, adding extra reinforcement, etc.

Emphasize this is the foundation for the pinball machine, so being determined to build everything well will affect the project for the rest of the week

Encourage campers to think about what they can do to make sure each building step is done right

★ Support BEING DETERMINED as you demo how to assemble the cardboard pegboard box

First thing is assemble the pegboard box

- The pegboard holes will allow easy install/rearrangement of pinball components
- Taping or gluing components later in the week will not be necessary
Ask: How can you put in effort to make sure you’re doing a good job on this step?
- Make sure the corners are tight
- Make sure the box isn’t wobbly or uneven

Introduce the awl and discuss awl safety

Next step (making flipper cutouts) will involve using the awl
- Awl is a very pointy tool, not a toy!
  - Never put fingers directly behind the area being poked
  - Never point awl at anyone
- Always put awl back on a lunch tray; should not be left sitting around on the floor

★ Support BEING DETERMINED as you demo how to use the awl to create a perforated cutout

Show how to mark where the hole should go
- Use a 1.5 x 2" cardboard rectangle to mark the distance from the end of the box with a pen
  - Move the cardboard rectangle to the other side of the line, and then use it to trace a rectangle
Show how to use the awl to carefully create a perforated cutout

- Hold the box on its side and push the awl downward
- Reiterate you’re making sure your other hand is not where the awl is going to punch through
- Emphasize they’ll need to punch a lot of holes close together

Show how to use scissors to remove the cutout

- Open the scissors wide
- Insert each blade into a hole, then squeeze to cut through the perforations
- May need to add more holes if scissors can’t cut through cardboard
Inform they’ll repeat this for the other side; make sure second hole is lined up with first one

Ask: **How can you put in effort to make sure you’re doing a good job on this step?**
- Take time to create a lot perforated holes
- Measure carefully
- Double-check that the flipper cutouts are the same on both sides

**Introduce hot glue and hot glue safety**

Next step (making flippers) will involve using hot glue

Hot glue is great; easy to use and dries fast!
Can also be dangerous if they’re not careful

Instruct campers to avoid burns by:
- Keeping fingers away from the metal tip
- Applying glue to the larger surface, especially if the material they’re gluing on is tiny
- Not touching fresh glue; waiting 30 seconds before touching hot glue
- Waiting patiently for their turn; never grabbing the glue gun
- Always putting glue guns back in their glue gun home when done

Take care of burns by:
- Running the burn under cold water until it stops hurting
- Getting an ice pack from the office if it’s still hurting

**Support BEING DETERMINED as you show how to make a flipper**

Use the cardboard rectangle again to mark the craft stick
Hot glue a cube with holes onto the stick next to the line; should be on the side closest to the middle of the stick.

Call out specific ways campers can be determined while doing this step:
- Double-checking that the flippers are made symmetrically
- Double-checking that the cubes are attached securely; not wobbly

Demo how to install a flipper and attach a rubber band

Tape a rubber band somewhere near the middle or the end of the flipper
Use a fastener to attach the other end of the rubber band to the pegboard

Choose a spot for the flipper and install it with two fasteners: one for the cube and one for the rubber band

Call out rubber band needs to have just the right tension
- Can put the fastener in different places to change the tension
- Flippers should completely reset after being flipped up
- Don’t want it to stretch the band too tight or tape will pull off/flipper will be hard to use
- Give a heads-up they might need to adjust where rubber band is taped or fastened once they test

Tape down the fastener that is being used for the cube (Note: fasteners on other components added later in the week do not need to be taped unless specified)
Demo how to trace the cardboard tube legs at each corner of the box

Emphasize short legs go in front, long legs in back; ensures pinball will roll down toward the flippers

Place the tube against the bottom corner of the box and trace a circle

★ Support BEING DETERMINED as you demo how to use globs of hot glue to attach the legs

Emphasize using small globs of glue instead of lines
- Apply three or four small globs around the circle
- Globs of glue don’t dry out as fast as a thin line of glue; allows for more time to work
Attach the leg and hold in place until glue sets enough

Show how you can apply more glue around the outside of the leg once it’s on

Repeat for a second leg

No need to finish attaching legs if they understand after showing them twice

Ask: *How can you put in effort to make sure you’re doing a good job on this step?*

- Take time to hold the leg in place until the glue dries
- Trace and measure carefully; double-check that the legs are in the same place on both sides
- Add more glue/re-glue if the leg is still wobbly or in the wrong place
Support BEING DETERMINED as you review the building goals for the flippers and legs

At this point, they can test out their pinball machines!

Review criteria flippers should meet
- Should completely reset
- Should be symmetrical
- Should not be wobbly

Review criteria legs should meet
- Should be attached securely
- Should not be wobbly

Encourage being determined to adjust/redo/reinforce as necessary if they realize something is not ideal as the play

★ Ask campers to take on the Mindset Challenge: BE DETERMINED

Remind that as they work they might be tempted to rush through certain steps that might be hard or taking longer than they would like

Present challenge: *When this happens you have the choice to construct your pinball foundation in a mediocre way or use your powers of determination to build carefully and do the best job you can on every single step.*

Have campers say “I will be determined” if they accept your challenge
### Independent Work Time

#### Creating the Box, Flippers & Legs (30 min)

<table>
<thead>
<tr>
<th>What campers will do: Assemble the pegboard box, cut out perforated holes, build and install the flippers, and glue on the legs</th>
<th>CREATE (pegboard box)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREATE (flipper cutouts)</td>
<td></td>
</tr>
<tr>
<td>1. Assemble the pegboard box.</td>
<td>2. Use the 1.5 x 2&quot; cardboard rectangle to trace two flipper cutouts. Cutouts should be 2&quot; from the corner of the box.</td>
</tr>
<tr>
<td>3. Use an awl to punch a series of holes around the traced rectangle cutouts where the flippers will go.</td>
<td>CREATE (flippers)</td>
</tr>
<tr>
<td>4. Use the 1.5 x 2&quot; cardboard rectangle to trace a line onto two jumbo craft sticks. These will be the flippers.</td>
<td>5. Glue a cube with a hole onto the flipper next to the line, 2&quot; from the end of the flipper.</td>
</tr>
<tr>
<td>6. Tape a thin rubber band onto the flipper.</td>
<td>7. Install the flipper into the pinball machine by placing a fastener through the hole in the cube. Tape the underside of the fastener.</td>
</tr>
<tr>
<td>8. Use another fastener to attach the rubber band to the pegboard so it has some tension, but not too much.</td>
<td>CREATE (legs)</td>
</tr>
<tr>
<td>9. Trace and hot glue two 4&quot; cardboard tubes in the front corners of the underside of the pinball machine.</td>
<td>10. Trace and hot glue two 6&quot; tubes to the back corners of the underside of the pinball machine.</td>
</tr>
</tbody>
</table>

**TEST, EVALUATE & REDESIGN**

<table>
<thead>
<tr>
<th>TEST, EVALUATE &amp; REDESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Test by dropping a marble onto the playing field. Try to keep it from falling behind the flippers.</td>
</tr>
<tr>
<td>12. Adjust flippers or legs as necessary. Glue pieces of cardboard onto the bottoms of the legs to make slight adjustments to the height if necessary.</td>
</tr>
</tbody>
</table>

### Facilitate CREATE (pegboard box)

- If campers are having trouble assembling the box, you can hold the box together while they tuck in the flap
  - You can also pair up campers to help each other with this step; one person holds the box together while the other tucks

### Facilitate CREATE (flippers)

- **➢ Have TL focus on coaching campers who are not familiar with hot glue guns**
- Make sure campers are using the 1.5 x 2" cardboard guides as shown in the demo to measure:
  - The placement of the perforated cutout
  - Where to place the cube with holes
- Remind campers to hold the box on its side and push the awl downward
- Remind campers of how to place the scissors in holes for easiest cutting
<table>
<thead>
<tr>
<th>Facilitate CREATE (legs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make sure campers are taping down the fastener tabs that are holding the flippers in place; otherwise the flippers will come loose</td>
</tr>
<tr>
<td>Make sure campers are putting the short legs in front (where the flippers are)</td>
</tr>
<tr>
<td>Campers should use plenty of glue to secure the legs; they need to be stable</td>
</tr>
<tr>
<td>If the pinball machine is wobbly, campers can glue a cardboard scrap onto the bottom of the leg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facilitate TEST, EVALUATE &amp; REDESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand out marbles as campers are ready to test</td>
</tr>
<tr>
<td>Ask guiding questions that support test, evaluate, and redesign:</td>
</tr>
<tr>
<td>• Why do you think your flippers are not resetting?</td>
</tr>
<tr>
<td>• Why do you think your flippers are wobbly?</td>
</tr>
<tr>
<td>• How can you adjust the flippers so they work correctly?</td>
</tr>
<tr>
<td>• How can you make the whole pinball machine stable/not wobbly?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>★ Support BEING DETERMINED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emphasize campers don’t have to rush</td>
</tr>
<tr>
<td>• Can use time tomorrow to finish their pinball machines</td>
</tr>
<tr>
<td>• Better to build well than quickly</td>
</tr>
<tr>
<td>Remind campers working hastily about the value of putting in effort now</td>
</tr>
<tr>
<td>• Will set them up with a solid foundation; the next four days depend on having a good pinball machine foundation</td>
</tr>
<tr>
<td>• Having everything working well today will make the pinball machine more fun to play later on</td>
</tr>
<tr>
<td>Recognize determined campers; be specific about how they are being determined</td>
</tr>
<tr>
<td>• Ex: I noticed you’ve been super determined because you’re really building carefully and taking the time to make sure that every step is done well!</td>
</tr>
<tr>
<td>Ask guiding questions that support being determined:</td>
</tr>
<tr>
<td>• What do you notice about your flippers? Is there anything you can do to make them better?</td>
</tr>
<tr>
<td>• What do you notice about the stability of your pinball machine? Is there anything you can do to make it more stable?</td>
</tr>
<tr>
<td>• How can you put in extra effort on the step you’re doing right now?</td>
</tr>
</tbody>
</table>
## Clean Up (5 min)

**Clean Up**

- Make sure campers have their names on the pinball machines.
- You can stack the pinball machines in pairs as shown:
  - Avoid stacking more than two in this way; the legs of the bottommost one may break.
  - Try to put a sturdier one on the bottom.

---

## Lesson Wrap Up (5 min)

**★ Have campers share how they were DETERMINED and discuss the importance of BEING DETERMINED**

- Recognize everyone for taking the time to create a solid foundation for their pinball machines.
- Have campers give a thumbs-up if they practiced being determined by:
  - Working carefully and not rushing.
  - Putting in special effort to get their flippers to work or their machines to be stable.
- Have a few share how they put in special effort to get something working just right.
  - Others can give “me-too” signal if they had similar experience.
- Help camper see value of Mindset; ask:
  - *How did being determined make your pinball machine better?*
  - *Why do you think being able to be determined is important for innovators?*
  - *What other projects or activities do you do where it’s important to be determined?*

---

**Revisit today’s maker connection**

- Remind campers about the toy makers they learned about earlier.
- Ask: *Do you think these makers had to be visionary when making their toy? How?*
- If there’s a relevant Q&A read/revisit it now.
Lesson Materials

Copies
- copies, color, Pinball Machines pp. 1-4 (2 per classroom)
- copy, color, Maker Connection (2 per classroom)

General/Adhesives/Tools
- power strip, 6 outlets, for setting up glue guns (1 per 4 campers)
- extension cord, 25 ft., for setting up glue guns (1 per 4 campers)
- tape, blue, 2" wide, Uline, for taping extension cords to the floor (120" per 4 campers)
- glue gun, mini, low temp (1 per 2 campers)
- glue stick, melt, mini (1 per camper)
- tape, masking, 2" (40" per camper)
- scissors, medium, 5", pointed (1 per camper)
- pen, ballpoint, black (1 per 3 campers)
- awl, metal (1 per camper)
- tray, lunch, for holding awls (1 per 4 campers)

Required Materials
- box, cardboard, pegboard, 12" W x 18" L x 3" H (1 per camper and 1 per rotation)
- marble, asst. colors & sizes (3 per camper)
- cardboard, corrugated, 1.5 x 18", for measuring cutouts and cube placement (one 1.5 x 2" piece per camper, save rest of strip for tomorrow)

Pinball machine legs
- tube, cardboard, 1.5 x 4", toilet paper, for front legs (2 per camper)
- tube, cardboard, 1.5 x 6", for back legs (2 per camper)

Flippers
- craft stick, jumbo, 1 x 8" (2 per camper)
- cube, wood, 3/4", w/ 3/16" hole (2 per camper)
- rubber band, 3.5 x 1/16" (2 per camper)
- fastener, brass, 2 x 0.5" (4 per camper)

Materials Preparation

Assemble two pegboards and install a flipper in at least one of them. These will be used during your demo to show how the flipper works, how to build a flipper, and how to add the legs.

Cut 2" off of the end of a 1.5 x 18" cardboard strip (1 per camper). Save the leftover 16" strips. Don’t cut or throw away the leftover 16" strips. Campers will need them tomorrow.
Optional: Continue cutting 2" off of 18" strips so that each camper has two 16" strips for tomorrow. Even though they don’t need strips until tomorrow it’s most efficient to cut them all now while you have the cardboard out.

Advance Materials Preparation

Start prepping the wires for Day 3 (see details in the Day 3 prep). This prep is intensive and it’s recommended that you start now.

Setting Up the Space

Set at least 1 glue gun per 2 campers at each work table.
- Plug the glue guns into a power strip.
- Plug the power strip into an extension cord.
- Run the extension cord to the nearest outlet and plug it in.
- Tape the cords down with blue tape to prevent campers from tripping on them.
- Repeat at each work table.

Set up a materials station with all of the required materials. Label how many of each material campers must take.

Pinball Box and Marbles
- cardboard pegboard box (1 per camper)

Pinball Machine Legs
- tube, cardboard, 1.5 x 4", toilet paper (2 per camper)
- tube, cardboard, 1.5 x 6" (2 per camper)

Flippers
- craft stick, jumbo, 1 x 8" (2 per camper)
- cube, wood, 3/4", w/ 3/16" hole (2 per camper)
- rubber band, 3.5 x 1/16" (2 per camper)

Set aside marbles to be handed out as campers are ready to test.
Gather materials for the Demo & Discussion:
- Your assembled cardboard pegboard box with at least one flipper installed
- Materials to demo how to build and install a flipper
- Materials to demo how to attach the legs onto the pegboard box

Put up the following color copies on your copies display board:
- Pinball Machines pp. 1-4
- Maker Connection

**Morning Of Preparation**

Turn on the power strips to power the hot glue guns.

**On the Board**

**Design Challenge**
The pinball machine must:
- Have two working flippers
- Not be wobbly

**Mindset of the Day**
BE DETERMINED – I know that innovation and mastery require effort.

**Check In With Your TL**

➤ Make sure your TLs are clear about their role in helping today’s lesson run smoothly. Specific things your TL can help with today:
- Coach campers who need support with using hot glue
Today: Plunger and Bumpers
Campers create a plunger to launch the pinball into the playing field. They also add rubber band bumpers to the playing field. The bumpers must:
- Significantly change the pinball’s trajectory
- Make the game more fun
- Not trap the pinball

What’s Next
Tomorrow (Day 3) campers will create one or two electronic elements. Day 4 gives campers an opportunity to create visionary pinball elements, and Day 5 will be used to create a scoring system, rules, and decorations.
Today’s Project: At-A-Glance

Create and attach the elevated track

Create the plunger

Add a curved wall to the end of the track

Elevated cardboard track installed above the flipper

Plunger made out of a dowel, spring, and wooden wheels
Add and test one bumper

Bumper created by stretching rubber bands around spools and attaching spools with fasteners

It’s very easy to redesign the bumpers.

Continue to add and test bumpers one at a time

Focusing on one bumper at a time will ensure that the playing experience is fun and not cluttered with non-working designs.
Teaching the Lesson: Overview

OUR SECRET SAUCE: THE G.I.A.

KNOWLEDGE FOCUS

CONCEPTS AND FACTS: Angles and Trajectory
Campers understand how the angles of their pinball bumpers change the trajectory of the pinball.

Why? – In pinball, the purpose of the bumpers is to change the direction of the pinball upon contact. Campers need to know how the angle of a bumper will alter the pinball’s trajectory in order to have a bumper that interacts meaningfully with the ball.

PROCESS FOCUS

TEST AND EVALUATE: One Change at a Time
Campers focus on making and redesigning one bumper at a time and make sure it’s working before moving on to creating another one.

Why? – Campers will have a tendency to build all their bumpers first before testing them, which can result in a pileup of issues to troubleshoot. Testing one bumper at a time will enable campers to identify and address issues more easily and help ensure they don’t over-clutter their playing fields.

MINDSET FOCUS

BE REFLECTIVE – I take time to think about what is and isn’t working in my design.
Campers carefully observe what happens to the trajectory of the ball as they play and decide if and how they need to modify the bumper so that it changes the ball’s trajectory.

Why? – Campers may get caught up in the fun of testing today and not notice what’s happening as they play. They may also assume that a bumper is working as long as the ball hits it, even if the bumper isn’t actually causing the ball to bounce around more. Today’s Mindset Focus helps campers recognize opportunities for improvement and make adjustments to their bumpers that will lead to a more exciting gameplay experience.

Remember to include these special ingredients to transform today’s project into a Galileo, innovation-based lesson. Bam!
# Lesson Breakdown & Camper Goals

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td>5 min</td>
</tr>
<tr>
<td><strong>Demo &amp; Discussion: How to Build a Plunger and Bumpers</strong></td>
<td>15 min</td>
</tr>
<tr>
<td>□ Discuss what trajectory is</td>
<td></td>
</tr>
<tr>
<td>□ Demo how to build the plunger and elevated track</td>
<td></td>
</tr>
<tr>
<td>□ Demo how to build bumpers</td>
<td></td>
</tr>
<tr>
<td>□ Demo testing and evaluating one bumper at a time</td>
<td></td>
</tr>
<tr>
<td><strong>Independent Work Time: Build the Plunger and Bumpers</strong></td>
<td>35 min</td>
</tr>
<tr>
<td>□ Add the elevated track and plunger</td>
<td></td>
</tr>
<tr>
<td>□ Create, test, evaluate, and redesign bumpers; the bumpers must:</td>
<td></td>
</tr>
<tr>
<td>• Significantly change the pinball’s trajectory</td>
<td></td>
</tr>
<tr>
<td>• Make the game more fun</td>
<td></td>
</tr>
<tr>
<td>• Not trap the pinball</td>
<td></td>
</tr>
<tr>
<td><strong>Clean Up</strong></td>
<td>5 min</td>
</tr>
<tr>
<td><strong>Wrap Up</strong></td>
<td>10 min</td>
</tr>
</tbody>
</table>

## Timing Notes
Campers are on track so long as everyone builds a working plunger and has time to create, test, evaluate, and redesign at least one bumper.

If campers or groups are behind
- It’s okay. Campers will have an opportunity to add more gameplay features, like bumpers, on Day 4. Also, Day 5 is a buffer day (Day 5 activities are not crucial to finishing the project), so campers won’t run into problems if some of the goals for today get pushed to the following day.

If campers or groups are ahead
- Create as many bumpers as the materials limits will allow.
- Allow campers to try playing each other’s pinball machines.
### Introduction (5 min)

<table>
<thead>
<tr>
<th>Give context for today’s project: Introduce plungers and bumpers</th>
<th>Show the Pinball Machines pp. 1-4 color copies and point out the plungers and bumpers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build excitement and give an overview of today’s project</td>
<td>All modern pinball machines include</td>
</tr>
<tr>
<td></td>
<td>• A plunger to launch the ball into the playfield in an exciting way</td>
</tr>
<tr>
<td></td>
<td>• Bumpers to make the game more surprising and fun</td>
</tr>
</tbody>
</table>

### Build excitement and give an overview of today’s project

Announce getting to build a plunger that works exactly like the real thing!
Will also add their first elements to their pegboard playing area – bumpers!
• Pegboard makes it easy to add and move bumpers so they can tinker to get bumpers in just the right place
Review goals for bumpers
• Ball must change direction when it hits the bumper
• Bumpers must make the game more fun
• Pinball cannot get stuck on the playing field

### ★ Introduce the Innovator’s Mindset: BE REFLECTIVE

Point to this on your Innovator’s Mindset poster
Define the Mindset element in the context of today’s lesson
• *Today we’re going to focus on being reflective. This means that we’re going to take the time to notice whether or not the bumpers actually change the direction of the pinball, and if not, how we can redesign them so that they’re more fun and exciting.*

### Demo & Discussion

#### How to Build a Plunger and Bumpers (15 min)

<table>
<thead>
<tr>
<th>Introduce the concept of trajectory</th>
<th>Trajectory is the path followed by a moving object</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing the pinball’s trajectory makes the game more exciting; more fun if ball bounces in a lot of different directions</td>
<td></td>
</tr>
<tr>
<td>So far they have flippers to change the pinball’s trajectory</td>
<td></td>
</tr>
<tr>
<td>Elements they’re adding today (plunger and bumpers) will also change trajectory for more fun!</td>
<td></td>
</tr>
</tbody>
</table>
### Show how your example plunger works

- Make sure all campers can see your sample
- Point out elevated track that ball travels along when launched
- Show how spring compresses when plunger is pulled back and launches ball when released
- Explain trajectory (where ball starts to fall at top of box) can be changed based upon how much the plunger is drawn back

### Demo how to build the elevated track

- Continue to build on a pegboard box from yesterday’s demo
- Tape two 1.5 x 16” pieces of cardboard (prepped by you ahead of time) together to form the track
- Apply two globs of glue on one long edge of the track; remind about globs vs. lines
- Stick the track onto one side of the pinball machine above the flipper
  - Emphasize top of track should be level with the edge of the box; shouldn’t be a lot of space between the top of the flipper and the track
  - Emphasize holding the track in place until dry; can take some time
When dry, apply more glue to the long edge connected to the box.
Then glue the short edge of the track where it meets the box.

**Demo how to build the plunger**

Use an awl to poke a hole in the side of the box, in the center of the track.

Put a wheel onto a dowel:
- Note some wheels may be very loose or very tight.
- Loose wheels can be affixed by spreading hot glue onto the dowel before inserting it into the wheel.

Thread the dowel through the hole.
Put a spring onto the dowel, and cap it off with another wheel.
Test to ensure that the plunger’s action is snappy

Show how to add a curve to the end of the launch track

Explain a curved piece of foam changes the pinball’s trajectory
  • Helps launch pinball into the middle of the playing field
  • Without the curve, pinball will hit the back wall and roll directly downwards along the edge of the box

Tape one of the prepared 3 x 4.5" pieces of foam at the end of the track as shown

The foam piece can be cut to a different size

Demo how to create a 2-spool bumper (but position it so it won’t change the ball’s trajectory yet)

Now time to add actual elements to the playing area!

Secure a spool to the playing field with a fastener; fold the fastener tabs on the underside of the pegboard
  • Emphasize unlike yesterday they don’t have to tape fasteners
  • This will make it easy to change bumper design/placement

Repeat with one more spool

Loop a rubber band around both spools

Build your example so it’s right against the back wall of the pinball machine
<table>
<thead>
<tr>
<th>Support TESTING AND EVALUATING by discussing working on one bumper at a time until it meets all the goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will test bumpers by launching a ball and hitting it with the flippers!</td>
</tr>
<tr>
<td>Emphasize testing and evaluating one bumper at a time</td>
</tr>
<tr>
<td>• If bumper isn’t working (doesn’t meet one of the goals) they’ll redesign before adding another one</td>
</tr>
<tr>
<td>• Easier to try to fix one bumper at a time</td>
</tr>
<tr>
<td>• Ensures game stays fun as they add more and more bumpers</td>
</tr>
<tr>
<td>Review criteria they’ll evaluate bumpers according to; must</td>
</tr>
<tr>
<td>• Change the ball’s trajectory</td>
</tr>
<tr>
<td>• Make game more fun (too many bumpers or bumpers in certain places might be annoying)</td>
</tr>
<tr>
<td>• Not get the ball stuck in bumper (not fun!)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Introduce the opportunity to practice BEING REFLECTIVE before moving onto the next bumper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call out as an opportunity to choose:</td>
</tr>
<tr>
<td>• Not practicing being reflective – playing without really observing what’s happening to the ball; moving on to a new bumper even though the first one isn’t great</td>
</tr>
<tr>
<td>• Practicing being reflective – taking the time to notice how the bumper is working; thinking about if it can be adjusted to interact with the ball in a more fun/surprising/consistent way</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model testing and evaluating your bumper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test your bumper in front of the campers</td>
</tr>
<tr>
<td>• May need to play your pinball machine backwards or sideways so campers can see the playing field</td>
</tr>
<tr>
<td>• May also test your bumper by manually rolling the pinball into it</td>
</tr>
<tr>
<td>Notice your bumper is not really changing the trajectory of the ball</td>
</tr>
<tr>
<td>• If the bumper wasn’t there, the pinball would hit the back wall anyway</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discuss possible ways to redesign bumpers, and redesign your sample by adding a third spool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask: How can I redesign my bumper to change how the ball hits/bounces off of it?</td>
</tr>
<tr>
<td>If not suggested mention:</td>
</tr>
<tr>
<td>• Unfastening and moving one spool to change angle of bumper or tension of band</td>
</tr>
<tr>
<td>• Moving both spools to change location of bumper completely</td>
</tr>
<tr>
<td>• Adding a spool to change the shape of the bumper</td>
</tr>
<tr>
<td>Redesign yours by adding a third spool to create a triangle</td>
</tr>
</tbody>
</table>
Retest to see the ball is now deflected to the left or right; success!

★ Ask campers to take on the
Mindset Challenge: BE
REFLECTIVE

Present challenge: *As you test you have the choice to play without noticing how elements are affecting the ball or to use your powers of reflection to make sure each element is designed to maximize playability and fun!*  

Have campers give a thumbs-up if they accept your challenge

**Independent Work Time**

**Build the Plunger and Bumpers (35 min)**

<table>
<thead>
<tr>
<th>What campers will do: First build the plunger, and then build bumpers</th>
<th>CREATE (elevated track and plunger)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tape two 1.5 x 16&quot; cardboard strips together lengthwise at a right angle to create a straight track.</td>
<td></td>
</tr>
<tr>
<td>2. Choose a side of the pinball machine for the plunger. Glue the track above the flipper so that the top of the track lines up with the top of the box.</td>
<td></td>
</tr>
<tr>
<td>3. Use an awl to poke a hole for the plunger; the hole lines up with the center of the track.</td>
<td></td>
</tr>
<tr>
<td>4. Push a wooden wheel onto one end of the dowel.</td>
<td></td>
</tr>
<tr>
<td>5. Insert the other end of the dowel through the hole in the box and slide a spring and another wooden wheel onto the dowel.</td>
<td></td>
</tr>
<tr>
<td>6. Tape a curved piece of foam sheet at the end of the plunger track.</td>
<td></td>
</tr>
</tbody>
</table>

CREATE (bumpers)

| 7. Secure spools to the pegboard using fasteners and stretch rubber bands around the spools to create the first bumper. | |

TEST, EVALUATE & REDESIGN (bumpers)

| 8. Launch a ball into the playfield and try playing the pinball game to determine if the bumper is changing the pinball’s trajectory in a way that improves the gameplay experience. | |
| 9. Reposition the spools or change the rubber bands as necessary and test again. | |
| 10. Once it’s working, repeat to create more bumpers. | |
| Facilitate CREATE (elevated track and plunger) | Campers may forget to glue the short edge of the track to the box; remind them to do so  
Make sure campers are gluing tracks level with top of box  
• Many will have a tendency to glue it too high  
• Reassure it’s fine if there’s not much space between track and flipper  
Campers can build and attach the track using only tape if they want  
Campers may have difficulty fitting the wheels onto the dowel; help with this as necessary |
|---|---|
| Facilitate CREATE (bumpers) | Make sure campers are not using tape or glue for the bumpers  
• The whole purpose of the pegboard is to be able to easily redesign the game  
• This includes the underside of the pegboard; the bumper fasteners shouldn’t need to be taped down like the flippers |
| ★ Facilitate TEST, EVALUATE & REDESIGN and support BEING REFLECTIVE | Watch out for and redirect campers who are getting caught up in the fun of playing and forgetting to reflect  
Recognize reflective campers; be specific about how they are being reflective  
• Ex: I see that you noticed your ball was getting stuck a lot and now you’re making some changes to fix that. Way to be reflective!  
Ask guiding questions that support testing, evaluating, and being reflective:  
• What do you notice about how the bumpers change the pinball’s trajectory?  
• Tell me about whether or not the bumper improves the game. How can you redesign if it doesn’t?  
• What if you change the angle/position/shape/tension of the bumper?  
• Why do you think the pinball keeps getting stuck? |

### Clean Up (5 min)

| Clean Up | You can stack the pinball machines like yesterday  
Ask for a few campers to volunteer sharing their samples with the group during the Wrap Up |

### Lesson Wrap Up (10 min)

| ★ Have campers share how they were REFLECTIVE and discuss the importance of BEING REFLECTIVE | Recognize everyone for creating bumpers that made their pinball machines more fun and exciting!  
Have campers give a thumbs-up if they practiced being reflective by  
• Noticing something that wasn’t working and changing it  
• Thinking about what it was like to play their games as they tested  
• Thinking about what rubber band shapes and angles worked best for changing the trajectory of the ball  
Have a few share pinball machines by holding boxes up to the group  
• Have them share things they noticed/discovered that worked well |
• Have them share if there was an element they noticed wasn’t working well and how they redesigned it to make it better
• Recognize them for their careful evaluation and reflection

Help campers see value of Mindset; ask:
• How did being reflective make your pinball machine better?
• Why do you think being able to reflect is important for innovators?
• What other projects or activities do you do where it’s important to be reflective?

★ Invite campers to recognize each other for BEING REFLECTIVE

Can recognize teammates they saw being reflective or who helped them be more reflective

Encourage specificity about how person was reflective

You and TL can recognize campers as well
Get Ready!

Lesson Materials

Copies
- copies, color, Pinball Machines pp. 1-4 (2 per classroom)

General/Adhesives/Tools
- glue gun, mini, low temp (1 per 2 campers)
- glue stick, melt, mini (1 per camper)
- tape, masking, 1" (16" per camper)
- scissors, medium, 5" (1 per camper)
- awl, metal, for poking hole for plunger (1 per camper)

Required Materials
Plunger and track
- cardboard, corrugated, 1.5 x 18", for elevated track (two 1.5 x 16" strips per camper, one should have been saved from yesterday)
- spring, conical, compression, ¾ x 5/16 x2" (1 per camper)
- wheel, wood, treaded, 0.25" center, 1.25 x 0.5" (2 per camper)
- dowel, wood, 0.25 x 4" (1 per camper)
- foam sheet, asst. colors, 6 x 9", for curve at end of track (one 3 x 4.5" piece per camper)

Camper Choice Materials
(Campers will choose some of these materials, but not all of them. You have not been supplied with enough choice materials for every camper to use each option. Choice materials are supplied for variety under the assumption that not every camper will choose every material.)

Bumper materials
- spool, wood, asst. sizes & colors (10 per camper)
- rubber band, asst. sizes & colors (6 per camper)
- fastener, brass, 2 x 0.5" (10 per camper)

Materials Preparation
Cut foam sheets in quarters to make 3 x 4.5" pieces (1 piece per camper).

You should have one 1.5 x 16" cardboard strip per camper saved from yesterday. Each camper will need two 1.5 x 16" strips today. So if you haven’t already, cut 2" off additional 1.5 x 18" pieces so each camper has another 1.5 x 16" strip.

Advance Materials Preparation
Start prepping the wires for Day 3 (see details in the Day 3 prep). This prep is intensive and it’s recommended that you start now.
## Setting Up the Space

Set up a materials station with all of the bumper materials. Label how many of each material campers are able to take.

- spool, wood, asst. sizes & colors (10 per camper)
- rubber band, asst. sizes & colors (6 per camper)
- fastener, brass, 2 x 0.5" (10 per camper)

Set up a materials station with all of the plunger and track materials. Label how many of each material campers are able to take.

- cardboard, corrugated, cut into 1.5 x 16" strips (2 strips per camper)
- spring, conical, compression, ¾ x 5/16 x 2" (1 per camper)
- wheel, wood, treaded, 0.25" center, 1.25 x 0.5" (2 per camper)
- dowel, wood, 0.25 x 4" (1 per camper)
- foam sheet, asst. colors, cut into 3 x 4.5" pieces (1 piece per camper)

Gather materials for the Demo & Discussion:

- the pegboard boxes that you made during your demos yesterday
- enough materials to create a track, plunger, and bumpers for each rotation

## Morning Of Preparation

Plug in the glue guns.

## On the Board

**Design Challenge**

The bumpers must:

- Significantly change the pinball’s trajectory
- Make the game more fun
- Not trap the pinball

**Mindset of the Day**

BE REFLECTIVE – I take time to think about what is and isn’t working in my design.

## Check In With Your TL

➤ Make sure your TLs are clear about their role in helping today’s lesson run smoothly. Specific things your TL can help with today:

- Help campers fit wheels onto dowels
Day 3: Pinball Machine, Part 3 of 5

Today: Light-Up Targets and Motorized Spinners
Campers choose to create one or two electronic elements for their pinball machines by following a series of visual directions. The electronic elements must work reliably.

What’s Next
Tomorrow (Day 4) is dedicated to creating custom interactive elements. Day 5 is focused on adding a scoring system and giving the pinball machine a theme.
Today’s Project: At-A-Glance

Option 1: Create a light-up target

A wire is taped to a magnet on one side of the paper; when the pinball hits the target the magnet and wire stick to the battery on the other side of the paper; completes the circuit to turn on the LED
Option 2: Create a motorized spinner

Motorized spinner that spins when the button is pushed; ball gets trapped by bumper next to spinner; turning spinner on pushes the ball back into play
Teaching the Lesson: Overview

OUR SECRET SAUCE: THE G.I.A.

KNOWLEDGE FOCUS

SKILLS AND TECHNIQUES: Following Visual Directions
Campers practice using a step-by-step pictorial to create the electronic elements for their pinball machines.

Why? – Following visual directions is a great way to learn how to create something for the first time and many great maker resources (MAKE magazine, YouTube, Instructables) present content in this way. Having campers practice following visual directions will enable them to work independently today and will give them the skills to continue to be self-directed learners in the future.

SKILLS AND TECHNIQUES: Wire Twisting
Campers learn a specific technique to easily and tightly twist two wires together.

Why? – The wires will probably disconnect at some point if they’re not twisted tightly together. Showing campers the proper technique for connecting the wires will prevent disconnections and allow campers to focus on more meaningful parts of the project.

PROCESS FOCUS

TEST AND EVALUATE: Test in Stages
Campers test the electronic element in three stages before moving on to the next step. Test and evaluate steps are explicitly called out in each set of visual directions.

Why? – Electronics can be difficult for campers to troubleshoot. Incrementally testing the circuit and other components will help campers to isolate problems earlier, making them easier to fix. Explicitly calling out when campers should test and evaluate in the visual directions will help ensure campers don’t skip these steps today and help them build good troubleshooting habits that they can apply in the future.

MINDSET FOCUS

BE DETERMINED – I persevere until I achieve my goal.
Campers stay committed to getting their electronic elements to work as consistently as possible and in just the way they want.

Why? – While testing in stages will address some of the major issues, it will take continued tinkering to get the spinner and light working just right. Yet, campers are likely to settle for a less-than-ideal design as long as the component works sometimes. Today’s Mindset helps campers recognize and act on opportunities to take their components to the next level of refinement, leading to a more reliably gratifying playing experience.

Remember to include these special ingredients to transform today’s project into a Galileo, innovation-based lesson. Bam!
# Lesson Breakdown & Camper Goals

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td>5 min</td>
</tr>
<tr>
<td><strong>Demo &amp; Discussion: Electronic Element Options</strong></td>
<td>10 min</td>
</tr>
<tr>
<td>□ Demo how to make the light-up target using the visual directions</td>
<td></td>
</tr>
<tr>
<td>□ Discuss testing the light in stages</td>
<td></td>
</tr>
<tr>
<td>□ Demo how to make the motorized spinner using the visual directions</td>
<td></td>
</tr>
<tr>
<td>□ Discuss testing the spinner in stages</td>
<td></td>
</tr>
<tr>
<td><strong>Independent Work Time: Creating Light-Up Targets and/or Spinners</strong></td>
<td>40 min</td>
</tr>
<tr>
<td>□ Use the visual directions to create the light or the spinner</td>
<td></td>
</tr>
<tr>
<td>□ Test the electronic element in stages to check if it’s working before moving on to the next step</td>
<td></td>
</tr>
<tr>
<td>□ Make adjustments until it’s working just right and consistently</td>
<td></td>
</tr>
<tr>
<td>□ Create the other electronic element that hasn’t been made yet</td>
<td></td>
</tr>
<tr>
<td><strong>Clean Up</strong></td>
<td>5 min</td>
</tr>
<tr>
<td><strong>Wrap Up</strong></td>
<td>10 min</td>
</tr>
</tbody>
</table>

## Timing Notes
Campers are on track so long as everyone has gotten at least halfway done with one electronic component.

If campers or groups are behind

- Campers can finish the first or second electronic element tomorrow. Day 5 is a buffer day (Day 5 activities are not crucial to finishing the project), so campers won’t run into problems if some of the goals for today get pushed to the following day.
- If the whole group is behind from yesterday, set the expectation that everyone should finish anything that’s unfinished first and focus on creating just one electronic element.

If campers or groups are ahead

- They can play with the pinball machine and experiment with different positions for the light-up target if they’ve made one.
# Teaching the Lesson: Play-by-Play

## Introduction (5 min)

| Welcome campers and make a quick story connection | Ex: How are Lucy, Finn and the makers doing with their Super Duper Toy? (Pretty well, but Mr. Evile is trying to keep them from winning at ToyFest.) Do you think they could use some motivation to keep on making? Let’s show them how it’s done by doing some great work on our toys today. Our innovative ideas might even inspire their designs! |
| Build excitement and give an overview of today’s project | Show the Pinball Machines pp. 1-4 color copies |
| • Pinball machines have lights and moving parts to add excitement and fun | • Pinball machines have lights and moving parts to add excitement and fun |
| • Point out some of the electronic elements | • Point out some of the electronic elements |
| Announce today campers get to add their own electronic elements! | • Options are a light-up target and a motorized spinner |
| • Options are a light-up target and a motorized spinner | • Can have both if there’s time |
| Will use a step-by-step pictorial to guide them | Will use a step-by-step pictorial to guide them |
| • Makers often use instructions created by fellow makers to get started on a new project | • Makers often use instructions created by fellow makers to get started on a new project |
| • A good way to learn the basics so you can build and innovate on them! | • A good way to learn the basics so you can build and innovate on them! |

★ **Introduce the Innovator’s Mindset: BE DETERMINED**

| Point to this on your Innovator’s Mindset poster | Define the Mindset element in the context of today’s lesson |
| • Today we’re going to focus on being determined – I persevere until I achieve my goal. This means that we’re going to stay committed to getting our electronic elements to work just right. Even if they’re kind of working, that’s not good enough for us! We’re going to practice being determined until they’re perfect! |

## Demo & Discussion

### Electronic Element Options (10 min)

| Show and explain how your sample light-up target works (prepped ahead of time) | Make this short and sweet |
| Make this short and sweet | • Just explain how it works/point out main components |
| • Don’t explain how to do each step; will have visual directions for this |
| Point out LED has two leads (metal pins) | For LED to turn on a complete circle/circuit needs to be made |
| For LED to turn on a complete circle/circuit needs to be made | • One lead needs to connect to one side of the battery |
| • Other lead needs to connect to other side of the battery |  |
Describe the battery side of the target
- Wire taped to one side of the battery connects to one LED lead
- Battery with wire is hot glued to one side of folded cardstock

Describe the magnet side of the target
- Wire wrapped around magnet connects to the other LED lead
- Magnet with wire is hot glued to the other side of the folded cardstock
- Magnet wire not yet connected to other side of the battery; circuit isn’t complete

Folded cardstock attached to playing field with craft stick; magnet side can swing back and forth

When ball hits the cardstock the magnet wire sticks to the other side of the battery; now both wires are connected to the battery so light turns on!

Show and explain how your sample motorized spinner works (prepped ahead of time)

Circuit is created by attaching motor to a battery pack and on/off button
Motor installed in playing field with blocks and fasteners
Bumper installed next to spinner to trap ball

When ball is caught by bumper, spinner can be turned on to knock ball back into play!

Show campers how to twist wires together using two pipe cleaners

Campers will need to twist wires for both electronic elements
Show the technique for securely twisting two wires
• Pinch the pipe cleaners with one hand to form an X shape
• Use the other hand to twist the pipe cleaners around each other
• Bend the twisted wire in half; this helps prevent the wire from coming undone

Show how to build the light-up target using the Light Up Target color copy

Hold up the Light Up Target copy so all campers can see; individual steps shown below for your reference
Walk through how to create the light by referring to the pictures and text
- Don’t go into too much detail
- Goal of these directions is to allow campers to make it on their own without having to watch a long demo

For the following steps refer to your physical sample as you review them
- Step 2: wrapping the wire around the magnet
- Steps 3 & 4: making a hole in the paper and threading the wires through
- Step 4: making sure the magnet and battery line up

Support TEST AND EVALUATE by highlighting testing and evaluating the light in stages

Point out that some steps call out testing and evaluating
- Should stop doing this before moving on when they get to these steps
- Easier to fix issues as they come up, especially with electronics
- Waiting until the end can result in a pileup of problems that are harder to figure out when they’re mixed together

Go over key things campers should stop to test and evaluate before moving on
- Magnet and battery line up
- Wire touches battery when cardstock is pressed together
- Wires are twisted onto LED well

★ Introduce the opportunity to practice BEING DETERMINED when tinkering with the light

Emphasize goal is for light to turn on and stay lit consistently

Inform that the light will most likely need some fine-tuning to get there
- Might turn on sometimes but not consistently
- Might stop turning on altogether after a while
- Magnet might not attach/paper might not move when hit by ball
- Might be impossible/too hard for ball to hit the target

Call out as an opportunity to choose:
- Not practicing being determined – leaving it as-is since it’s kind of working; not caring if it only works half the time
- Practicing being determined – rechecking/re-taping connections; adjusting placement so ball can hit target; cutting the paper if battery and magnet aren’t lined up with the bottom

Show how to build the spinner using the Motorized Spinner color copies

Hold up the Motorized Spinner copies so all campers can see; individual steps shown below for your reference
Walk through how to create the spinner by referring to the pictures and text

- Don’t go into too much detail

For the following steps refer to your physical sample as you review them

- Step 6: mounting the motor to the underside of the pegboard
- Step 10: creating a bumper that holds the ball next to the spinner

Call out spinner also has specific places to test and evaluate before moving on

Go over key things campers should stop to test and evaluate before moving on

- Make sure wires are twisted together securely
- Make sure the motor spins
- Make sure tops of cubes are lined up with the top of the motor

Emphasize goal is to have spinner turn freely and to have the pinball get caught next to it

Spinner and bumper will most likely need some fine-tuning to get there

- Might not turn very well, or not at all
- Might not catch the ball ever, or only rarely
- Spinner might get stuck on the bumper

Call out as an opportunity to choose:

- Not practicing being determined – leaving it as-is since it’s kind of working; not caring if it works poorly or rarely
- Practicing being determined – adjusting the bumper, checking/readjusting wire connections; enlarging the hole in the pegboard so the spinner turns freely

Remind that as they work their electronic elements might not work perfectly at first

Present challenge: When this happens you have the choice to leave it as it is even if it’s not really working, or use your powers of determination to keep improving your design until it’s reliable and fun!

Have campers flex their biceps if they accept your challenge
Independent Work Time
Creating Light-Up Targets and/or Spinners (40 min)

<table>
<thead>
<tr>
<th>What campers will do: Choose one of the electronic elements and create it according to the visual directions</th>
<th>CREATE, TEST &amp; EVALUATE (light)</th>
</tr>
</thead>
</table>
| 1. Reference the visual directions to create the light if the camper is choosing to make this component.  
  • Tape a wire to the magnet and battery.  
  • Fold cardstock and make a hole in it.  
  • Glue the magnet and the battery to the cardstock.  
  • Test the LED and connect it.  
  • Install it into the pinball machine. | 2. Test the light at each interval according to the directions. |
| CREATE, TEST & EVALUATE (spinner) |
| 3. Reference the visual directions to create the spinner if the camper is choosing to make this component.  
  • Connect and twist the wires of the motor, battery pack, and switch.  
  • Glue cubes to the motor.  
  • Mount the motor. | 4. Test the spinner at each interval according to the directions. |
| REDESIGN |
| 5. Fine-tune and adjust components until they’re working reliably. |

Extension
Create the other electronic element (can carry over into tomorrow or Day 5).

Facilitate CREATE
Redirect questions to the visual directions as much as possible

- The visual directions are designed to offload most of the campers’ questions from you
- Gives you more time to troubleshoot and support the GIA

Make sure the visual directions are displayed as clearly as possible (see prep: Setting Up the Space)

➤ Have TL help campers understand the visual directions if they’re confused about a particular step

Facilitate TEST AND EVALUATE
Remind campers not to skip the test and evaluate steps; reiterate this is a key practice all good electrical engineers practice

Have campers show you how something works if they’re not stopping to test

Facilitate REDESIGN
Possible redesigns you can suggest for the light:

- Trimming the paper so it doesn’t drag against the pegboard
- Re-creasing the paper so it requires less force to fold
- Realigning the position of the magnet or battery

Possible redesigns you can suggest for the spinner:

- Adjusting the bumper position
- Enlarging the hole for the propeller
Support BEING DETERMINED

Share successful redesigns you see (especially ones not mentioned during the discussion) to encourage other campers to keep improving.

Recognize determined campers; be specific about how they are being determined.

- Ex: I see that even though your light turns on sometimes, you’re trimming the paper to make sure it works every time! Way to be determined!

Ask guiding questions that support being determined:

- What could be better about your spinner/light?
- How might you make that happen?
- What if you try (suggest redesign option from above)?

Clean Up (5 min)

Clean Up

You can continue to stack the pinball machines like the previous days.

Ask a few campers to volunteer to share their pinball machines during the Wrap Up; don’t put these away.

Lesson Wrap Up (10 min)

★ Have campers share how they were DETERMINED and discuss the importance of BEING DETERMINED

Recognize everyone for being super determined and getting their electronic elements to work reliably.

Have campers flex their muscles if they had to practice being determined to get their lights or spinners to work reliably.

Have a few share their pinball machines and talk about how they had to be determined to get them working reliably; ask prompts like:

- What wasn’t working/working as well as it could?
- What did you have to do it to work? How did you make your component better?

Others can give “me-too” signal if they had similar experience.

Help campers see value of Mindset; ask:

- How did being determined make your electronic elements better?
- Why do you think being able to be determined is important for innovators?
- What other projects or activities do you do where it’s important to be determined?

★ Invite campers to recognize each other for BEING DETERMINED

Can recognize teammates they saw being determined or who helped them be more determined.

Encourage specificity about how person was determined.

You and TL can recognize campers as well.
Lesson Materials

*(starred) materials appear multiple times in this list

Copies
- copies, color, Pinball Machines pp. 1-4 (2 per classroom)
- visual directions, Light Up Target (2 per classroom)
- visual directions, Motorized Spinner (2 per classroom)

General/Adhesives/Tools
- glue gun, mini, low temp (1 per 2 campers)
- glue stick, melt, mini (2 per camper)
- tape, masking, 1" (40" per camper)
- scissors, medium, 5", pointed (1 per camper)
- awl, metal, (1 per camper)

Required Materials
Light-up target
- battery, coin cell, 20 mm, 3V (1 per camper)
- wire, red, 5", pre-stripped (1 per camper)
- wire, black, 5", pre-stripped (1 per camper)
- cardstock, asst. colors, 2 x 6" (1 per camper)
- magnet, round, small, 0.5" dia x 0.25" thick (1 per camper)
- craft sticks, mini, asst. colors, 3" (1 per camper)

Motorized spinner
- motor, 3V, high torque, low rpm, w/ leads (1 per camper)
- propeller, 3-blade, flat (1 per camper)
- cardboard, corrugated, circle, 3" (1 per camper)
- holder, battery, 2 AA, w/ leads (1 per camper)
- battery, AA (2 per camper)
- switch, pushbutton, momentary, w/ wire leads (1 per camper)
- cube, wood, 3/4", w/ 3/16" hole (2 per camper)
- fastener, brass, 2 x 0.5" (2 per camper)
- spool, wood, asst. sizes & colors (3 per camper)
- rubber band, asst. colors, 7 x 1/8" (2 per camper)
- golf tee, wood, asst. colors (2 per camper)

Camper Choice Materials
(Campers will choose some of these materials, but not all of them. You have not been supplied with enough choice materials for every camper to use each option. Choice materials are supplied for variety under the assumption that not every camper will choose every material.)
- LED, green, 5 mm, for Light Up Target, campers choose one color (1 per camper)
- LED, red, 5 mm, for Light Up Target, campers choose one color (1 per camper)
Materials Preparation

NOTE: Before using the wire strippers, make sure you have read the instructions found in Using Self-Adjusting Wire Strippers in the Notes section below.

_strip the ends of wires for all electrical components. Wires should be stripped at each end so that there is about 0.5" to 0.75" of exposed wire. Be sure to watch the video on Telescope: Automatic Wire Strippers.

Create a light-up target and add it to your example pinball machine.

Create a motorized spinner and add it to your example pinball machine.

Setting Up the Space

Set up the visual direction posters Motorized Spinner and Light Up Target.

• Place the visual directions posters on opposite sides of your classroom.

Ensure that campers can see the posters from any seat in the room.

Set up a materials station with all of the materials for the light-up target. Set batteries aside for LI and TL access only.

• battery, coin cell, 20mm, 3V (1 per camper)
• wire, 5", pre-stripped, red (1 per camper)
• wire, 5", pre-stripped, black (1 per camper)
• cardstock, asst. colors, 2 x 6" (1 per camper)
• magnet, round, small, 0.5" dia x 0.25" thick (1 per camper)
• craft sticks, mini, asst. colors, 3" (1 per camper)
• LED, green, 5 mm, for Light Up Target, campers choose one color (1 per camper)
• LED, red, 5 mm, for Light Up Target, campers choose one color (1 per camper)
Set up a materials station with all of the choice materials for the **motorized spinner**. Set batteries aside for LI and TL access only.

- motor, 3V, high torque, low rpm, w/ leads (1 per camper)
- propeller, 3-blade, flat (1 per camper)
- cardboard, corrugated, circle, 3" (1 per camper)
- holder, battery, 2 AA, w/ leads (1 per camper)
- battery, AA (2 per camper)
- switch, pushbutton, momentary, w/ wire leads (1 per camper)
- cube, wood, 3/4", w/ 3/16" hole (2 per camper)
- fastener, brass, 2 x 0.5" (2 per camper)
- spool, wood, asst. sizes & colors (3 per camper)
- rubber band, asst. colors, 7 x 1/8" (2 per camper)
- golf tee, wood, asst. colors (2 per camper)

Gather materials for the Demo & Discussion:
- Visual directions for both the light-up target and the motorized spinner
- Your example pinball machine that has both electronic elements

### Morning Of Preparation

Plug in the glue guns.

### Notes

**Materials Management**
Make a clear distinction between the materials for each electronic element.

### On the Board

**Design Challenge**
The electronic elements must work reliably.

**Mindset of the Day**
BE DETERMINED – I persevere until I achieve my goal.

### Check In With Your TL

- Make sure your TLs are clear about their role in helping today’s lesson run smoothly. Specific things your TL can help with today:
  - Clarify steps in the visual directions for campers
Today: Creating Special Elements
Campers design unique elements such as targets, ramps, multi-ball mechanisms, and drains. They take a break to play each other’s machines and then keep working. Campers must:

- Incorporate at least one new idea into their own pinball machines during the second Work Time

What’s Next
Tomorrow (Day 5) campers focus on making a scoring system, inventing rules for how to win, and giving the pinball machine a theme.
Today’s Project: At-A-Glance

Create special elements

Example of a spinning target created with a hinge, paper ramps, and a multi-ball holder created from paper (balls pushed out when holder is hit)
Play each other’s pinball machines

Campers experience each other’s ideas for special elements firsthand

Integrate ideas sparked by sharing

Example of building off the idea of a spinner by creating a spinning target that also uses a hinge but spins on a different axis
Teaching the Lesson: Overview

OUR SECRET SAUCE: THE G.I.A.

PROCESS FOCUS

GENERATE IDEAS: Starter Ideas and Project Share
Before starting campers observe simple pinball structures and discuss how to build off these basic ideas to invent new elements. Midway through Work Time, campers stop and play each other’s pinball machines to gain more new ideas for special elements.

Why? – It’s totally up to campers what pinball elements to create today and there are tons of possibilities. Yet, campers may not have a clear idea of where to start or may not recognize how far they can go with just a few basic elements. Today’s Process Focus helps campers gather a wealth of ideas to draw from, leading to richer designs and engagement in today’s more self-directed Work Time.

MINDSET FOCUS

BE COLLABORATIVE – I build on the ideas of others.
Campers actively draw inspiration from the ideas discussed and shared by others and think about ways to incorporate good ideas into their own work.

Why? – Campers don’t always stop to notice other people’s great ideas when working on individual projects and they don’t always recognize how someone else’s idea can push their own work forward. Today’s Mindset Focus highlights the benefit of looking beyond one’s own project for inspiration and helps ensure campers get the most out of the group brainstorm and project share.

Remember to include these special ingredients to transform today’s project into a Galileo, innovation-based lesson. Bam!
# Lesson Breakdown & Camper Goals

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<tr>
<td><strong>Demo &amp; Discussion: Special Pinball Elements</strong></td>
<td>10 min</td>
</tr>
<tr>
<td>- Show and discuss Real Pinball Special Elements pp. 1-3</td>
<td></td>
</tr>
<tr>
<td>- Show and discuss Basic Pinball Mechanism Ideas I-V</td>
<td></td>
</tr>
<tr>
<td>- Brainstorm how to incorporate ideas into the pinball machine</td>
<td></td>
</tr>
<tr>
<td><strong>Independent Work Time: Creating Special Elements</strong></td>
<td>20 min</td>
</tr>
<tr>
<td>- Create special elements that enhance the pinball machine’s gameplay</td>
<td></td>
</tr>
<tr>
<td><strong>Guided Activity: Project Share</strong></td>
<td>10 min</td>
</tr>
<tr>
<td>- Facilitate playing another camper’s pinball machine</td>
<td></td>
</tr>
<tr>
<td>- Help campers notice what special elements it has and think about what ideas it inspires</td>
<td></td>
</tr>
<tr>
<td>- Facilitate repeating with a different pinball machine</td>
<td></td>
</tr>
<tr>
<td>- Facilitate deciding on at least one idea to incorporate in some way</td>
<td></td>
</tr>
<tr>
<td><strong>Independent Work Time: Incorporating New Ideas</strong></td>
<td>15 min</td>
</tr>
<tr>
<td>- Continue creating/refining special elements</td>
<td></td>
</tr>
<tr>
<td><strong>Clean Up</strong></td>
<td>5 min</td>
</tr>
<tr>
<td><strong>Wrap Up</strong></td>
<td>5 min</td>
</tr>
</tbody>
</table>

## Timing Notes

Campers are on track so long as everyone has finished yesterday’s goal of creating a working electronic component and started to create some simple unique components.

If campers or groups are behind:
- It’s okay. Day 5 is a buffer day (Day 5 activities are not crucial to finishing the project), so campers won’t run into problems if some of the goals for today get pushed to the following day.
- You can also have campers play with just one pinball machine during the group share instead of two.

If campers or groups are ahead:
- Extend the group share to include three pinball machine shares instead of two.
# Teaching the Lesson: Play-by-Play

## Introduction (5 min)

| Build excitement and give an overview of today’s project | Announce getting to create their own special elements today that make game more fun/exciting  
- Can include fun actions (spinning, knocking things down, etc.)  
- Can include making the ball do special things  
Will be added to the pegboard using fasteners or golf tees so it’s easy to adjust them (no tape or hot glue)  
Outline the structure of today’s lesson  
- Will see lots of examples of special elements to get inspiration  
- Will build and test special elements for 20 minutes  
- Then everyone gets to play each other’s machines to get more ideas!  
- Will keep building, finding a way to incorporate new ideas sparked |
| --- | --- |
| ★ Introduce the Innovator’s Mindset: BE COLLABORATIVE | Point to this on your Innovator’s Mindset poster  
Define the Mindset element in the context of today’s lesson  
- *Today we’re going to focus on being collaborative. This means that even though we’re all working on our own machines, we’re going to be on the lookout for good ideas other people are trying. Then we’re going to think about how we can build on those ideas to make our own projects even better!* |

## Demo & Discussion

### Special Pinball Elements (10 min)

<table>
<thead>
<tr>
<th>Show examples of real pinball targets, ramps, and other features</th>
<th>Show Real Pinball Special Elements pp. 1-3 color copies</th>
</tr>
</thead>
</table>
| | Read the captions to identify some elements  
- Targets that fall over when hit  
- Ramps that lead the ball to special places  
- Target/ramp that causes pinball to disappear and reappear somewhere else  
- Element that releases extra balls into the playing field |
| Show today’s available materials for building components | Real pinball elements are good inspiration, but they’ll need to figure out how to make elements using available materials  
Component materials  
- cardstock  
- mini craft sticks  
- wooden dowels |
• skewers
• straws
• spools
• pipe cleaners
• rubber bands
• foam shapes
• bells
• raspberry basket
• paper cups

Emphasize that any elements they think of need be able to be attached to the pegboard with a fastener or golf tee so they can be repositioned easily.

**Demo how to cut woodcraft using the cutting part of the wire strippers**

Place the material in the cutting part of the wire strippers and cut.

**Explain how to create a basic hinge**

Point out hinge on [Basic Pinball Mechanism Ideas I-V color copies](#).

Explain how hinge allows something to move back and forth:
- The straw is placed over a dowel, but not glued or taped; this allows the straw to spin; anything attached to the straw can also spin
- The same idea can be used with a fastener and spool

**Support GENERATING IDEAS by discussing how to build off the basic idea of a hinge**

Ask: *What fun pinball elements could you create that utilize a back-and-forth movement?*
- Target/gate that swings back and forth when hit
- Arm that swings and hits something like a bell

Support building off the basic hinge shown for more possibilities:
- Ask: *How could you modify the hinge shown?*
- Ask: *What if you change the direction/size/number/materials?*
Some suggestions if campers need help getting ideas flowing

- Change direction of hinge so element swings horizontally
- Make really long/short/tall/short hinged elements
- Attach multiple hinges to one long rod
- Put multiple hinges next to one another (a tunnel of hinged elements)

Explain how to create a basic ramp

Explain how it's built/how it works

- A simple ramp is made from folded cardstock and held in place with a fastener
- The back of the ramp is slightly elevated with a mini craft stick

Support GENERATING IDEAS by discussing how to build off the basic idea of a ramp

Support building off the basic ramp shown for more possibilities

- Ask: How could you modify the ramp shown?
- Ask: How might you combine it with a hinge or other materials?

Some suggestions if campers need help getting ideas flowing

- Create ramps with guide rails by folding the paper
- Have a bell or something else the ball hits at the top of the ramp
- Add a hinge so the ball spins something as it goes up/down a ramp
- Make a hinged ramp (like a see-saw)

Explain how to create a multi-ball elements

Point out multi-ball element on Basic Pinball Mechanism Ideas color copy

Explain how it’s built/how it works

- A container holding an extra pinball is made from paper
- When the pinball hits it, it knocks the extra pinball into play; now there are two pinballs going on at once!
### Support Generating Ideas by Discussing How to Build Off the Basic Example of a Multi-Ball Element

Support building off the basic multi-ball element shown for more possibilities

- **Ask:** *How could you modify the multi-ball element shown for different possibilities?*

Some suggestions if campers need help getting ideas flowing

- Find a way to hold more than one extra ball
- Change the position of the opening of the holder so the extra ball can come out the side instead of from the top

### Explain How to Create a Basic Drain

In pinball, the drain is a hole that the pinball falls into, causing the round to end

- Drains make the game much more challenging, but can also be much more fun

Drains are usually located in between the flippers

### Explain How It’s Built/How It Works

- Use the same perforated hole technique to make a hole behind the flippers
- Can cover up the hole later with cardstock

### Support Generating Ideas by Discussing How to Build Off the Basic Idea of a Drain

Support building off the basic drain idea shown for more possibilities

- **Ask:** *How could you modify the drain shown for different possibilities?*
- **Ex:** Drain can be larger or smaller for different degrees of difficulty
- **Ex:** Can make drains in other parts of the pinball playing field as targets, like a pool table

### ★ Introduce the Opportunity to Be Collaborative When Designing Their Special Elements

Up to campers to decide how to design their special element(s)

- May be unsure about what they want to do
- May reach a point where they’re not sure what to do next/how to make their elements better once they’ve started

Call out as an opportunity to choose:

- Not practicing collaboration – not building on any of the ideas shown/discussed; not looking for inspiration around them if they’re stuck
- Practicing collaboration – continuing to build off basic ideas to create new ones; noticing/incorporating what others around them are trying to help them brainstorm/make their own ideas better

Highlight wealth of ideas all around them

- Lots of ideas just from the group’s quick brainstorm
- More great ideas will continue to be generated as everyone works

Have campers high-five a neighbor if they accept your challenge of being collaborative by utilizing all the great ideas around them
# Independent Work Time

## Creating Special Elements (20 min)

<table>
<thead>
<tr>
<th>What campers will do: Build and test special elements</th>
<th>GENERATE IDEAS AND CREATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Refer to the color copies for inspiration and decide on a special element idea to begin with.</td>
</tr>
<tr>
<td></td>
<td>2. Create the special element. Make sure the element has a golf tee or fastener attached to it so it can be attached to the pegboard.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST AND EVALUATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Test the special elements by playing the game. Balls can be hit using flippers or rolled through the element to quickly see if it works.</td>
</tr>
<tr>
<td>4. Continue building and testing special elements until the group share.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facilitate GENERATE IDEAS AND CREATE</th>
<th>Today is very open-ended; make sure campers have a plan/direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ensure elements are added to the pegboard with fasteners or golf tees</td>
</tr>
<tr>
<td></td>
<td>• Should not use tape or glue to adhere elements to the machine</td>
</tr>
<tr>
<td></td>
<td>• Can use tape and glue to build the element itself</td>
</tr>
<tr>
<td></td>
<td>Help with construction techniques and review building basic mechanisms as necessary</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facilitate TEST AND EVALUATE</th>
<th>Talk to campers about whether elements are working as planned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Success is more subjective today</td>
</tr>
<tr>
<td></td>
<td>• Still, elements shouldn’t unintentionally trap ball or disrupt other features</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>★ Support BEING COLLABORATIVE</th>
<th>Encourage campers who are stuck or who feel done right away to take a gallery walk for more inspiration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Recognize collaborative campers; be specific about how they are being collaborative</td>
</tr>
<tr>
<td></td>
<td>• Ex: I see you’ve built off the idea of creating a tunnel that Anna suggested earlier. Love how you put your own twist on it. Way to be collaborative!</td>
</tr>
<tr>
<td></td>
<td>Ask guiding questions that support being collaborative:</td>
</tr>
<tr>
<td></td>
<td>• Tell me about what ideas excited you during the discussion. How can you build off those ideas?</td>
</tr>
<tr>
<td></td>
<td>• What do you notice about what people around you are trying?</td>
</tr>
<tr>
<td></td>
<td>• How might you combine/add onto/modify ideas you like?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transition to the upcoming Guided Activity</th>
<th>Give 5, 3, and 1 minute warnings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Have campers stop building and testing; can stay at workstations, but must focus on your instructions</td>
</tr>
<tr>
<td></td>
<td>➤ Ask TL to collect pinballs from campers who continue to play</td>
</tr>
</tbody>
</table>
Guided Activity
Project Share (10 min)

| Introduce the goal of collecting ideas to build off and incorporate into their own projects | Announce getting to play each other’s pinball machines for more inspiration

Goal is to come away with at least one idea they’re inspired by and can build off
Can include
• Taking part of an idea they like and combining it with their own ideas
• Seeing something that sparks a totally new idea and adding that new idea to the machine
• Modifying something they’ve already built based on something they see
• Making a totally new component based on something they see |

| Explain how the project share will work | Explain they’ll play two different pinball machines for 3-4 minutes each

Go over signal (words, clap, etc.) for “start playing” and “stop playing”
Explain how campers will rotate (up to you, but you should have a system)
• Possible ideas: rotate table groups clockwise or walk around and stop wherever they are when you say so
• Should expose campers to projects that they probably haven’t seen yet
Will debrief as a whole group then return to working on their own projects |

| ★ Introduce the opportunity to practice BEING COLLABORATIVE as they play with each other’s machines | Call out as an opportunity to choose:
• Not practicing collaboration – playing without noticing what they like; not being open to getting new ideas while playing
• Practicing collaboration – being on the lookout for good ideas; thinking about how they can use/combine/build on the ideas they like |

| ★ Support SHARE and BEING COLLABORATIVE | Have campers travel to another camper’s machine

Have them play for 3-4 minutes
Give the signal to stop playing and have them take note of good ideas
• Ask: What element or part of an element was especially fun/cool/interesting?
• Ask: What made it fun/cool/interesting?
• Have them give a thumbs-up when they have something in mind
Have campers switch machines and repeat |

| ★ Support BEING COLLABORATIVE and GENERATING IDEAS | Gather campers to the Demo & Discussion area

Have campers popcorn-share some good ideas they saw
Ask follow-up questions to prompt thinking about how they might incorporate them into their own projects
• Will you add the idea to an existing component or have you been inspired to create a new component?
• How will you add to/tweak the idea to build off it and make it your own?
Remind that their collaborative challenge is to incorporate at least one good idea they saw in some way
• Reiterate building off ideas of others makes their own ideas better
• Have campers air high-five you if they’re up for the challenge |
Independent Work Time

Incorporating New Ideas (15 min)

<table>
<thead>
<tr>
<th>What campers will do: Continue building special elements</th>
<th>GENERATE IDEAS AND CREATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Continue creating pinball special elements and/or create new components, incorporating ideas from the group share.</td>
<td></td>
</tr>
</tbody>
</table>

**Facilitate GENERATE IDEAS AND CREATE, and support BEING COLLABORATIVE**

Ask guiding questions that support generating ideas, creating, and being collaborative:

- Tell me about a special element that you saw that you liked. What did you like about it?
- How might you add to it/combine it with another idea/change part of it to make a new idea?

### Clean Up (5 min)

<table>
<thead>
<tr>
<th>Clean Up</th>
</tr>
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<tbody>
<tr>
<td>Have campers put any unused materials back at the materials station</td>
</tr>
<tr>
<td>Ask for campers to volunteer to share their special elements</td>
</tr>
</tbody>
</table>

### Lesson Wrap Up (5 min)

**Have campers share how they were COLLABORATIVE and discuss the importance of BEING COLLABORATIVE**

Recognize how many fun, unique elements everyone created

Have campers give you an air-high five if they practiced being collaborative by building on and incorporating the ideas of others to create an element

Have a few share about an element that they created by building off ideas and using inspiration from their teammates; ask:

- How does it work?
- How did you build on another’s idea to create that element/what ideas inspired you to come up with this element?

Others can give “me-too” signal if they had similar experience

Help campers see value of Mindset; ask:

- How did being collaborative make your special elements better?
- Why do you think being able to be collaborative is important for innovators?
- What other projects or activities do you do where it’s important to be collaborative?

**Invite campers to recognize each other for BEING COLLABORATIVE**

Can recognize teammates they saw being collaborative or who helped them be more collaborative

Encourage specificity about how person was collaborative

You and TL can recognize campers as well
### Lesson Materials

* (starred) materials appear multiple times in this list

#### Copies
- copies, color, Real Pinball Special Elements pp. 1-3 (2 per classroom)
- copies, color, Pinball Special Element Ideas I-V (2 per classroom)

#### General/Adhesives/Tools
- glue gun, mini, low temp (1 per 2 campers)
- glue stick, melt, mini (3 per camper)
- tape, masking, 1" (28" per camper)
- scissors, medium, 5", pointed (1 per camper)
- awl, metal (1 per camper)
- wire stripper, multi-gauge, for cutting woodcraft (2 per classroom)

#### Camper Choice Materials
(Campers will choose some of these materials, but not all of them. You have not been supplied with enough choice materials for every camper to use each option. Choice materials are supplied for variety under the assumption that not every camper will choose every material.)
- paper, cardstock, brights, asst. colors, 8.5 x 11" (1 per 2 campers)
- craft sticks, mini, asst. colors, 3" (6 per camper)
- craft stick, large, 3/4 x 6", asst. colors (4 per camper)
- dowel, wood, 0.25 x 4" (1 per camper)
- skewer, wood, 10" (4 per camper)
- straw, red, 10" (2 per camper)
- spool, wood, asst. sizes & colors (5 per camper)
- pipe cleaner, asst. colors, 12" (5 per camper)
- rubber band, asst. sizes & colors (5 per camper)
- foam shape, asst. sizes & colors (5 per camper)
- bells, jingle, silver, asst. sizes (5 per camper)
- basket, raspberry (1 per camper)
- cup, paper, 3 oz. (1 per camper)
- fastener, brass, 2 x 0.5", for attaching components to pegboards (5 per camper)
Setting Up the Space

Set all the choice materials at a materials table. Label how many of each material campers are able to take.

- paper, cardstock, brights, asst. colors, 8.5 x 11" (1 per 2 campers)
- craft sticks, mini, asst. colors, 3" (5 per camper)
- dowel, wood, 0.25 x 4" (1 per camper)
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- rubber band, asst. sizes & colors (5 per camper)
- foam shape, asst. sizes & colors (5 per camper)
- bells, jingle, silver, asst. sizes (5 per camper)
- basket, raspberry (1 per camper)
- cup, paper, 3 oz. (1 per camper)
- golf tee, wood, asst. colors (5 per camper)
- fastener, brass, 2 x 0.5" (5 per camper)

Gather materials for the Demo & Discussion:

- sample of all choice materials

Put up the following color copies on your copies display board

- Pinball Special Element Ideas I-V
- Real Pinball Special Elements pp. 1-3

Morning Of Preparation

Plug in the glue guns.

On the Board

Mindset of the Day
BE COLLABORATIVE – I build on the ideas of others.

Check In With Your TL

➤ Make sure your TLs are clear about their role in helping today’s lesson run smoothly. Specific things your TL can help with today:

- (If necessary) Help focus campers by collecting pinballs between the first Work Time and the Guided Activity
Today campers focus on creating a visionary theme for the pinball machine to add fun and flair to what otherwise looks like a cardboard box. They can also create a scorekeeping system and rules for how to win.
Today’s Project: At-A-Glance

Theme the pinball machine

Cardstock, markers, and foam sheets create a underwater pinball machine
Optional: Create a scoring system

Beads or paper can be used to create several different kinds of scorekeeping systems.

Optional: Create rules for scoring/goals

For example, players win by hitting this target three times.
Teaching the Lesson: Overview

OUR SECRET SAUCE: THE G.I.A.

PROCESS FOCUS

GENERATE IDEAS & DESIGN: Visual Triggers
Campers see images of environments to spark theme ideas and then discuss how to integrate those ideas into existing and new pinball machine elements.

Why? – While some campers may have clear theme ideas right away, others may not. Observing rich visual imagery is a useful strategy for sparking creative ideas, and is often used by makers and innovators as a way to get inspiration for a project. Having campers practice this strategy today will help ensure everyone has an idea they’re excited about and will give them a simple tool they can use for coming up with ideas in the future.

MINDSET FOCUS

BE VISIONARY – I imagine things that don’t exist yet.
In their minds’ eyes, campers imagine the themed features that they want their pinball machines to include and strive for clarity and specificity around their visions before beginning to build.

Why? – Campers often settle on an idea before they’ve thought through the specifics, only to realize halfway through building that the idea was not as rich or exciting as they first thought. Today’s Mindset helps ensure campers choose a theme with rich possibilities that they’re excited about. It also supports campers having a clear direction, leading to more cohesive final designs.

Remember to include these special ingredients to transform today’s project into a Galileo, innovation-based lesson. Bam!
Lesson Breakdown & Camper Goals

<table>
<thead>
<tr>
<th>Introduction</th>
<th>5 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided Activity: Theme Brainstorm</td>
<td>10 min</td>
</tr>
<tr>
<td>- Discuss examples of scorekeeping and rules for winning the game</td>
<td></td>
</tr>
<tr>
<td>- Have campers brainstorm theme ideas using visual triggers</td>
<td></td>
</tr>
<tr>
<td>- Discuss how existing elements can be redesigned to match a theme</td>
<td></td>
</tr>
<tr>
<td>- Discuss how a backboard can match a theme</td>
<td></td>
</tr>
<tr>
<td>- Have campers envision and share their final theme idea</td>
<td></td>
</tr>
</tbody>
</table>

| Independent Work Time: Finishing the Pinball Machine | 35 min |
| - Modify or add to the pinball machine according to their chosen theme |

| Wrap Up | 15 min |

| Clean Up | 5 min |

**Timing Notes**

If campers or groups are behind

- They can use this day to finish any unfinished components. You can encourage them to theme out their components at home if they don't have time today.
# Teaching the Lesson: Play-by-Play

## Introduction (5 min)

| Welcome campers and make a quick story connection | Ex: Are the makers ready for ToyFest today? (Hope so!) We should be sure to be ready, too. Let’s finish the week strong by wrapping up our toy engineering and showing everyone at ToyFest what awesome results can come from truly innovative making. |
| Build excitement and give an overview of today’s project | Announce today is all about transforming machines by taking them to the next level of pinball awesomeness!  
- Won’t just be a ball hitting a piece of cardboard by the end of today  
- Will have a unique theme (superhero, space, etc.) just like classic pinball  
Will generate possible theme ideas as a group before getting to work  
Then will bring theme/vision to life; can include  
- Redesigning/adding to existing elements to match theme  
- Creating new themed elements  
- Adding a backboard inspired by the theme  
Can also create a scoreboard and/or a goal (way to win) to make game more than just about hitting the ball around randomly  
Will have time at the end of rotation to play each other’s pinball machines again! |

⭐ Introduce the Innovator’s Mindset: BE VISIONARY

Point to this on your Innovator’s Mindset poster  
Define the Mindset element in the context of today’s lesson  
- Today we’re going to focus on being visionary – I imagine things that don’t exist yet. Today, this means imagining how we want to transform our plain games into unique pinball worlds and coming up with a clear picture of what we want those worlds to look like. |

## Guided Activity

### Theme Brainstorm (10 min)

| Quickly show examples of scorekeeping construction techniques | Before you get into the theme brainstorm activity discuss option of adding a scoreboard  
Show color copies Example Scorekeeping Ideas pp. 1-3 |

Point out  
- beads on skewer  
- moving beads from cup to a golf tee
Quickly discuss having scoring rules or an object of the game

Point out if they have a scoreboard they probably need rules for how to earn points!
- Ex: 1 pt. every time they turn the light on

May also want to set rules for how to win the game whether they have a scoreboard or not
- Ex: Turn light on 3 times

Invite campers to create rules that are simple or complex, easy or hard; examples are just suggestions

Support GENERATING IDEAS for themes by introducing the visual triggers brainstorm activity

Now it’s time to come up with their themes; reiterate theme is what makes each pinball machine special and more fun!

May not have a theme idea yet; that’s okay!

Announce they’ll generate ideas by looking at images to get thoughts flowing
- Call out this is a common and useful technique makers and innovators use to spark ideas

Support GENERATING IDEAS for themes by showing the visual triggers

Show color copies Pinball Brainstorm: Rich Imagery pp. 1-4

Ask campers to name a theme based upon the image then call out elements that go with that theme
- For example: jungle theme with monkeys, trees, tigers, etc.
- Elements can be ones they see in the images and other ideas sparked

Write camper suggestions on the board

Repeat for each image

Then ask campers to popcorn-share any other fun theme ideas that are sparked (don’t necessarily have to relate to images)

Quickly write these on the board as well
Support GENERATING IDEAS by discussing how existing elements might be transformed to match a theme

Discuss how theme elements can be integrated onto existing things
  • Ex: For jungle theme, draw a monkey and attach it to a target
  • Ex: For a racing theme, turn the spinner into a car tire

Have a few campers share ideas for how they might transform one of the components to match some of the themes listed on the board

Scorekeeping and rules can also be themed
  • Ex: For jungle theme, earn a banana (yellow bead) each time you hit the monkey target
  • Ex: For racing theme, each time the motorized spinner is activated with a pinball in it, you gain 10 mph; the goal is to get up to 100 mph

Introduce the idea of a backboard and discuss how a backboard can be used to emphasize a theme

Campers may add a backboard to the pinball machine
  • Backboard is cardboard piece glued to the back of the pinball machine
  • The theme is often most pronounced on the backboard because it’s what people can see from far away
  • Backboard can also have rules and/or scoring system on it

Show the cardboard piece campers can use for the backboard
  • Hold it against the back of a pinball machine to model where it should go

★ Introduce the opportunity to practice BEING VISIONARY as they finalize their ideas

Inform before they start they’re going to take time to envision and choose a theme

Call out as an opportunity to choose:
  • Not practicing being visionary – decorating at random; not intentionally working toward a particular theme; not really thinking about what the machine might look like during this activity; keeping ideas general (ex: something cool-looking)
  • Practicing being visionary – really picturing what different elements would look like in their machines; envisioning specific details; trying to get a clear image of an end goal before starting

Have campers give you an air-high five if they accept your challenge to be visionary

★ Support BEING VISIONARY and DESIGN

Have campers silently decide on their themes and come up with at least three supporting components

Have campers decide on their top 1-3 themes and imagine what their machines would look like if themed in that way

Help campers get specific by prompting them to imagine:
  • Elements that go with the theme
  • How they could transform electronic components to match the theme
  • How they could transform other components like targets, bumpers, etc. to match the theme
  • What they might put on a backboard to match the theme (name, decorations, etc.)

If they’re having trouble starting with a theme invite them to try imagining just one detail
  • Imagine turning the spinner/light/target into something awesome
  • Then think of a theme they could build around that element

Give another 60 seconds to silently decide on a theme and think of three theme-related element ideas they’re picturing on their machines
  • Remind them to get specific
They’ll share ideas in a moment and should have a clear idea
Have them give a thumbs-up when ready

Have campers turn to someone next to them and share their themes and ideas
If time, have a few share out a partner’s idea they thought was especially fun/visionary
Can begin building once both campers have shared with their partners

### Independent Work Time

#### Finishing the Pinball Machine (35 min)

<table>
<thead>
<tr>
<th>What campers will do: Finish their pinball machines to match their themes</th>
<th>CREATE</th>
</tr>
</thead>
</table>
| 1. Modify or add to the pinball machine according to their chosen themes. This can include:  
  • Creating a themed backboard  
  • Modifying existing components  
  • Adding new themed components  
  2. (optional) Create a way to keep score.  
  3. (optional) Create rules for how to win the game. | |

<table>
<thead>
<tr>
<th>Facilitate CREATE and support BEING VISIONARY</th>
<th></th>
</tr>
</thead>
</table>
| Encourage campers having trouble crystallizing their theme ideas to talk with you or TL before starting  
  Help campers figure out how to use the limited materials to match the vision for the theme  
  For complicated elements suggest laying out materials without attaching them together until they’re happy with the arrangement  
  • Ex: Trying to make a lion? Try arranging Woodsies and pipe cleaners on the table in different ways until it works before gluing it together  
  Ask guiding questions that support being visionary:  
  • *Tell me about your theme idea and what you were envisioning before you started working.*  
  • (For campers still unsure of ideas) *Imagine something awesome you’d like to turn your spinner/light/target into. What theme can you build around that?* |
Lesson Wrap Up (15 min)

| Give campers a chance to play each other’s pinball machines | Can be loosely structured
| | • Can pair up and switch with one person
| | • Or can play several people’s pinball machines
| | Do this for 5 minutes
| ★ Have campers share how they were VISIONARY and discuss the importance of BEING VISIONARY | Recognize everyone for creating such unique and fun pinball machines this whole week!
| | Have campers give a thumbs-up if they practiced being visionary by trying to have a really clear picture in their heads of what they were going for today
| | Have a few share
| | • How brainstorming and having a specific vision from the beginning helped them create today
| | • Something specific they imagined that they were actually able to create
| | Help campers see value of Mindset; ask:
| | • *How did being visionary make your pinball machine better?*
| | • *Why do you think being able to be visionary is important for innovators?*
| | • *What other projects or activities do you do where it’s important to be visionary?*
| ★ Invite campers to recognize each other for BEING VISIONARY | Can recognize teammates they saw being visionary or who helped them be more visionary
| | • Ex: A partner who shared an idea that was really clear or who helped them get clearer about their initial ideas
| | Encourage specificity about how person was visionary
| | You and TL can recognize campers as well

Clean Up (5 min)

| Clean Up | Have campers return any unused materials to materials station
| | Have campers put pinball machines back in team areas except during third rotation; these campers can leave machines on tables for Friday Closing |
# Lesson Materials

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<td>copies, color, <strong>Pinball Brainstorm: Rich Imagery</strong> pp. 1-4 (2 per classroom)</td>
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<tr>
<td>glue stick, melt, mini (2 per camper)</td>
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<tr>
<td>tape, masking, 1&quot; (40&quot; per camper)</td>
<td></td>
</tr>
<tr>
<td>scissors, medium, 5&quot;, pointed (1 per camper)</td>
<td></td>
</tr>
<tr>
<td>marker, washable, asst. color, set of 8 (2 per classroom)</td>
<td></td>
</tr>
<tr>
<td>marker, Sharpie, fine pt., black (1 per 4 campers)</td>
<td></td>
</tr>
<tr>
<td>awl, metal (1 per camper)</td>
<td></td>
</tr>
<tr>
<td>cutter, safety, Klever Koncept, <em>for cutting cardboard</em> (1 per 4 campers)</td>
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</tr>
<tr>
<td>choice materials from yesterday (do not exceed yesterday's maximum materials allotment)</td>
<td></td>
</tr>
<tr>
<td>cardboard, corrugated, 9 x 12&quot;, <em>for backboard</em> (1 per camper)</td>
<td></td>
</tr>
<tr>
<td>bead, wood, asst. sizes and colors (5 per camper)</td>
<td></td>
</tr>
<tr>
<td>skewer, wood, 10&quot; (1 per camper)</td>
<td></td>
</tr>
<tr>
<td>paper, cardstock, brights, asst. colors, 8.5 x 11&quot; (1 per camper)</td>
<td></td>
</tr>
<tr>
<td>foam, alphabet piece, sticky back (10 per camper)</td>
<td></td>
</tr>
<tr>
<td>sticker, star, metallic, 440 pk. (5 per camper)</td>
<td></td>
</tr>
<tr>
<td>foam shape, asst. sizes &amp; colors (10 per camper)</td>
<td></td>
</tr>
<tr>
<td>Woodsies, asst. shapes (star, heart, square, triangle) (4 per camper)</td>
<td></td>
</tr>
<tr>
<td>pipe cleaner, asst. colors, 12&quot; (3 per camper)</td>
<td></td>
</tr>
<tr>
<td>googly eye, self stick, 10 mm (4 per camper)</td>
<td></td>
</tr>
<tr>
<td>cup, paper, 5 oz. (1 per camper)</td>
<td></td>
</tr>
<tr>
<td>craft sticks, mini, asst. colors, 3&quot; (4 per camper)</td>
<td></td>
</tr>
</tbody>
</table>

# Advance Materials Preparation

Preview the Materials Prep for the Week Ahead (at the start of each theme), especially Monday’s prep, which needs to be completed by the end of the day Friday.

Review the essential resources for your upcoming theme in your Telescope Library and complete any tasks prescribed there including highlighting key points in lessons, creating samples, and/or watching videos. If this is your second time teaching the theme make sure to check the curriculum updates section even if you’ve already looked at the other resources previously.
Setting Up the Space

Set out the choice materials next to the leftover choice materials from yesterday:

- cardboard, corrugated, 9 x 12", *for backboard* (1 per camper)
- spool, wood, asst. sizes & colors (5 per camper)
- skewer, wood, 10" (1 per camper)
- paper, cardstock, brights, asst. colors, 8.5 x 11" (1 per camper)
- foam, alphabet piece, sticky back (10 per camper); spread out the foam alphabet stickers onto two lunch trays so campers can easily sort through the letters
- sticker, star, metallic (5 per camper)
- foam shape, asst. sizes & colors (10 per camper)
- Woodsies, asst. shapes (star, heart, square, triangle) (4 per camper)
- pipe cleaner, asst. colors, 12" (3 per camper)
- googly eye, self stick, 10 mm (4 per camper)
- cup, paper, 5 oz. (1 per camper)
- craft sticks, mini, asst. colors, 3" (4 per camper)

Put up the following color copies on your copies display board:

- Scorekeeping Example pp. 1-3
- Pinball Brainstorm: Rich Imagery pp. 1-4

Notes

Materials Management

You may keep the materials from previous days out, but campers should still not exceed the total maximum amount of materials. Make it clear that the number of materials shown at the materials table is the total number that is allowed in the whole pinball machine.

On the Board

Mindset of the Day

BE VISIONARY – I imagine things that don’t exist yet.

Check In With Your TL

- Make sure your TLs are clear about their role in helping today’s lesson run smoothly. Specific things your TL can help with today:
  - Help campers who are struggling with coming up with a theme they’re excited about