Galileo Makers: Toys
Camp Galileo
2016 Nebula Science
(For rising kindergarten 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: Golf Game, Part 1 of 3

Golf toys make it easy for people to play golf anywhere!

**Today: Building the Golf Club**
Campers make a golf club by taping together paint stirrers and balsa wood. They’ll test it by waving the club and using it to hit a ball into a cup. The club must:
- Be as long as a camper’s leg
- Be rigid (not break or bend significantly when swung)
- Include a club head

![Golf Club Image]

**What’s Next**
Tomorrow (Day 2) campers will create a cardboard base for the golf game, with a hole, putting green, and obstacles. On Day 3 campers will add mini golf-inspired 3D hills and tunnels.

![Day 2 and Day 3 Images]
Today’s Project: At-A-Glance

Create a stick from paint stirrers

Test the stick height

Test the stick rigidity
Attach a balsa wood head

Test the rigidity

Test at the golf range
Teaching the Lesson: Overview

OUR SECRET SAUCE: THE G.I.A.

KNOWLEDGE FOCUS

CONCEPTS AND FACTS: Rigidity
Campers understand what rigidity is and focus on the rigidity of their clubs.
Why? – Campers must pay attention to this as they build, as a club with wobbly or loose connections will be hard to use.

SKILLS AND TECHNIQUES: Taping Techniques (Overlap and Wrap)
Campers practice overlapping two materials and wrapping them tightly with masking tape.
Why? – Good taping is key for creating rigid clubs, but many Nebulas won’t know the most effective way to tape their materials together. Explicitly teaching the overlap and wrap technique will allow campers to create their clubs more successfully and independently.

PROCESS FOCUS

TEST AND EVALUATE: Test in Stages
After creating the stick campers test it for height and rigidity. After adding the head they test it for rigidity.
Why? – Taping a head on if the club height isn’t right will result in the need for a lot of un-taping and re-taping. In addition, it will be hard for campers to figure out where and how they need to add tape if the entire club is wobbly. Testing in stages will mitigate the need for undoing attachments and help campers more easily identify and fix loose connections.

MINDSET FOCUS

BE DETERMINED – I persevere until I achieve my goal.
Campers stay motivated if the golf club doesn’t succeed during a test and commit to making the club strong and easy to use.
Why? – Campers may become discouraged or frustrated if they aren’t able to tape successfully at first, or they may be content with a poorly constructed club. Today’s Mindset Focus will help campers acknowledge when there’s a need to redesign while also helping them feel confident in their ability to do so successfully.

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>Welcome to Science</th>
<th>10 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>5 min</td>
</tr>
<tr>
<td>Demo &amp; Discussion: Golf Club Construction</td>
<td>10 min</td>
</tr>
<tr>
<td>□ Demo overlap-and-wrap with the golf stick</td>
<td></td>
</tr>
<tr>
<td>□ Demo the height pretest</td>
<td></td>
</tr>
<tr>
<td>□ Show different head options and demo attaching one</td>
<td></td>
</tr>
<tr>
<td>□ Demo the rigidity pretest</td>
<td></td>
</tr>
<tr>
<td>□ Demo using a golf club at the testing stations</td>
<td></td>
</tr>
<tr>
<td>Independent Work Time: Build a Golf Club</td>
<td>25 min</td>
</tr>
<tr>
<td>□ Overlap and wrap paint stirrers in order to create a stick</td>
<td></td>
</tr>
<tr>
<td>□ Test the stick for height and rigidity; the stick must</td>
<td></td>
</tr>
<tr>
<td>▪ Be as long as the camper’s leg</td>
<td></td>
</tr>
<tr>
<td>▪ Not break or bend significantly</td>
<td></td>
</tr>
<tr>
<td>□ Attach a golf club head</td>
<td></td>
</tr>
<tr>
<td>□ Test the club head for rigidity</td>
<td></td>
</tr>
<tr>
<td>□ Use the golf club at a putting green and practice technique</td>
<td></td>
</tr>
<tr>
<td>Clean Up</td>
<td>5 min</td>
</tr>
<tr>
<td>Wrap Up</td>
<td>10 min</td>
</tr>
<tr>
<td>Transition</td>
<td>5 min</td>
</tr>
</tbody>
</table>

Timing Notes

Campers are on track so long as they have a rigid golf club that they can use for the next two days.

If campers or groups are behind
  • Keep testing at the putting green to a minimum by changing 3 hits to 2 hits.
If campers or groups are ahead
  • They can wrap yarn or attach foam shapes around the golf club to add comfort to the handle.
  • They can be ball collectors stationed at the testing area.
# 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 golf play sets

Ask: Has anybody heard of golf or ever played golf?

Show Golf color copy

Ask: Golf is played in big open spaces! But I really want to play golf in this room. What can I do?

• Build a mini-golf toy play set!

Build excitement and give an overview of today's project

Inform campers they’ll work on their golf play sets for the next 3 days

• Today they’ll make the golf club
• Tomorrow and the next day they’ll make the course

Show your unsuccessful golf club (directions for making this in prep section)

• Swing the club
• It’s way too short and won’t even touch the ground!
• Swing the club again, causing it to wobble or have a piece fall off
• It’s too wobbly to hit a ball!

Ask: Can you help me make a better golf club?

★ Introduce the Innovator's Mindset: BE DETERMINED

Point to this on your Innovator’s Mindset poster and introduce today’s mindset:

• Today we’re going to focus on being determined to make our golf clubs easy to use and strong. This means even if they don’t work right away we’re not going to give up!

Demo & Discussion

Golf Club Construction (10 min)

Review the main parts of the golf club

Show the Golf color copy again

Ask: What are all the parts of the golf club?

• Stick lets the club reach the ball on the ground
• Club makes it easier to hit the ball
• Handle makes it nice and comfortable to hold

Clarify they’ll make stick first then add clubs; will add handles if they have time

Explain the need to attach paint stirrers to create the stick

Ask: Was one paint stirrer long enough to reach the ground? (No!)

Ask: What can we do to make this stick longer?

• Tape more paint stirrers together

Demo overlapping the sticks and wrapping them with tape

Announce the secret art of overlap and wrap as a way to tape sticks together

Have campers repeat: “Overlap and wrap” as you do the following arm motions
Take two paint stirrers and put them end to end

- Ask: *Is this overlapping?* (No!)
- Stick is longer but taping two sticks like this will be wobbly

Overlap the paint stirrers by a few inches

- Ask: *Is this overlapping?* (Yes!)
- Stick is longer and will not be wobbly

Put the two sticks on top of each other
• Point out this is too much overlapping
• Stick isn’t any longer than it was before

After sticks are overlapped it’s time to wrap

With the help of your TL wrap tape around paint stirrers
• Have TL hold paint stirrers while you tape
• Make sure the stick is shorter than your leg for the next section

Support TESTING and EVALUATING by demoing the height test

Before they add the head, they want to make sure stick is tall enough
• Good to test now or they might build the whole club too small

Explain they’ll test by holding stick against their legs; if it’s the same height it passes the test

Demo testing the height of your stick to show it’s too short
Call out you’re going to be determined and redesign until your stick is the right height.
Tape on one more paint stirrer so that it matches your height; do a poor job taping so you can model redesigning for rigidity in a moment.
Test the height again; the club is now long enough!

Define rigidity
Announce a second test for their golf sticks; testing if they’re rigid.
Explain rigid means straight and not wobbly:
• Put your arms out in a straight line
• Have campers copy you and say “rigid”!
Golf clubs need to be rigid or they won’t be able to hit the ball!

Support TESTING and EVALUATING by introducing the rigidity test
Show how to test for rigidity by moving stick back and forth; emphasize:
• Holding it with both hands
• Swinging gently (not harder than for a real golf swing)
• Stick should be below waists (as if golfing) not above heads
• Don’t stand right next to someone when testing
Have campers help you notice if anything is wobbly/not rigid (last piece you taped on should be wobbly)

★ Model BEING DETERMINED as you reinforce your wobbly connection
Ask: My stick is falling apart! What am I going to do now? Give up?
• No! You’re going to be determined to fix it!
Ask: What can I do to fix my golf stick?
• Take the tape off and try again with a new strip
• Add some more tape where it’s wobbling
Re-tape your wobbly stick; emphasize wrapping tightly or it won’t be rigid

★ Model BEING DETERMINED by adding to your stick so it passes the height test (but don’t tape the piece securely)
Show the two golf club head options and demo taping one on
Next step is to attach a head to hit the ball
Show choices for club heads
• Square or circle
For your demo place square piece on your stick

- Emphasize it overlaps over the stick, but doesn’t completely cover it

Place two pieces of tape on one side of the square
- Emphasize that the tape needs to be on both the paint stirrer and the cardboard
- Emphasize pressing down on the tape well

| Test the rigidity of the head and redesign by adding tape on the other side of the head |
| Time to test again; swing the club gently as before to show head is not rigid |
| Explain that the other side needs to be taped so it’s rigid |
| Flip the golf club so that you can see its un-taped side; attach two pieces of tape using the same method as before |
| Test again to show the entire club is now rigid! |
| • You just did a lot of work and were determined to get it done |
| • Now your club is ready to use! |

<p>| Demo how to properly hold and swing the finished club |
| Inform they can use golf clubs at the putting greens once they pass all the tests |
| • Will need to show adult at testing station that club is rigid and straight before golfing |</p>
<table>
<thead>
<tr>
<th><strong>Point out the testing stations</strong>&lt;br&gt; (set up ahead of time) and go over testing procedure</th>
<th><strong>Review building instructions to check camper comprehension</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Show how to hold club at top of stick and stand with knees straight</td>
<td>Emphasize for safety the club head should not go above their knees when swinging</td>
</tr>
<tr>
<td>The line to play starts at the “X” (prepped ahead of time) and they shouldn’t move past it</td>
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</tr>
<tr>
<td>Everyone has three swings</td>
<td>Everyone has three swings</td>
</tr>
<tr>
<td>• Don’t have to chase after ball if it rolls away until the end of their turn; can just get another ball from ball deli container (set up ahead of time)</td>
<td>• Don’t have to chase after ball if it rolls away until the end of their turn; can just get another ball from ball deli container (set up ahead of time)</td>
</tr>
<tr>
<td>• When turn is over they must gather balls and put them back in the ball container</td>
<td>• When turn is over they must gather balls and put them back in the ball container</td>
</tr>
<tr>
<td>• Then they can get back in line or go back to workstations to build</td>
<td>• Then they can get back in line or go back to workstations to build</td>
</tr>
<tr>
<td>Demo testing three times (verbally counting up to three) then collecting balls and getting back in line</td>
<td>Demo testing three times (verbally counting up to three) then collecting balls and getting back in line</td>
</tr>
<tr>
<td>Overlap and wrap to make the golf stick</td>
<td>Overlap and wrap to make the golf stick</td>
</tr>
<tr>
<td>Test to make sure it’s the right height and rigid</td>
<td>Test to make sure it’s the right height and rigid</td>
</tr>
<tr>
<td>Add a head</td>
<td>Add a head</td>
</tr>
<tr>
<td>Test to make sure it’s rigid</td>
<td>Test to make sure it’s rigid</td>
</tr>
<tr>
<td>Try golfing!</td>
<td>Try golfing!</td>
</tr>
<tr>
<td>★ Review what campers can do to practice BEING DETERMINED today</td>
<td>★ Review what campers can do to practice BEING DETERMINED today</td>
</tr>
<tr>
<td>Fixing height of the golf club if it’s too short or too long</td>
<td>Fixing height of the golf club if it’s too short or too long</td>
</tr>
<tr>
<td>Fixing the club if it breaks or wobbles and not giving up</td>
<td>Fixing the club if it breaks or wobbles and not giving up</td>
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</tbody>
</table>
## Independent Work Time

### Build a Golf Club (25 min)

<table>
<thead>
<tr>
<th>What campers will do: Build a golf club</th>
<th>CREATE, TEST &amp; EVALUATE (stick)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Overlap and wrap paint stirrers to make the golf stick.</td>
</tr>
<tr>
<td></td>
<td>2. Test the height by holding the stick next to a leg.</td>
</tr>
<tr>
<td></td>
<td>3. Add, reposition, or remove paint stirrers if the stick does not match the height of their legs.</td>
</tr>
<tr>
<td></td>
<td>4. Test the rigidity of the stick by swinging it back and forth. Re-tape as necessary.</td>
</tr>
<tr>
<td></td>
<td>CREATE, TEST &amp; EVALUATE (head)</td>
</tr>
<tr>
<td></td>
<td>5. Choose and attach a cardboard golf club head.</td>
</tr>
<tr>
<td></td>
<td>6. Test the rigidity of the head by swinging it back and forth. Re-tape as necessary.</td>
</tr>
<tr>
<td></td>
<td>TEST (final putting test)</td>
</tr>
<tr>
<td></td>
<td>7. Test the golf club at one of the testing station by trying to putt a small wiffle ball into a container.</td>
</tr>
</tbody>
</table>

**Extension Options**

Wrap yarn onto the stick to make a comfortable handle.

Decorate the golf club with foam shapes and markers.

Be a ball collector for campers who are testing and put balls in containers.

<table>
<thead>
<tr>
<th>Facilitate CREATE, TEST &amp; EVALUATE (stick)</th>
<th>Limit tape usage; encourage focusing on wrapping tightly and pressing down instead of using more tape</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Remind campers to work together when working with the paint stirrers; directly tell a camper to hold the paint stirrer and another to tape</td>
</tr>
<tr>
<td></td>
<td>If necessary, designate a specific area in the room where campers can test if the testing interferes with camper work spaces</td>
</tr>
<tr>
<td></td>
<td>Ensure campers are testing safely; not waving sticks in the air</td>
</tr>
<tr>
<td></td>
<td>Ask guiding questions that support testing and evaluating:</td>
</tr>
<tr>
<td></td>
<td>• What do you notice about the length/rigidity of your stick when you test?</td>
</tr>
<tr>
<td></td>
<td>• How can you overlap/tape in a different way to make your stick taller/shorter/more rigid?</td>
</tr>
<tr>
<td></td>
<td>• Where might you re-tape/add more tape?</td>
</tr>
<tr>
<td></td>
<td>➤ Have TL write campers’ names on paint stirrers as they work</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facilitate CREATE, TEST &amp; EVALUATE (club)</th>
<th>Make sure campers have tested their sticks before adding heads</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ask guiding questions listed previously to support evaluating clubs</td>
</tr>
</tbody>
</table>

| Facilitate TEST (final putting test) | ➤ Have TL manage testing station to manage flow and enforce rules |
|-------------------------------------|• Remind TL to have campers show club passes all tests before golfing |
Facilitate Extension Options

Can show these options to individual campers, small groups, or the whole class at once

Introduce wrapping yarn to make a comfortable handle
- Tape one end of yarn to top of stick
- Wrap yarn, and then tape the other end of yarn
- Can also invite campers to decorate clubs with markers and/or foam shapes

Encourage campers to help the TL by grabbing some balls (if they moved past the testing station) and returning them to the TL to put into the ball container

★ Support BEING DETERMINED

Don’t correct campers right away if you see them building in a way that won’t work; give campers a chance to discover and solve their own problems

Celebrate incremental progress/improvements; have campers high-five you or the TL when they finish a step or fix a problem

Recognize determined campers; be specific about how they are being determined
- Ex: *When you taped your golf club the first time it was a little bit loose, but you were determined to re-tape it and now it works a lot better!*

Ask guiding questions that support being determined:
- *How can you make your golf club easier to use/stronger?*

The lesson focuses on determination during construction but you can shout out the opportunity to be determined when practicing golfing
- Might be a new skill for them
- Putting in effort and not giving up will help them get better!

Clean Up (5 min)

Clean Up

Have campers return any decorating materials back to the materials station
Round up all wiffle balls used at the testing station and have them stored away
Choose a sample of one camper’s work for Lesson Wrap Up
<table>
<thead>
<tr>
<th>Lesson Wrap Up (10 min)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Celebrate the golf clubs and recap what campers accomplished today</td>
<td>Recognize everybody for making such rigid golf clubs that are perfect for their heights!</td>
</tr>
</tbody>
</table>
| Hold up the chosen camper’s club | • Point out how the club’s height is well suited for that camper  
• Have campers point out where they see overlapping and wrapping; emphasize how it helps the club stay rigid |
| ★ Summarize the importance of BEING DETERMINED and have campers recall if/how they practiced this today | Highlight effect of practicing Mindset during today’s project  
• Ex: We had a specific goal today: to make our clubs long and strong enough so we could use them at the testing range. One thing that helped us get to that goal was determination! |
| Have campers flex their determination muscles if they practiced being determined today by: |  |
| • Fixing the club if it didn’t pass one of the tests  
• Working hard to do something themselves, without an adult’s help, even if it was tricky at first  
• Never giving up and having a positive attitude |  |
| If applicable recognize specific campers for exhibiting above behavior; be specific about what you observed during the Work Time |  |
| Review why determination is important for innovation | • Ex: When you’re innovating things don’t always go perfectly the first time. Getting to your goal might be hard, but you can use your powers of determination to help you keep going and get there! |
Get Ready!

Lesson Materials

* (starred) materials appear multiple times in this list

Copies

- copy, color, Golf (2 per classroom)

General/Adhesives/Tools

- tape, blue, 2" wide, for designating testing range (8" per 4 campers)
- tape, masking, 1" wide, for adhering paint stirrers and club head (20" per camper)
- marker, washable, asst. colors, set of 8, for decorating extension (1 set per 4 campers)
- container, plastic, deli, 16 oz., for storing wiffle balls (1 per 4 campers)

Required Materials

- paint stirrer, wood, 12", for golf club stick (3 per camper)

Testing range (preassembled by you)

- ball, wiffle, sm., for testing station (3 per 4 campers)
- cardboard, custom, 36 x 11" w/ 2 middle folds, as testing range base (1 per 4 campers)
- box, gift, white, 7 x 3 x 3", for easy hole (2 per classroom)
- basket, strawberry, for medium hole (1 per classroom)
- cup, plastic, heavy duty, red, 16 oz., for hard hole (1 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.)

Golf club head choices (each camper chooses one)

- cardboard, corrugated, 6 x 6", for golf club head (1 per camper)
- cardboard, corrugated, circle, 5", for golf club head (1 per camper)

Extension options

- yarn, jumbo, asst. colors, 5 ft. (20" per 2 campers)
- foam shape, asst. sizes & colors, for decorating extension (5 per camper)
Materials Preparation

Build an unsuccessful golf club for the Demo & Discussion.

- Adhere two pieces of tape only on one side of the bottom of a paint stirrer.
- Make sure that the pieces of tape are loosely adhered so that the cardboard square flops around.

Cut approximately 20” pieces of yarn (1 per 2 campers). Each length of yarn is about 5 feet and can be cut into thirds for this.

Rip 3” pieces of tape and set up a system for distributing it like a tape chair or wall (See Materials and Prep for the Summer for details).

Advance Materials Preparation

Start cutting the burlap, felt, and foam for Day 2 (see details in the Day 2 prep). This prep is intensive and it’s recommended that you start now.
## Setting Up the Space

Set three (four for larger classes) testing stations away from where campers will be working.

- Tape goal containers at the end of an 11 x 36” cardboard sheet; you have three possible options (and an extra one if you need to set up a fourth for large classes).
- Create a X using blue tape about three feet away from the edge of the cardboard to note where campers will stand in line.
- Place a deli container at one of the corners of the cardboard sheet and fill it with three wiffle balls.

![Image of goal container](image)

Note: Measurements do not have to be exact, but are simply guidelines.

Set Independent Work Time materials at the center of each workstation:

- 12” paint stirrers (3 per camper)
- 6” cardboard squares (1 per camper)
- 5” cardboard circles (1 per camper)

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

- yarn (one 20” piece per camper)
- foam shapes (5 pieces per camper)
- markers

Gather a set of all of today’s building materials for the Demo & Discussion.

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

- Golf color copy
## Notes

### Materials Management
Try and keep tape to a minimum if possible; Nebulas have a habit of overusing tape or thinking that additional tape is needed in situations where it’s not.

Most campers will only need two paint stirrers to make the stick, but you do have enough for each camper to use an extra stick to increase rigidity if they want.

### Suggestions for Large Classes
Set up an additional testing range station and request an SI for testing station support. While three stations are suggested, materials are available to set up an additional station.

## On the Board

### Design Challenge
The club must:
- Be as long as the camper’s leg
- Be rigid (not break or bend significantly when swung)
- Include a club head

### 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:
- Help check campers on their taping techniques
- Manage the testing stations to enforce expectations; make sure that each camper takes only three swings to reduce long lines and that wiffle balls are returned
Today’s maker inspiration comes from Samantha Packer and her Cardboard Putt Putt project.

Today: Building the Golf Course
Campers will create a portable golfing play set. Courses must include:

- A container/hole to hit the ball into
- Railings that prevent the ball from rolling off the game
- A tee-off area with enough friction to prevent the ball from rolling around
- Obstacles to that make the game not too easy and not too hard

What’s Next
Tomorrow (Day 3) campers will add 3D structures onto the golf set and add handles to make it portable.
Today’s Project: At-A-Glance

Attach a container to hit the ball into

Example of strawberry basket hole (a long box and solo cup are also options)

Attach railings

Large straws taped to prevent the ball from rolling off the course
Add a tee-off area

Example of burlap tee-off area (foam and fur are also options)

Create and attach other obstacles

Example of cut foam as “lake,” cut fur as “sand pits,” and layered foam shapes to create thicker obstacle
Teaching the Lesson: Overview

OUR SECRET SAUCE: THE G.I.A.

KNOWLEDGE FOCUS

SKILLS AND TECHNIQUES: Taping 3D Objects
Campers use effective taping techniques to adhere 3D objects, such as cups and straws, onto a 2D surface.
Why? – Good taping will be key in order for campers to attach their containers and straw railings. Taping 3D objects can be especially tricky for Nebulas so giving them concrete techniques for how to do this is important. These taping techniques will also form the foundation for tomorrow’s lesson, in which they will create 3D objects from paper.

CONCEPTS AND FACTS: Friction
Campers explore the effects of friction between wiffle balls and different surfaces of their golf courses.
Why? – This knowledge will help campers make informed decisions about which materials to add to different areas of their playing areas in order to achieve certain outcomes (keeping the ball in place when they start and adding an appropriate level of challenge to the course).

PROCESS FOCUS

EVALUATE
Throughout the day campers are presented with a simple question to ask themselves: “What will make my game most fun? Will this make my game fun?”

Why? – It’s going to be important for campers to add elements to their courses strategically; otherwise, their games won’t be fun or playable. Yet, Nebulas can make design choices arbitrarily and don’t always know how to approach evaluating what they’ve built. Providing a concrete question campers can ask themselves gives them a simple way to make sure they’re building games that will be fun.

MINDSET FOCUS

BE REFLECTIVE – I take time to think about what is and isn’t working in my design.
Campers take time to think about what they’re planning to do or what they’ve just built and carefully consider what effects their design decisions will have on the game.

Why? – This Mindset goes hand in hand with today’s evaluation process, ensuring that campers take time to utilize the evaluation question of the day in a meaningful way.

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: Holes and Railings</strong></td>
<td>10 min</td>
</tr>
<tr>
<td>- Introduce container/hole options</td>
<td></td>
</tr>
<tr>
<td>- Demo how to tape containers</td>
<td></td>
</tr>
<tr>
<td>- Demo how to tape straw railings</td>
<td></td>
</tr>
<tr>
<td><strong>Independent Work Time: Adding Holes and Railings</strong></td>
<td>10 min</td>
</tr>
<tr>
<td>- Pick and attach a container/hole</td>
<td></td>
</tr>
<tr>
<td>- Arrange and attach railings; railings must</td>
<td></td>
</tr>
<tr>
<td>- Prevent the ball from rolling off the cardboard</td>
<td></td>
</tr>
<tr>
<td><strong>Demo &amp; Discussion: Friction and Obstacles</strong></td>
<td>10 min</td>
</tr>
<tr>
<td>- Discuss friction</td>
<td></td>
</tr>
<tr>
<td>- Introduce and explore tee-off materials options</td>
<td></td>
</tr>
<tr>
<td>- Demo using materials to create obstacles</td>
<td></td>
</tr>
<tr>
<td><strong>Independent Work Time: Adding a Tee-Off Area and Obstacles</strong></td>
<td>15 min</td>
</tr>
<tr>
<td>- Pick and attach a tee-off area material; the tee-off area must</td>
<td></td>
</tr>
<tr>
<td>- Prevent the ball from rolling around before it’s hit</td>
<td></td>
</tr>
<tr>
<td>- Create and attach different obstacles</td>
<td></td>
</tr>
<tr>
<td>- Test and evaluate the course</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>
<tr>
<td><strong>Transition</strong></td>
<td>5 min</td>
</tr>
</tbody>
</table>

**Timing Notes**
Campers are on track so long as they have a container (hole) and railing attached to the playing area.

If campers or groups are behind
- Shorten the exploration of the different tee-off materials options.
- Skip the technique of layering materials to create obstacles.

If campers or groups are ahead
- They can try the courses of other campers who are done.
# Teaching the Lesson: Play-by-Play

## Introduction (5 min)

| Build excitement and give an overview of today’s project | Yesterday they made toy golf clubs, but now they need a toy golf course! Show the golf game starter they’ll transform into a course and point out details of the project:  
- Will work on this for two days  
- First thing they’ll need to do is add a “hole” to hit a ball into  
- Include railings so the ball won’t fall off  
- They will also add their own obstacles and challenges |
| ★ 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 paying close attention and thinking carefully about where we put things we’re adding to our courses. This will help us make sure our golf games are fun! |
| Introduce campers to a maker who created her own version of today’s project | Show today’s Maker Connection color copy for inspiration  
Read the maker’s name and quickly describe the project  
Pick one of the Q&A’s and share it with campers now:  
- Explain these are things the maker 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 this maker! |

## Demo & Discussion

### Holes and Railings (10 min)

| Introduce today’s evaluation question | Explain whenever campers are going to add or change something, they’ll be asking themselves the question of the day: What will make my game most fun? Will this make my game fun? |
Have campers repeat the question at least twice

Show three different containers campers can use as a hole
- White box
- Strawberry basket
- Solo cup

Inform campers that they’ll need to pick one of these to use

Ask: Which is easiest to hit a ball into? Hardest? In between?
- Long box is easiest, cup is hardest, and strawberry basket is in between

Model asking yourself question of the day: What will make my game most fun?
- Choose one hole type for your demo
- Point out this is personal; some may think an easy hole is most fun while others think hard is more fun
- Important part is they take time to reflect/think about their choices

Next they must decide where to place the hole

Review the question of the day: What will make my game most fun?

Place a container near front of cardboard and ball right in front of it

Ask: Will this make my game fun?
- No! It’s too easy!

Place container perpendicular so the hole is not facing the course
Ask: *Will this make my game fun?*

- No! It’s too hard! It’s impossible to get the ball into the hole this way!

Place container near other end of cardboard

Ask: *Will this make my game fun?*

- Yes! This is a good position. Not too hard and not too easy.

**Tape the container (so it’s not secure) and review golfing techniques as you test**

Use two 3-inch strips of tape to attach a container; tape loosely so the container will fall off when a ball hits it

Inform campers that today they’ll test where they’re building

Review safety and good golfing technique

- Hold with both hands near top of club
- Stand with knees straight
- Head shouldn’t go past knees when swinging

Test the game to show container flops around when ball hits it; this is no fun!

**Redesign by taping the container more securely**

Take the tape off and re-tape to show good taping technique

- Point out that the tape has to touch both the cardboard and container
- Remind campers to press tape down well

Test the game again with the well attached container, noting that the container is now stable and does not move; much more fun!

**Illustrate noticing the need for railings by hitting the ball off the edge of the cardboard**

Putt again; hit the ball so it rolls off the cardboard and you have to chase it

Point out having to keep chasing the ball isn’t that fun either!

Ask: *What can we do to keep the ball from rolling off the cardboard?*
Demo attaching railings and taping techniques

- Add railings!
- Show straws campers can use to do this

Tape at least two large tea straws at the edge of the cardboard to make a portion of the railings; emphasize
  - Making sure tape goes on both sides of the straw
  - Pressing both sides of tape down well

Remind if tape is loose they can un-tape and re-tape instead of just adding more tape

★ Model BEING REFLECTIVE and EVALUATING as you add railings

Position a large straw so it blocks a ball’s path to the container
Ask: *Let’s stop to reflect. Will this make my game fun?*
• No! It will get in the way of the ball

Reposition the large straw by placing it at the edge of the cardboard

Emphasize keeping straws at the edge and as straight as possible

<table>
<thead>
<tr>
<th>Give campers a heads-up about the second part of the activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alert campers they will work for some time but then come back to the center to learn a second exciting thing they’ll add to games</td>
</tr>
<tr>
<td>Practice an attention-getter that serves as the signal for campers to return for additional instruction to make this transition smoother</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>★ Review what campers can do to practice BEING REFLECTIVE today</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking themselves: “Will this make my game fun?” and thinking about what they can do to make their games most fun</td>
</tr>
<tr>
<td>Paying attention to how they’re taping and where they’re putting things</td>
</tr>
</tbody>
</table>

**Independent Work Time**

**Adding Holes and Railings (10 min)**

<table>
<thead>
<tr>
<th>What campers will do: Attach a goal container and railing and then test their games</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREATE</td>
</tr>
<tr>
<td>1. Decide which container to use.</td>
</tr>
<tr>
<td>2. Attach a container of choice on the golf game.</td>
</tr>
<tr>
<td>3. Arrange and adhere railings.</td>
</tr>
<tr>
<td>TEST, EVALUATE &amp; REDESIGN</td>
</tr>
<tr>
<td>4. Test and evaluate the positions of the container and railings.</td>
</tr>
<tr>
<td>5. Rearrange the container and railings if needed or desired.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facilitate CREATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>➤ Have TL refill the tape station if needed</td>
</tr>
<tr>
<td>➤ Have TL help write campers’ names on the bottom sides of their games</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>★ Facilitate TEST, EVALUATE &amp; REDESIGN and support BEING REFLECTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>➤ Have TL pass out wiffle balls and golf clubs to campers when ready to test</td>
</tr>
<tr>
<td>Support campers having trouble with tape</td>
</tr>
<tr>
<td>Encourage proper testing so they can see what game is really like (not rolling ball in by hand or putting ball right next to container to start, etc.)</td>
</tr>
<tr>
<td>Help campers place ball gently to keep it from rolling around before they putt (will redesign to solve this problem in the next part of the activity)</td>
</tr>
<tr>
<td>Ask guiding questions that support being reflective:</td>
</tr>
<tr>
<td>• <em>Does that make your game fun?</em></td>
</tr>
<tr>
<td>• <em>What do you notice as you play?</em></td>
</tr>
<tr>
<td>• <em>Is there something that makes your game too easy/too hard/not fun to use? What might you move/adjust/re-tape to change that?</em></td>
</tr>
<tr>
<td>Recognize reflective campers; be specific about how they’re being reflective:</td>
</tr>
<tr>
<td>• Ex: [In response to a thoughtful answer to a guiding question] Wow! You’re noticing a lot of things about what’s fun and not fun about your game. Way to be reflective! Now you have a lot of things you can do to make your game even more fun.</td>
</tr>
</tbody>
</table>
Transition to the next Demo & Discussion

Give 5, 3, and 1 minute warnings for stopping
Then have campers go to the circle
Reassure they’ll have time to keep working in a bit

Demo & Discussion

Friction and Obstacles (10 min)

<table>
<thead>
<tr>
<th>Introduce the need for a tee-off area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call out you noticed something that wasn’t so fun about your game; the ball kept rolling when you put it on the cardboard</td>
</tr>
<tr>
<td>• This makes ball hard to hit and is a little frustrating</td>
</tr>
<tr>
<td>• Ask if any campers noticed this</td>
</tr>
<tr>
<td>Announce they can solve this problem by creating a tee-off area that can keep the ball in place</td>
</tr>
<tr>
<td>• Tee-off area is where players start their balls in a golf course</td>
</tr>
<tr>
<td>• They’ll cover the tee-off area (front of the cardboard) with a different material to keep ball in place</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Introduce the concept of friction and how more friction causes the ball to move less</th>
</tr>
</thead>
<tbody>
<tr>
<td>To make the tee-off area they’ll need to think about friction</td>
</tr>
<tr>
<td>Explain friction is created when two things rub together</td>
</tr>
<tr>
<td>• Have campers rub hands together to create friction</td>
</tr>
<tr>
<td>Different materials/surfaces cause different amounts of friction</td>
</tr>
<tr>
<td>• If a ball rolls on something flat/smooth/slippery there isn’t a lot of friction; it will roll around easily and quickly</td>
</tr>
<tr>
<td>• If a ball rolls on something rough/bumpy/not flat there is more friction; it won’t roll around as easily and will go more slowly</td>
</tr>
<tr>
<td>Cardboard is smooth; doesn’t cause much friction</td>
</tr>
<tr>
<td>• The object (ball) will roll/move around more easily on plain cardboard</td>
</tr>
<tr>
<td>• Drop the ball about two inches above the cardboard to show this</td>
</tr>
</tbody>
</table>

Since they don’t want the ball to roll around on the tee-off area they’ll want to cover the cardboard with a material that has more friction
| Introduce three materials options for the tee-off area | Inform they'll pick one of these materials to glue onto the cardboard to create a tee-off area  
- Burlap  
- Foam  
- Fur |
|---|---|
| Pass around the foam swatch and test to see if it stops the ball from rolling | ➤ Have TL pass out a few swatches of foam  
Have campers feel foam and then pass it on; have them notice how flat/smooth/slippery it feels  
Ask: *Do you think this will have more or less friction than the cardboard? Do you think this will have enough friction to keep the ball from moving around?*  
- Campers can give a thumbs-up or thumbs-down if they think it will or won't work  
Lightly drop the ball about 2 inches above the material  
Conclude foam is smooth so ball still rolls around a little, but less than on plain cardboard |
| Repeat for the burlap and fur | Conclude burlap is a little less flat/smooth than foam; has a little more friction  
Conclude fur is the least flat/smooth; has the most friction |
| Demo how to attach one of the materials options with a glue stick | Remind that as they choose and attach a material they should think about what will make game most fun  
- Choose burlap for your demo  
- Again, point out it’s a personal choice of which material to choose, but they should think about it  
Use a glue stick to attach the burlap onto the front of the cardboard opposite the hole  
- Emphasize putting glue onto material then pressing onto the cardboard  
- If they put glue onto cardboard ball might get stuck to it when they’re playing (not fun!)  
- Remind about pressing material down well |
| Introduce adding obstacles to make the game a little more challenging and fun | In addition to making a tee-off area they can also add different materials to other places on the cardboard to make obstacles  
Show the Golf Courses color copy |
Point out golf courses have obstacles like sand traps (places with a lot of friction where ball gets stuck) or lakes to try to avoid
Obstacles make game a little more tricky; fun to have some challenge in a game as long as it’s not too hard!

**Demo how to cut and glue materials to create obstacles**

Can cut and glue foam, burlap, and fur to make pretend sand/lakes/grass/etc.
Demo this quickly by cutting a small shape of fur to make a “field of grass”

Use a glue stick to place glue on the back of the fur and then place it on the game; remind not to apply glue to the cardboard
Roll the ball over the fur obstacle to show it makes the ball slow down/get stuck

**Demonstrate how to layer materials**

**Timing Note**: This can be skipped if you are very behind
Point out they can put materials atop one another to make taller and unique obstacles; foam is best for this
Tell campers you’ll use layering to make a “mountain”
Show how to do this by cutting out three foam circles of increasing size

Emphasize that to layer the biggest piece should be on the bottom and the smallest should be on top so you can see it!
• Have campers tell you which piece should go first, second, third
• Glue accordingly
Attach the finished layered obstacle onto the game.
Roll the ball at the obstacle to show it makes the ball slow down or curve.

Support BEING REFLECTIVE by discussing how to make sure they add obstacles in a way that makes the game fun:

- Remind that as campers add obstacles they should think about if what they’re adding will make their games fun.
- Ask: If I only make one tiny obstacle and put it way in the corner will that make my game most fun?
  - No; ball will never hit obstacle
  - Game might be too easy and get boring after a while
- Ask: If I put obstacles all over the place and cover my whole entire board, even my hole, will that make my game fun?
  - No; might be impossible to get ball into hole!
  - If it’s too hard to get ball in game might get frustrating
  - Also alert campers they’ll be adding more fun things onto their games tomorrow so they want to leave some room for them.

Review what campers can do to practice BEING REFLECTIVE today:

- Asking themselves: What will make my game most fun? Will this make my game fun?

Thinking about what they’re using for obstacles and tee-off areas and where they’re putting them.

Hand out tee-off area materials:

- Have campers choose their tee-off area materials and hand them out to them.
- They can start working once they have a material.
- After they glue it down they can get additional materials for obstacles at the materials station.
Independent Work Time

**Adding a Tee-Off Area and Obstacles (15 min)**

<table>
<thead>
<tr>
<th>What campers will do: Use foam, burlap, and fur to add a tee-off area and different obstacles</th>
<th>CREATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Attach the tee-off material by adding glue to the back of the material and pressing it onto the cardboard.</td>
</tr>
<tr>
<td></td>
<td>2. Cut and glue additional obstacles from foam, burlap, and/or fur. Materials can be layered if desired.</td>
</tr>
<tr>
<td></td>
<td>TEST, EVALUATE &amp; REDESIGN</td>
</tr>
<tr>
<td></td>
<td>3. Test the game with new obstacles to make sure it’s not too easy and not too hard.</td>
</tr>
<tr>
<td></td>
<td>4. Redesign aspects of the game if needed or desired.</td>
</tr>
</tbody>
</table>

**Facilitate CREATE**

Remind campers to layer by starting with gluing the top-most piece on the next piece

Ensure campers are applying glue to material not cardboard; otherwise, cardboard will get sticky

➤ Have TL help campers who are still working on straw railings

Help campers cut burlap or fur if needed

Watch out for campers overusing materials; stick to materials limits

• Encourage using scraps if necessary

**★ Facilitate TEST, EVALUATE & REDESIGN and support BEING REFLECTIVE**

Watch out for campers covering too much of the cardboard with layered obstacles; these may affect ability to add paper tunnels/hills tomorrow

Invite trying each other’s games so they can see how fun someone else thinks their games are

Recognize reflective campers; be specific about how they’re being reflective:

• Ex: I see you had a lot of obstacles and now you’re taking some of them off. Tell me about why you decided to do that. What did you notice?...Way to be reflective!

Ask guiding questions that support being reflective:

• Which obstacles are most fun? Which are least fun? What if you change/remove those?

• What do you notice about the ball and your obstacles as you play? How does your ball move? Do the obstacles make your game too hard/easy/not fun?

**Clean Up (5 min)**

<table>
<thead>
<tr>
<th>Clean Up</th>
<th>Have campers return all reusable foam, burlap, and fur</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>If a camper has glued all over the cardboard don’t fold it up until dry so it doesn’t stick together</td>
</tr>
</tbody>
</table>
Lesson Wrap Up (10 min)

Celebrate campers for their work and recap what they learned today

Recognize campers for making such fun golf games today!
Show examples and have creators share one thing they added or changed to make their games as fun as possible
  • Have them share how material they added affects the ball (Does it make the ball change direction? Stop? Slow down? Etc.)
  • Others can give a me-too signal if they added or changed something similar

★ Summarize the importance of BEING REFLECTIVE and have campers recall if/how they practiced this today

Highlight effect of practicing Mindset during today’s project
  • Ex: *One thing that helped us create awesome golf courses was using our reflective powers to stop and think about how to make our games more fun!*

Have campers give a thumbs-up if they practiced being reflective today by:
  • Thinking about what container they were choosing and where they were putting it to make sure it made game fun
  • Thinking about how and where they were taping straws
  • Thinking about what other materials they were choosing and where they were putting them to make sure they made game more fun
  • Noticing something in the game that wasn’t fun and making it better

If applicable recognize specific campers for exhibiting above behavior (especially campers who changed something in their games)

Review why reflection is important for innovation
  • Ex: *We can use our powers of reflection to make sure our creations are turning out just the way we want and as awesome as possible!*

Revisit today’s maker connection

Remind campers about the toy maker they learned about earlier

Ask: *Do you think this maker had to be reflective when making her toy? How?*

If there’s a relevant Q&A read/revisit it now
**Lesson Materials**

* (starred) materials appear multiple times in this list

**Copies**
- copy, color, Golf Courses (2 per classroom)
- copy, color, Maker Connection (2 per classroom)

**General/Adhesives/Tools**
- tape, masking, 1", for attaching container and railings (25" per camper)
- scissors, medium, 5", pointed (1 per 2 campers)
- glue stick, washable, for adhering putting green or obstacles (1 per 2 campers)

**Required Materials**
- cardboard, custom, 36 x 11" w/ 2 middle folds (1 per camper)
- straw, milkshake (8 per camper)
- ball, wiffle, sm. (1 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.)

**Container materials** (campers each pick one)
- basket, strawberry (1 per camper)
- box, gift, white, 7 x 3 x 3" (1 per camper)
- cup, plastic, heavy duty, red, 16 oz. (1 per camper)

**Putting green and obstacle materials**
- fabric, burlap, asst. colors, 9 x 12" (two 4.5 x 6" pieces per camper)
- fur, green, 9 x 12" (two 3 x 3" pieces per camper)
- foam strip, asst. colors, 2 x 24" (four 2 x 6" pieces per camper)

**Materials Preparation**

1. Cut burlap into fourths (two 4.5 x 6" pieces per camper). Measurements don’t need to be exact and you can cut two to three sheets of burlap at a time for efficiency.

**Optional:** You also have to cut burlap into fourths for Day 5. Be efficient and get a head start on Day 5 prep by continuing to cut burlap while you have it out (one 4.5 x 6" piece per 2 campers). This burlap will be reused each rotation so just cut enough for your largest rotation.

2. Cut fur into twelfths (two 3 x 3" pieces per camper). Again, measurements don’t need to be exact.

3. Cut foam strips into fourths to make 2 x 6" pieces (4 pieces per camper). Again, measurements don’t need to be exact and you can cut multiple strips at a time for efficiency.

**Setting Up the Space**

Arrange the room in a way that will provide campers enough space to test their games without moving around. It’s suggested that campers work on the floor and not on tables due to the large size of their games.
Rip 3" pieces of tape and set up a system for distributing it like a tape chair or wall (see Materials and Prep for the Summer for details).

Set the game, container and railing materials at the center of each workstation:
- cardboard, custom, 36 x 11" w/ 2 middle folds (1 per camper)
- basket, strawberry (3 per 4 campers)
- box, 7 x 3 x 3", white jewelry (1 per camper)
- cup, plastic, heavy duty, red, 16 oz. (3 per 4 campers)
- straw, milkshake (8 per camper)

Gather materials for the Demo & Discussion:
- a sample of each container option and railing materials
- tape
- a ball

Set the materials for tee-off areas and obstacles on a lunch tray. Set it aside until the second half of the rotation.
- fabric, burlap, asst. colors, 9 x 12" (two 4.5 x 6" pieces per camper)
- fur, green, 9 x 12" (two 3 x 3" pieces per camper)
- foam strip, asst. colors, 2 x 24" (four 2 x 6" pieces per camper)
- scissors, medium, 5", pointed (1 per camper)
- glue stick, washable (1 per 2 campers)

Put up the following color copies on your copies display board:
- Golf Courses
- Maker Connection

Notes
Materials Management
You might not want to put out the obstacle materials options for each rotation all at once. This will help ensure campers are not overusing materials and that you have enough materials for each rotation.

On the Board
Design Challenge
Courses must include:
- A container/ hole to hit the ball into
- Railings that prevent the ball from rolling off the game
- A tee-off area with enough friction to prevent the ball from rolling around
- Obstacles to that make the game not too easy and not too hard

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 hand out clubs and balls when campers are ready to test
- Help pass around materials swatches during the friction demo
Day 3: Golf Game, Part 3 of 3

Today campers will complete their golf games by adding handles and creating a paper hill and tunnel. Then they’ll add tabbed and hanging paper shapes to transform their hills and tunnels into special elements. The golf game must:

- Include a paper tunnel that a ball can roll through
- Include a paper hill that a ball can roll over
- Remain intact when carried around
Today’s Project: At-A-Glance

Create a paper tunnel

Create a paper hill

Attach pipe cleaners handles
Create tabbed and/or hanging elements
Teaching the Lesson: Overview

OUR SECRET SAUCE: THE G.I.A.

KNOWLEDGE FOCUS

SKILLS & TECHNIQUES: 3D Paper Construction
Campers learn to bend, fold, tab, and tape flat paper strips to create three-dimensional structures.

Why? – These techniques are necessary for creating functional hills and tunnels for their games, and learning them will expand what campers are able to make with paper in the future.

PROCESS FOCUS

GENERATE IDEAS: Trigger List
Campers view images of different environments (oceans, rainforests, space, etc.) to help them get ideas about what elements they might turn their hills and tunnels into. They brainstorm as a group before starting.

Why? – Campers can turn their structures into literally anything, and while some campers may have clear ideas right away, others may not know where to start. Taking time to brainstorm as a group helps give everyone a solid launch pad for their ideas and is a great way to get campers excited about building. Using imagery as inspiration is a simple and effective idea generation strategy.

MINDSET FOCUS

BE VISIONARY – I imagine things that don't exist yet.
Campers imagine many new and different ways to transform their tunnels and hills, and they envision special golf courses unlike any other.

Why? – Today's project lends itself especially well to endless possibilities, yet campers may latch onto the one idea you demo or whatever idea their best friends are doing. Today’s Mindset Focus helps encourage campers to recognize and pursue a wide variety of ideas, leading to golf course elements that are more unique, personalized, and exciting!

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>Guided Activity: Paper Hills, Tunnels, and Handles</strong></td>
<td>15 min</td>
</tr>
<tr>
<td>☐ Facilitate constructing paper tunnels</td>
<td></td>
</tr>
<tr>
<td>☐ Facilitate constructing paper hills</td>
<td></td>
</tr>
<tr>
<td>☐ Facilitate attaching pipe cleaner handles</td>
<td></td>
</tr>
<tr>
<td><strong>Demo &amp; Discussion: Tabbed and Hanging Elements</strong></td>
<td>10 min</td>
</tr>
<tr>
<td>☐ Demo attaching and testing tabbed elements</td>
<td></td>
</tr>
<tr>
<td>☐ Brainstorm possible tabbed elements</td>
<td></td>
</tr>
<tr>
<td>☐ Demo attaching and testing hanging elements</td>
<td></td>
</tr>
<tr>
<td>☐ Brainstorm possible hanging elements</td>
<td></td>
</tr>
<tr>
<td><strong>Independent Work Time: Finishing the Golf Game</strong></td>
<td>25 min</td>
</tr>
<tr>
<td>☐ Draw, cut, and adhere tabbed and/or hanging elements</td>
<td></td>
</tr>
<tr>
<td>☐ Test by rolling a ball and carrying the game; the game must</td>
<td></td>
</tr>
<tr>
<td>• Include a paper tunnel that a ball can roll through</td>
<td></td>
</tr>
<tr>
<td>• Include a paper hill that a ball can roll over</td>
<td></td>
</tr>
<tr>
<td>• Remain intact when carried around</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>
<tr>
<td><strong>Transition</strong></td>
<td>5 min</td>
</tr>
</tbody>
</table>

**Timing Notes**

Campers are on track so long as they have a playable golf game with handles and all elements firmly attached to the board.

If campers or groups are behind

- Demonstrate either tabbed or hanging elements, but not both.

If campers or groups are ahead

- Let campers play their games and try the games of other campers who are finished.
# 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. Eville 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**

Ask if anyone has played golf on a course with extra fun features like tunnels, hills, pretend buildings, etc.

Show the Mini Golf color copy; maybe something like this!

Announce transforming their courses today by adding some special features

- Will make a tunnel and hill all together
- Then will transform their tunnels and hills to look like whatever special things they want

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

Define the Mindset element in the context of today’s lesson

- Today we’re going to focus on being visionary! This means using our imaginations to think about how we can create special features for our golf courses that have never existed before!

## Guided Activity

**Paper Hills, Tunnels, and Handles (15 min)**

**Introduce 3D shapes using the 8 x 3” strips of cardstock**

Inform campers will create hills and tunnels from cardstock strips

Lay a strip on the ground and ask: *Is this the shape of a hill or tunnel?*

- No, right now the strip is flat

Explain when the strip is lying flat it’s two-dimensional or 2D

Bend the paper to form an arc; confirm this is the shape of a hill or tunnel

Explain when the strip is not flat like this it’s three-dimensional or 3D

To make hills/tunnels today they’ll need to bend and tape paper to make it 3D

- Inform you’ll show them technique for this
- Then they’ll try it out themselves!
Discuss positioning the tunnel

First thing they’ll add is a tunnel

Want to pick a place on the board where they have some space
  - OK if it goes over a fairly flat obstacle from yesterday
  - Want to watch out for tall/layered obstacles

Just like yesterday they want to think of where it would be fun to have a tunnel
  - Will be hard for ball to go through it if they put it at the very edge/start

Emphasize strip should go across the width of the course not up and down the length
  - Show the difference between this so campers understand
  - If not tunnel will be sideways and ball won’t be able to go through it

Demo how to construct a paper tunnel using the longer 8 x 3” cardstock strips (prepped ahead of time)

Lay strip down at desired spot and tape one end

Put another piece of tape on the other end of the paper strip, but don’t tape it to the cardboard yet!

Push the unattached end of the strip towards the other side to form a 3D tunnel
Once you have a good size tape down the other end

- Remind that the tunnel has to be big enough for a ball to pass through
- Can slowly make tunnel taller and have campers tell you when to stop

Now it’s time to test to make sure ball can go through easily and tunnel is taped well

Demo rolling a ball through the tunnel with your hand

Clarify they’ll get to use clubs to play their games later, but for now they just want a quick way to test size/stability so clubs aren’t needed

➤ Have TL help pass out each camper’s game, long strips of cardstock, and trays with tape

Ensure campers are laying strips across the width of the course

Remind campers to be mindful of where they place their tunnels

Invite campers to ask a friend to hold the paper strip in place while they tape if they’re having trouble doing both at the same time

Pass out a few balls as campers finish taping tunnels

- Instruct campers to pass ball to another camper waiting to test once they’ve successfully tested

Help campers re-tape and reposition paper as needed after testing
<table>
<thead>
<tr>
<th>Discuss positioning the hill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once all campers have tested collect balls</td>
</tr>
<tr>
<td>Next thing they’ll make is a hill for ball to roll over</td>
</tr>
<tr>
<td>Just like tunnel want to make sure they have space and it’s in a fun spot</td>
</tr>
<tr>
<td>Emphasize unlike tunnel they’ll place this strip up and down the length not across</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Demo constructing paper hills using the shorter 4 x 3&quot; cardstock strips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lay the 4&quot; strip up and down the length of the cardboard and tape one end</td>
</tr>
<tr>
<td>Again, put a piece of tape on the other end of the strip but don’t tape down yet!</td>
</tr>
<tr>
<td>Just like tunnel pull the unattached end towards attached end</td>
</tr>
<tr>
<td>Make the hill too steep at first then try to roll ball up it</td>
</tr>
</tbody>
</table>
• Point out when the hill is too big the ball can’t go over it
• Also can’t make paper hill too big without putting something under it since paper is really bendy
Redesign to make the hill smaller and test again

• Emphasize you only need to scrunch paper together a little bit (the size of a fingertip)

Have campers create a hill using a shorter strip of cardstock

➤ Have TL help pass out shorter strips of cardstock
Ensure campers are laying strips up and down the length of the course
Pass out balls to campers as they finish taping hills
Help campers re-tape and reposition paper as needed after testing
Recollect balls once all campers have tested

Demo how to attach large pipe cleaners as handles

Last thing they’ll do is add handles so they can carry toy around!
Fold cardboard in half
Fold a U-shape with a pipe cleaner and tape it to the top of the game
• Emphasize making sure tape covers both ends of pipe cleaner
• Emphasize pressing well but not too hard or they’ll squish their paper hills and tunnels on the inside!
Flip the game over and repeat with another pipe cleaner on the other side.

Have campers attach pipe cleaner handles onto their games.

➤ Have TL help pass out large pipe cleaner pieces

Help campers tape and complete this step as fast as possible

• Campers should not struggle with this step
• This is not meant to be a main designable element for today

Demo and Discussion

Tabbed and Hanging Elements (10 min)

| Introduce the goal of transforming the hill and tunnel into unique elements | Announce their next goal: use their visionary powers to transform their plain tunnels and hills
• Maybe they make the tunnel look like a mountain or a pirate ship!
• Maybe they make the hill look like a bridge or a dragon!
Will learn two more building techniques to do this
Will still need to test as they build to make sure ball can still go through tunnel/over hill and that the game is still fun |
| Introduce the idea of adding standing paper shapes and cut an example shape | Explain one way to transform hills and tunnels is to add different paper shapes beside them
Inform you really want your hill to look like a mountain |
Draw and cut a large mountain shape from construction paper

Hold it up to the side of the hill to show how now from the side when the ball goes over the hill it will look like it’s going through a mountain!

This works great, except it’s tricky to get a flat 2D shape to stand up; using tabs is a great way to do this.

Demo transforming structures by adding tabs to your example shape

Show the precut tabs (prepped ahead of time) you’ll use to make your mountain stand up next to your tunnel

Explain you’ll use two tabs, one for each side of the mountain

Fold tabs in half

Using a glue stick, put a glue on half of one tab and adhere it to one side of the mountain; point out that half of tab is hanging off

Repeat with other tab

Add glue to the other half of the tabs and press the tabs onto the cardboard
Lift the mountain shape and crease the tabs to make the mountain stand up.

Review tabbed shape options
- Could cut another mountain shape and add it on the other side of hill so it looks like a mountain from both sides!
- Could add tabbed shapes to sides of tunnel in same way

Discuss testing after adding a tabbed shape
Remind testing the tunnel/hill after adding a tabbed shape to make sure ball can still roll through/go over
  - Can use their hands to roll ball like before
Also want to test that shapes are glued well
  - Show how to do this by folding game in half, holding it by handles and walking around a bit
  - All pieces of the game should still be stuck on when reopened

★ Support BEING VISIONARY and GENERATING IDEAS by showing visual triggers and brainstorming other tabbed elements as a group
Announce taking some time to use their visionary powers to imagine fun shapes/elements they could add next to their tunnels/hills to transform them
To help them do this they’ll look at some fun pictures; show the Trigger List: Ocean, Rainforest, Space, Big Cities color copies
Brainstorm ideas as a group; ask:
- What do you see in these pictures?
- Does that give you any ideas about what else a tunnel/hill could be besides a mountain?
- Who has a totally different idea than the one just shared?

Emphasize there are wrong answers; anything campers can draw and imagine will work!

Introduce the idea of adding hanging paper shapes and cut an example shape

Another way they can turn their tunnels/hills into something else is to add hanging shapes

Call out now that you have a mountain you want your tunnel to turn into a cave with a bird flying around it

Draw and cut a large bird from construction paper
But how will you attach your shape so it hangs in the air? (Pipe cleaners!)

**Demo transforming structures by hanging your example shapes with pipe cleaners**

Lay your cutout on a surface and tape one end of a pipe cleaner to it.

Attach another strip of tape on the opposite end of the pipe cleaner.

Tape the pipe cleaner to the tunnel; emphasize you’re pinching the pipe cleaner between your thumb and fingers to press tape down well.
Show how you can change the direction/position of the bird shape by bending pipe cleaner gently

- Can bend to make shapes stick up, stick out, or hang down
- Emphasize bending in small increments so pipe cleaner doesn’t come loose

Review hanging shape options
- Could add multiple hanging shapes to other spots around tunnel
- Could add hanging shapes to sides of hill in same way

Discuss testing after adding a hanging shape
Again will need to test to make sure hanging pieces don’t get in the way
May need to bend pipe cleaner or make shape smaller if the hanging piece is in the way
May also need to remove some hanging pieces or make them smaller if they’re too heavy and pulling the tunnel/hill down

★ Support BEING VISIONARY and GENERATING IDEAS by showing visual triggers and brainstorming other hanging elements as a group

Ask: *What else can we add using pipe cleaners to the tunnels/hills to turn them into something else?*

Ask: *Who has a totally different idea than the one just shared?*

Refer back to visual triggers as a way for campers to get ideas

Some fun character possibilities you might mention
- Could make eyes or antennae that stick up
- Could make arms/appendages that stick out
- Could make teeth shape that hangs down from tunnel to make a giant mouth
Support BEING VISIONARY by having campers close their eyes and imagine how they want to transform their structures.

Inform campers that they’re going to use their visionary powers again to imagine what elements they want in their final games.

Have them close their eyes and think silently to themselves:
- Ask: What do you imagine as part of your course that will make it super fun and special?
- Ask: Think of one idea you heard so far that you think is awesome and might want to turn your tunnel or hill into.
- Ask: Think of one idea no one has said yet that you might want to turn your tunnel or hill into.

Have them give a thumbs-up when they have at least one idea.

If time have a few share their visions of what they might want to make.

**Independent Work Time**

**Finishing the Golf Game (25 min)**

<table>
<thead>
<tr>
<th>What campers will do: Add tabbed and hanging elements to transform their tunnels and hills</th>
<th>CREATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Draw and cut shapes from 4.5 x 6&quot; pieces of construction paper.</td>
<td></td>
</tr>
<tr>
<td>2. Glue 3 x 1&quot; tabs to attach shapes standing up next to tunnels or hills, or tape pipe cleaners to hang shapes from the sides of tunnels or hills.</td>
<td></td>
</tr>
</tbody>
</table>

**TEST & EVALUATE**

| 3. Test the game to see if the ball can go through the tunnels and hills. |
| 4. Make sure nothing falls off the game when it’s folded and moved. |

**Extension**

Play with the golf toy and try the toys of their friends who are also finished.

---

Facilitate CREATE

If campers have drooping tabbed shapes:
- Help them crease their tabs again so they’re more upright
- If necessary put a small amount of glue or a piece of tape and attach it to the side of the tunnel or hill

Remind campers to pinch the tape and press the glue whenever they adhere for strong connections.

Redirect campers who are drawing on a cardstock hill to draw on tabbed or hanging decorations instead; the hills are flimsy and may get damaged.
| Facilitate TEST AND EVALUATE | Remind campers to bend pipe cleaners in small increments  
Remind campers to occasionally fold up the game and walk around the room with it; have them check if anything falls off  
Have campers test by rolling the ball; toward the last 5-10 minutes of class, you can pass out campers’ golf clubs and have them play their games |
| ★ Support BEING VISIONARY | Do some one-on-one brainstorming with campers having trouble thinking of ideas; reference the visual triggers  
If campers do want to do the same thing as a neighbor encourage them to imagine how they can add a twist to make their versions special/different  
Ask campers about what they’re creating/imagining; something that doesn’t look like anything to you could have an amazing visionary story behind it  
Recognize visionary campers; be specific about how they are being visionary  
  • Ex: Wow! I’ve never seen a golf game with a tunnel that looks like a giant alien head with seven eyes! Way to be visionary! |
| Clean Up (5 min) | Clean Up  
Have campers put all usable scraps into the scrap bin and any unused tabs back in deli containers  
Fold and stack camper games to save space |
| Lesson Wrap Up (5 min) | ★ Summarize the importance of BEING VISIONARY and have campers recall if/how they practiced this today  
Recognize how different and creative everybody’s work is  
Highlight effect of practicing Mindset during today’s project  
  • Ex: One thing that helped us create so many interesting golf courses that are all different was using our powers of being visionary!  
Have campers use visionary goggles if they practiced being visionary today by:  
  • Imagining lots of different ideas for what else a tunnel and hill could be  
  • Imagining and creating something to make their courses special  
If time have a few campers share one visionary idea they created to make their courses special  
Review why vision is important for innovation  
  • Ex: You can use your powers of being visionary to help you imagine lots of new and surprising ways to transform an ordinary thing like a hill or a tunnel. |
Get Ready!

Lesson Materials

* (starred) materials appear multiple times in this list

Copies
- copy, color, Mini Golf (2 per classroom)
- copy, color, Trigger List: Ocean (1 per classroom)
- copy, color, Trigger List: Rainforest (1 per classroom)
- copy, color, Trigger List: Space (1 per classroom)
- copy, color, Trigger List: Big Cities (1 per classroom)

General/Adhesives/Tools
- tape, masking, 1", for attaching paper/pipe cleaners (25" per camper)
- scissors, medium, 5", pointed (1 per camper)
- glue stick, washable, for adhering tabs (1 per camper)
- marker, washable, asst. color, set of 8, for decorating and coloring (1 per 4 campers)
- tray, lunch, for storing supplies (1 per 4 campers)
- container, plastic, deli, 16 oz., for storing paper tabs (1 per 4 campers)

Required Materials
- pipe cleaner, asst. colors, giant, for handles (2 half pieces per camper)
- cardstock, strips, bright colors, 3 x 24", for tunnels and hills (one 8 x 3" and one 4 x 3" strip per camper)
- ball, wiffle, sm. (1 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.)
- paper, construction, Brights, asst. colors, 9 x 12", for custom shapes (two 4.5 x 6" sheets per camper)
- pipe cleaner, asst. colors, 12", for hanging shapes (six 4" pieces per camper)
- index card, lined, asst. colors, 4 x 6", for tabs (four 3 x 1" strips per camper)

Materials Preparation

Cut cardstock for tunnels (1 sheet per 4 campers). Cut strips into fourths to create 8 x 3" strips (1 strip per camper).
  - Cut multiple strips at a time for efficiency.
  - Precise measurements are not important for this.

Important: Don’t cut all the cardstock you have to this size as some of it needs to be cut to a different size for hills.

Cut cardstock for hills (1 sheet per 8 campers). Cut sheets into eighths to create 4 x 3" strips (1 strip per camper).
  - Cut multiple sheets at a time for efficiency.
  - Precise measurements are not important for this.

Important: Don’t cut all the cardstock you have to this size as some of it needs to be cut to a different size for tunnels.
Cut construction paper for custom shapes (1 sheet per 2 campers). Cut sheets in fourths to create 4.5 x 6" pieces (2 pieces per camper).
- Use the paper cutter and cut multiple sheets at a time for efficiency.
- Precise measurements are not important for this.

Cut index cards into eighths to create 3 x 1" strips for tabs (4 strips per camper).
- Create folded guidelines by holding it horizontally and folding it in half. Then fold it hot dog style twice.
- Open and cut along the folds.
- You can cut at least 3 to 4 index cards at a time for efficiency.
- Precise measurements are not important for this.

Cut giant 18" pipe cleaners in half for the handles (2 half pieces per camper).
- Group multiple pipe cleaners together and make one cut for efficiency.
- Precise measurements are not important for this.

Cut 12" pipe cleaners into thirds for hanging shapes (6 pieces per camper).
- Group multiple pipe cleaners together and make one cut for efficiency.
- Precise measurements are not important for this.

Rip 2" pieces of tape and set up a system for distributing it like a tape chair, wall, or tray (see Materials and Prep for the Summer for details).

### Setting Up the Space

Set aside materials for making hills, tunnels, and handles so you can easily pass them out during the first activity.
- pipe cleaner, asst. colors, giant, for handles (2 half pieces per camper)
- cardstock, strips, bright colors, cut into 8 x 3" strips, for tunnels (1 strip per camper)
- cardstock, strips, bright colors, cut into 4 x 3" strips, for hills (1 strip per camper)

Be prepared to pass out each camper’s golf game during the first activity.

Set out the following materials on trays to be passed out for the second part of the lesson:
- scissors, medium, 5", pointed, for cutting construction paper (1 percamper)
- glue stick, washable, for adhering tabs and decorations (1 per camper)
- marker, washable, asst. color, set of 8, for decorating and coloring (1 set per workstation)
- paper, construction, Brights, asst. colors, cut into 4.5 x 6" pieces (2 pieces per camper)
- deli containers of index card tabs (4 tabs per camper)

Gather materials for the Demo & Discussion:
- Your sample golf game from yesterday
- A set of tunnel and hill making materials
- A set of materials for adding tabs and pipe cleaners

Put up the following color copies on your copies display board
- copy, color, Mini Golf
- copies, color, Trigger List: Ocean, Space, Rainforest, Big Cities
- copy, color, Maker Connection
Notes

Materials Management
Just like yesterday, it’s probably easiest to have campers work on the floor the whole day.
Note that campers can go home with wiffle balls on Friday.

On the Board

Design Challenge
The golf game must:
• Include a paper tunnel that a ball can roll through
• Include a paper hill that a ball can roll over
• Remain intact when carried around

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:
• Be ready to pass out campers’ games for the Guided Activity
• Help pass out materials for the Guided Activity and help campers with making paper tunnels and hills
Day 4: Magnet Game

This magnetic game is inspired by the classic 1960s toy, the Magnetic Dollhouse.

Campers build a magnetic game piece and wand. They try to push a wooden wheel into a cup by moving the game piece across a cardboard game board. They add appendages to the game piece to make the game easier and obstacles to the board to make it more challenging. The game must:

- Be fun in the camper’s opinion
- Not be too hard and not be too easy
Today’s Project: At-A-Glance

Make the wand and the game piece

A small rare earth magnet taped to a paint stirrer wand and a foam game piece

Use the wand and game piece to push a wheel into a cup

The goal is to push a wheel into a goal (cup)

Add appendages to the game piece to make the game easier

Pipe cleaner appendages added to make it easier to push the wheel around
Add obstacles to make the game more challenging.

Rubber band barriers, pipe cleaner hoops, and wheels added as obstacles on the game board.

Share the games with friends.

Campers share their games with each other at the end of the rotation.
Teaching the Lesson: Overview

OUR SECRET SAUCE: THE G.I.A.

KNOWLEDGE FOCUS

CONCEPTS AND FACTS: Magnets and Polarity
Campers understand the basics of magnetism and how the polarity of magnets matters when magnets are interacting.

Why? – Magnets might appear to be mysterious and unpredictable at times. By giving campers knowledge about how magnets work, they’ll be better able to build and control their magnetized game pieces.

PROCESS FOCUS

IDENTIFY THE GOAL and EVALUATE
After testing their games, campers ask themselves, “Do I want to make my game easier or harder?” They then redesign the game piece or the board based on their answer.

Why? – Campers don’t always know how to evaluate and redesign meaningfully. Giving campers one simple question to answer is a good way to help campers redesign with purpose, and makes it more likely that they’ll recognize and act on opportunities to improve the gameplay experience.

MINDSET FOCUS

BE REFLECTIVE – I take time to think about what is and isn’t working in my design.
Campers pay careful attention to what it’s like to play their games and take the time to consider whether they want to make their games easier or harder.

Why? – Campers may get wrapped up in playing with their games and forget to think about how they can continue to improve them. Today’s Mindset helps ensure campers go through the Process steps of evaluating and identifying a goal as they play.

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: Magnets</strong></td>
<td>5 min</td>
</tr>
<tr>
<td>- Introduce how magnets work and how the polarity of magnets is important</td>
<td></td>
</tr>
<tr>
<td><strong>Guided Activity: Build the Wand and Game Piece</strong></td>
<td>15 min</td>
</tr>
<tr>
<td>- Facilitate campers taping magnets to the wand and foam game piece</td>
<td></td>
</tr>
<tr>
<td>- Facilitate as campers try playing the game by pushing a wheel into a cup</td>
<td></td>
</tr>
<tr>
<td><strong>Demo &amp; Discussion: Appendages and Obstacles</strong></td>
<td>5 min</td>
</tr>
<tr>
<td>- Demo how to add pipe cleaner appendages to the game piece</td>
<td></td>
</tr>
<tr>
<td>- Model how to evaluate the difficulty of the game</td>
<td></td>
</tr>
<tr>
<td>- Discuss what makes a game fun (balance of easy and challenging)</td>
<td></td>
</tr>
<tr>
<td><strong>Independent Work Time: Make the Game More Fun</strong></td>
<td>10 min</td>
</tr>
<tr>
<td>- Add appendages to the game piece</td>
<td></td>
</tr>
<tr>
<td>- Add obstacles to the game board</td>
<td></td>
</tr>
<tr>
<td>- Playtest the magnet game; the game must:</td>
<td></td>
</tr>
<tr>
<td>- Be fun in the camper’s opinion</td>
<td></td>
</tr>
<tr>
<td>- Not be too hard and not be too easy</td>
<td></td>
</tr>
<tr>
<td><strong>Guided Activity: Share the Game Boards</strong></td>
<td>10 min</td>
</tr>
<tr>
<td>- Facilitate as campers test the game boards and game pieces of other campers</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>
<tr>
<td><strong>Transition</strong></td>
<td>5 min</td>
</tr>
</tbody>
</table>

Timing Notes
Campers are on track so long as everyone is able to create a magnetic game piece, add obstacles, and playtest their game boards a few times.

If campers or groups are behind
- Skip or shorten the board-sharing activity.

If campers or groups are ahead
- Give campers more time to play each other’s games.
- Have campers do a super thorough cleanup and sort the obstacle materials.
- Allow campers to try using their wands and game pieces on their golf courses.
# Teaching the Lesson: Play-by-Play

## Introduction (5 min)

<table>
<thead>
<tr>
<th>Give context for today’s project: Introduce magnetic games</th>
<th>Show the color copy Magnetic Board Game</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image" alt="Magnetic Board Game" /></td>
</tr>
<tr>
<td></td>
<td>• Magnetic games are played by moving pieces around with magnets</td>
</tr>
<tr>
<td></td>
<td>• You don’t actually touch the game pieces; you use a magnetic wand to move them</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Build excitement and give an overview of today’s project</th>
<th>Announce making their own magnetic toys today!</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Will make a game piece and magnetic wand to move it (show your sample)</td>
</tr>
<tr>
<td></td>
<td>• Will design a board to move piece around on</td>
</tr>
<tr>
<td></td>
<td>• Can also add to the game piece</td>
</tr>
<tr>
<td></td>
<td>• Then will share and try each other’s boards!</td>
</tr>
<tr>
<td></td>
<td>Clarify they’ll take wands and pieces home, but not boards</td>
</tr>
<tr>
<td></td>
<td>• Can move pieces around on golf sets at home</td>
</tr>
<tr>
<td></td>
<td>• Can also create new boards with cardboard</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Point to this on your Innovator’s Mindset poster</th>
<th>Define the Mindset element in the context of today’s lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Today we’re going to focus on being reflective. This means that while we play our games we’re going to think carefully about how fun our games are and whether they’re too easy or too hard, just like we did with our golf games. This will help us make our games as fun as possible!</td>
</tr>
</tbody>
</table>

## Demo & Discussion Magnets (5 min)

<table>
<thead>
<tr>
<th>Demo how magnets can connect just by being next to each other</th>
<th>Tell campers to help them make magnetic toys they’ll learn a little about magnets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ask: <em>What do you think will happen if we put two magnets near each other?</em></td>
</tr>
<tr>
<td></td>
<td>Put two magnets on a pen so they will attract one another</td>
</tr>
</tbody>
</table>
Slowly move them together until they connect and repeat a few times

Conclude that magnets pull towards each other

Demo the polarity of magnets using the prepared floating magnet stack

Flip one of the magnets around so it now repels the first one; stack more magnets in this way

Try pushing on the floating magnet stack; it will bounce up again like a spring
<table>
<thead>
<tr>
<th>Show how magnets attract through cardboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk amongst the campers and allow them to push down on the floating magnet stack</td>
</tr>
<tr>
<td>Ask: <em>Wait! How come these magnets aren’t pulling towards each other?</em></td>
</tr>
<tr>
<td>• Magnets will only be attracted to each other on one side</td>
</tr>
<tr>
<td>• If they’re facing the wrong way they’ll go away from each other!</td>
</tr>
</tbody>
</table>

| Ask: *Do you think magnets will still stick together if there’s something in between them?* |
| Place a magnet on some cardboard; hold another magnet under the cardboard and move it around |

| Conclude that magnets pull towards each other even through other things |
| If time you can try this through the table to show that the magnets can’t stick together if the surface is too thick |

| Show campers the rare earth magnets and demo how strong they are |
| Explain magnets come in all shapes and sizes |
| Show the rare earth magnets campers will be using; these are also magnets even though they look different |
| Place two magnets on your finger, one on each side; the magnetism should hold them in place |
Guided Activity

**Build the Wand and Game Piece (15 min)**

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Details</th>
</tr>
</thead>
</table>
| **Have campers tape a magnet to one end of the paint stirrer**              | Campers can stay on floor for this Pass out paint stirrers Demo and have campers put a magnet on one piece of tape  
  - Emphasize trying to keep tape from sticking to itself Then show how to wrap the tape around one end of the paint stirrer  
  - Emphasize trying to keep magnet flat against stick ➤ Have TL help struggling campers so everyone can finish at the same time |
| **Have campers to tape a magnet to the edge of a piece of poly foam**       | Pass out poly foam Have campers put magnets on tape again Demo and have campers attach the tape to any edge of the game piece ➤ Again have TL help struggling campers |
Demo how to move the piece around the game board and how to play the game

Have campers gather around one of the prepared pegboard game boards
Lay the game piece on the board and put the wand under it; should stand upright

Ask: *What can I do if my wand is pushing my piece away instead of sticking to it?*
- Flip the wand over
- Will happen if the magnets are not facing each other in the right way
- Demo flipping the wand back and forth to see which way is the right way

Introduce the goal of the game: pushing a wheel into a cup!
Show how to do this

Assign campers to the game boards
Give campers a few minutes to try pushing the wheel into the cup themselves
As campers play write names on wands with Sharpies
- Write names so they're showing when correct side of wand is up
  ➤ Have TL help write names as well

Have campers test the game piece on the game board by trying to push the wheel into a cup
### Demo & Discussion

#### Appendages and Obstacles (5 min)

| Discuss the challenges of pushing the wheel into the cup | Have campers leave their game pieces at their boards and gather around one game board  
  
  Have campers share what’s hard about the game  
  - Sometimes the game piece turns around  
  - Sometimes the wheel rolls away from the game piece  
  - Some may have found it to be easy; that’s okay  
|---|---|
| Show how to add appendages to the game piece to make it easier and test again | Poke two ¼” pieces of pipe cleaner into the game piece  
  
  Bend the appendages into arm-like shapes  
  
  Try pushing the wheel around again  
  
  Point out it’s a bit easier to keep the wheel next to the game piece  
  
  Ask: Do you think it would be even easier if I added more than two arms? (Yes!)  
| Support EVALUATING and IDENTIFYING THE GOAL by introducing today’s evaluation question | Now it’s easier to win the game, which can be fun, but it might also get boring if it’s too easy  
  
  Refer to the golf game: a game is most fun when it’s not too hard and not too easy  
  
  Introduce the evaluation question campers should ask: Do I want to make my game easier or harder?  
  
  - Campers should ask this after each time they test to help them figure out how to make their games more fun  
  
  - Up to them to decide what will be most fun, but should think about it  
  
  Model asking yourself the question out loud; decide you want to make your game harder  
| Show how to add wheel, rubber band, and pipe cleaner obstacles to the board to make it harder | Demo how to add:  
  - A wood wheel with a golf tee  
  - A pipe cleaner hoop  
  - Two golf tees and a rubber band  

Model BEING REFLECTIVE and support EVALUATING and IDENTIFYING THE GOAL as you test your new board

Reiterate they can change the game piece or the game board to make the game harder or easier

Model being reflective by verbalizing your thoughts about your game so far

- Ex: Hmm, I’m going to be reflective by thinking about how fun my game is. Right now it’s not very fun because even though I added an obstacle my game is still too easy. I think I’ll try adding another obstacle or two to make it harder.

Add another obstacle in front of the goal and try again

Model reflecting again

- Ex: Whoa, now it’s way too hard! I can’t get in the goal at all. I’ll need to make this a bit easier. I think I’ll take that obstacle out and put it somewhere else.

Review what campers can do to practice BEING REFLECTIVE today

Stop and ask themselves: “Do I want to make my game easier or harder?”; keep thinking about how to make their games more fun

Make a plan about if they’re going to change the piece or the board

Independent Work Time

Make the Game More Fun (10 min)

<table>
<thead>
<tr>
<th>What campers will do: Add appendages to their pieces and/or obstacles to the board</th>
<th>CREATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Add appendages to the game piece to be better able to push the wheel around the game board.</td>
<td></td>
</tr>
<tr>
<td>2. Add obstacles to the game board to make the game more challenging.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EVALUATE, IDENTIFY GOALS &amp; REDESIGN</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Stop and notice if the game is fun and if it’s too hard or too easy.</td>
<td></td>
</tr>
<tr>
<td>4. Decide whether to make the game easier by adding appendages or by removing obstacles</td>
<td></td>
</tr>
<tr>
<td>5. Decide whether to make the game harder by adding obstacles.</td>
<td></td>
</tr>
</tbody>
</table>
Facilitate CREATE

- Have campers return to their game boards
- Pass out trays of choice materials

★ Facilitate EVALUATE, IDENTIFY GOALS & REDESIGN, and support BEING REFLECTIVE

- Continually prompt campers to stop playing their games and ask guiding questions that support evaluating and being reflective:
  - What do you notice when you play your game?
  - Do you want to make your game easier or harder? How might you do that?
  - What if you add/remove/change the shape of appendages?
  - What if you add/remove/move obstacles?

- Recognize reflective campers; be specific about how they are being reflective
  - Ex: (To a thoughtful response to a guiding question) I can tell you’re really noticing a lot of things about your game as you play. Way to be reflective! That will give you a lot of good ideas about what else to add!

Guided Activity

Share the Game Boards (10 min)

- Regroup campers and explain the procedure and expectations for trying each other’s magnet games
- Quickly get campers’ attention by having them wave magnet wands in the air and bring wands and pieces to front of room with them
- Announce it’s time to share and try each other’s game boards!
- Set expectations about how to play
  - Play the same way: push a wheel into a cup
  - Treat each other’s game boards gently
  - When then hear the signal they’ll take the piece and wand to a new game
- Come up with the signal you’ll use to let campers know it’s time to switch to a new game and practice it

- Have campers rotate to different game pieces and boards
- Have campers go to a friend’s board and give them 1 or 2 minutes to try it
- As they play have them give a thumb-o-meter to rate if the game is too hard, easy, or just right for them
- At the end of 1 or 2 minutes give the switch games sign
  - Make sure campers don’t switch before the signal
  - Make sure they take their game pieces and wands with them
  - Help direct campers to new game boards
- Rotate and repeat until it’s time to clean up

Clean Up (5 min)

- Clean Up
  - Have campers remove everything from their game boards and return materials to trays for the next rotation
  - Make sure campers’ names are on wands and have them stick game pieces to wands
  - ➤ Have TL rip more tape for the next rotation
### Lesson Wrap Up (10 min)

| ★ Summarize the importance of BEING REFLECTIVE and have campers recall if/how they practiced this today | Recognize everyone for making super fun magnet games! Highlight effect of practicing Mindset during today’s project  
• Ex: *By being reflective and thinking about if we needed to make our games easier or harder we were able to make our magnet games really fun!*  
Have campers stroke their innovator’s beards if they practiced being reflective today by:  
• Stopping to ask themselves today’s evaluation question (“Should I make my game easier or harder?”)  
• Thinking about if the game was fun and what could make it more fun  
• Noticing what it was like to play their own games or someone else’s  
Have a few campers share what made their games or someone else’s fun (not too easy and not too hard!)  
Review why reflection is important for innovation  
• Ex: *Being reflective helps us notice how we can make something even better.*  |
| Discuss opportunities for continued innovation | Remind that campers can find new ways to play with their magnet toys at home even if they’re not going home with boards  
• Empty cereal box turned on side works great as a board  
• Can use golf game surface  
Ask: *What else might you be able to use at your house to make new boards?*  
Ask: *What new games might you invent with your toy besides getting a wheel in a cup?* |
Lesson Materials

* (starred) materials appear multiple times in this list

**General/Adhesives/Tools**
- tape, masking, 1", *for taping magnets and attaching the cup to the game board* (20" per camper)

**Required Materials**
- magnet, round, 1" dia, 3/8" hole, asst. colors, *for demo* (5 per classroom)
- pen, *for demo* (1 per classroom)
- poly foam, 4 x 7", dense, *for game piece* (one 2 x 3.5" piece per camper)
- paint stirrer, wood, 12", *for wand* (1 per camper)
- magnet, rare earth, 7/16 x 1/16" (2 per camper)
- pipe cleaner, asst. colors, 12", *for appendages* (4 fourths per camper)*
- sticker, eye, for creating characters (2 per camper)
- box, cardboard, pegboard, 12" W x 18" L x 3" H, *for game board* (1 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.)

**Obstacles**
- golf tee, wood, asst. colors (6 per camper)
- rubber band, asst. sizes & colors (2 per camper)
- wheel, wood, 0.25" center, 2 x 5/8" (2 per camper)
- pipe cleaner, asst. colors, 12" (3 per camper)*

**Materials Preparation**

Cut pipe cleaners into quarters for appendages (4 pieces per camper). Cut several at a time for efficiency.

Cut poly foam into quarters to make 2 x 3.5" pieces (1 piece per camper).

Separate rare earth magnets and place them on the edge of the large metal oil pan from the National Parks theme.
To separate a stack of magnets:

- Hold the stack in your fist
- Make sure your thumb is clean and dry
- Use your thumb to push the magnet on the top of the stack over your index finger
- Use your other hand to pick up the magnet

Rip pieces of tape that are about 4” long (2 pieces per camper) and place them along the edge of the pan with magnets to be used during the Guided Activity.

**Advance Materials Preparation**

Start cutting the felt, burlap, and foil for Day 5 (see details in the Day 5 prep). This prep is intensive and it’s recommended that you start now.
Setting Up the Space

Tape cardboard pegboards between chairs or tables as shown (1 per camper).

Set aside materials for the Guided Activity so they can be easily accessed and passed out when it’s time:
- poly foam, cut into 2 x 3.5" pieces (1 piece per camper)
- paint stirrer, wood, 12", for wand (1 per camper)
- googly eye, self stick, 10 mm, for creating characters (2 per camper)

Gather materials for the Independent Work Time and set them aside on lunch trays. Pipe cleaners can stay directly on trays. Put the other obstacle materials in deli containers.
- pipe cleaner, asst. colors, 12", for appendages (4 fourths per camper)
- pipe cleaner, asst. colors, 12", for obstacles (3 per camper)
- golf tee, wood, asst. colors (6 per camper)
- rubber band, asst. sizes & colors (2 per camper)
- wheel, wood, 0.25" center, 2 x 5/8" (2 per camper)

Put up the following color copies on your copies display board:
- Magnetic Board Game

Notes

Materials Management
Keep the magnets away from electronics.

On the Board

Design Challenge
The game must:
- Be fun in the camper’s opinion
- Not be too hard and not be too easy

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 who are behind in taping their magnets on
  • Rip tape for the next rotation
Bubble blowers are classic outdoor toys.

Campers will create bubble blowers and experiment with blowing solution through different membrane materials. First they’ll test what kinds of bubbles they can create using felt, paper, burlap, and/or denim. Then they’ll design custom membranes by poking holes through foil.
Today’s Project: At-A-Glance

Build the bubble blower and add a membrane material

Cups attached to the cardboard cone; a felt membrane being attached with the help of a partner

Test at the bubble blowing station

Examples of bubbles created using different membranes; clockwise: felt, burlap, doily, denim

Try other membranes
Create a foil membrane

Holes poked with a golf tee with the help of a partner

Test and redesign
Teaching the Lesson: Overview

OUR SECRET SAUCE: THE G.I.A.

KNOWLEDGE FOCUS

CONCEPTS AND FACTS: Membranes
Campers learn that the size and closeness of holes, as well as the thickness of a material, affect how fluids move through a material.

Why? – Experimenting with and manipulating these variables is key to getting different types of bubbles. Understanding how these variables affect the movement of the bubble solution will allow campers to better control the types of bubbles they are getting.

PROCESS FOCUS

TEST AND REDESIGN
Campers go through several rapid cycles of choosing or creating a membrane, testing it, and then replacing it with another.

Why? – Testing and redesigning multiple options can be challenging or unappealing for Nebulas if the construction process is long or complex. Today’s project is designed to promote experimenting with a wide variety of options though simple construction that allows campers to swap out materials easily and compare different designs within a short time.

MINDSET FOCUS

BE COLLABORATIVE – I use my strengths to support the work of others.
Campers willingly help their partners construct bubble blowers and look out for other ways to help and share with their partners during testing and redesigning.

Why? – While the construction process is simple, campers will need the help of a friend to hold materials in place. Today’s Mindset ensures campers are able build and redesign quickly so they can experiment with as many different options as possible. In addition, today’s Mindset helps campers take advantage of the opportunity to help one another by sharing testing observations and ideas about what else to try.

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>
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</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>5 min</td>
</tr>
<tr>
<td>Demo &amp; Discussion: Membranes and Bubble Blowers</td>
<td>10 min</td>
</tr>
<tr>
<td>- Introduce bubbles and membranes</td>
<td></td>
</tr>
<tr>
<td>- Showcase the materials</td>
<td></td>
</tr>
<tr>
<td>- Assign building partners</td>
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</tr>
<tr>
<td>- Demonstrate bubble blower construction and model collaboration</td>
<td></td>
</tr>
<tr>
<td>- Outline expectations for testing</td>
<td></td>
</tr>
<tr>
<td>Independent Work Time: Exploring Premade Membranes</td>
<td>10 min</td>
</tr>
<tr>
<td>- Create bubble blowers with the help of a building partner</td>
<td></td>
</tr>
<tr>
<td>- Test blowing bubbles through a variety of membrane materials</td>
<td></td>
</tr>
<tr>
<td>Demo &amp; Discussion: Debrief and Foil Membranes</td>
<td>10 min</td>
</tr>
<tr>
<td>- Facilitate sharing discoveries so far</td>
<td></td>
</tr>
<tr>
<td>- Demo creating foil membranes</td>
<td></td>
</tr>
<tr>
<td>Independent Work Time: Creating Foil Membranes</td>
<td>10 min</td>
</tr>
<tr>
<td>- Poke holes in foil to create custom membranes with the help of a building partner</td>
<td></td>
</tr>
<tr>
<td>- Test the bubble blower with the building partner</td>
<td></td>
</tr>
<tr>
<td>Clean Up</td>
<td>5 min</td>
</tr>
<tr>
<td>Wrap Up (includes foil membrane debrief)</td>
<td>15 min</td>
</tr>
<tr>
<td>Transition</td>
<td>5 min</td>
</tr>
</tbody>
</table>

Timing Notes
Campers are on track so long as they have a bubble blower and a foil piece, and have experimented with at least two membrane materials.

If campers or groups are behind
- Have campers only make one foil piece instead of two.

If campers or groups are ahead
- Invite campers to try layering materials to get different bubbles.
- Invite partners to make foil pieces to exchange with one another.
# 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. |
| Give context for today’s project: Introduce bubbles and bubble blowers | Ask: Who has ever blown any bubbles? Have you ever used a bubble-blowing toy? |
| Build excitement and give an overview of today’s project | Announce creating their own bubble blowers today, but not regular ones that blow just one bubble at a time or just one kind of bubble! Inform that they’ll be experimenting with lots of materials to discover and invent all kinds of ways to make lots of different kinds of bubbles Make it clear they’ll each be working with a bubble buddy today • Everyone will get to make their own blowers but will need to help each other to make them |

★ 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 by helping our bubble buddies as much as possible! Helping each other will make creating our bubble blowers easier and more fun. It will also help us discover as many different bubbles as possible! |

## Demo & Discussion

### Membranes and Bubble Blowers (10 min)

| Explain what is needed to blow a bubble | Need an opening/hole for bubble solution to stretch across When air passes through the hole a bubble is made! |
| Demo how different kinds of bubbles are made when solution is blown through different sized holes | Hold a straw and pipe cleaner wand and point out the opening in each Have campers guess if they’ll make the same kind of bubble Blow a bubble using the large straw then the pipe cleaner wand Ask: Were the bubbles the same or different? • One was small and one was bigger Ask: Which one made the bigger bubble? Why is that? • The bubble wand has a bigger hole so it can make bigger bubbles |
| Show burlap and have campers guess what kind of bubbles it might make | Show a piece of burlap and ask: Could we use this material to blow bubbles? Are there holes in this material? • Yes! There are a lot of tiny holes! Ask: What kind of bubbles do you think this would make? |
• Don’t tell them what will happen; play up excitement of getting to discover on their own in a bit

Inform that burlap is an example of a membrane
Have campers say the word “membrane”

Explain that a membrane is a thin surface with holes that let air pass; perfect for bubbles since you need holes that air can pass through

There are lots of different kinds of membranes
• Can have different sized holes
• Can be thick or thin
• Different membranes make different kinds of bubbles

Introduce materials available besides burlap (denim, felt, and doilies)

Ask the following as you intro each:
• Does this have big or little holes?
• Are the holes very close together or far apart?
• What kind of bubbles do you think that might make?
• Is the membrane thick or thin? Do you think air will be able to pass through? (Let campers feel denim for this question)

Will be up to campers to discover what kinds of bubbles different membranes make, but first they need to make a bubble blower

Point out that the membrane materials are very floppy
• Will be hard to blow bubbles if material is flopping all over
• Ex: How do I blow bubbles with just the membrane? Do I put my mouth on this membrane when it’s all soapy? (No!)
• Need to create something to hold membrane nice and tight

Show your example blower and how the membrane is stretched over it

Explain you dip membrane end into solution and blow into cone end

Take blower apart to show components

★ Model BEING COLLABORATIVE as you demo how to add the cone to the cup

➤ Have TL be your bubble buddy (partner) for the rest of the demo

Call out TL will be collaborative by helping you make your bubble blower
• Steps are tricky without help; will be faster and easier with help!
• Remind that everyone will have a bubble buddy they’ll be in charge of helping, and who will be in charge of helping them

Have TL hold one cup with both hands at the base of the cup
  • Cup should drinking-side up
  • Emphasize holding cup straight up and down on a surface

Insert the cardboard cone into the cup
  • First do it loosely and turn cup upside down to show it falls out
  • Redo it and press down so it’s tight

★ Model BEING COLLABORATIVE by switching roles to help TL add his/her cone to a cup

Announce that now it’s your turn to be collaborative by helping your TL
  • Demo this even though steps are simple to make it clear how to take turns helping each other

Have campers remind you what each person should do to check if they remember steps; ask:
  • Which side of the cup should be up?
  • Should I hold the cup crooked or straight?
  • Should the TL press the cone in hard or lightly?

Reiterate benefit of collaboration
  • Ex: We got that done so fast by helping each other! Thanks buddy!
**Model BEING COLLABORATIVE as you demo adding a membrane**

<table>
<thead>
<tr>
<th>Pick the first membrane you want to experiment with</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have TL hold the bubble blower so that the cone points down</td>
</tr>
<tr>
<td>Place the material swatch on top of the cup</td>
</tr>
<tr>
<td>• Emphasize all of opening should be covered with material</td>
</tr>
<tr>
<td>• Point out that if there’s a gap, they should redo it</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Slowly slide second cup over the first to hold the material in place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repeat to help TL place membrane over his/her bubble blower</td>
</tr>
</tbody>
</table>

**Outline how campers will take turns testing with a buddy**

<table>
<thead>
<tr>
<th>Emphasize buddies will test together when both are done adding membranes; will go to the testing area with their partners, not alone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explain one person will be tester and the other will be the test-watcher; then they’ll switch roles</td>
</tr>
<tr>
<td>• Tester will sit or kneel next to bin to blow the bubbles</td>
</tr>
<tr>
<td>• Test-watcher will stand to the tester’s side</td>
</tr>
<tr>
<td>Decide with TL that you’ll be the tester first and s/he will be the test-watcher; kneel by bin while TL stands next to you</td>
</tr>
<tr>
<td>Emphasize that test-watcher can help the buddy by observing the bubbles blown by the tester and sharing anything cool s/he notices</td>
</tr>
</tbody>
</table>

**Discuss how to blow bubbles but don’t actually blow any yet**

| Demo how to dip the bubble blower gently in the solution and let any extra solution drip back into the bowl; emphasize |
• No splashing!
• Dipping just once or twice
• Dipping just the end; don’t want the blower to be soaking wet

Discuss blowing bubbles by breathing in, putting the bubble blower to your mouth, and then breathing out
• Emphasize not breathing in with the bubble blower in their mouths or they could swallow bubble solution
• Emphasize only blowing bubbles into the bin
• Alert if they feel tired/dizzy, they should stop and take a break

Inform each person gets to dip and blow 3 times then it’s the buddy’s turn
• Have campers repeat: “Three dips then switch!”; use this phrase to reinforce the rule during the lesson

Instruct patting bubble blowers dry on the towels when done testing
When both are done they’ll go back and redesign with a new material

Assign building partners

➤ Have TLs help group campers
If you have an odd number make a group of three
Have partners high-five to start off their collaboration!

★ Review what campers can do to practice BEING COLLABORATIVE today

Helping their partners make their bubble blowers
Taking turns testing; sharing anything cool/helpful they notice about buddy’s bubbles

Independent Work Time

Exploring Premade Membranes (10 min)

<table>
<thead>
<tr>
<th>What campers will do: Create the bubble blower and test at least two different membrane materials</th>
<th>CREATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Insert the cardboard cone while the partner holds the cup right-side up.</td>
<td></td>
</tr>
<tr>
<td>2. Choose a membrane material.</td>
<td></td>
</tr>
<tr>
<td>3. Hold the material swatch over the cup and slide another cup over it while the partner holds the cone.</td>
<td></td>
</tr>
<tr>
<td>4. Help the partner while s/he does the same.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST &amp; REDESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Go to the testing station with their partners.</td>
</tr>
<tr>
<td>6. Take turns being the tester and test watcher. The tester dips the bubble blower and blows up to three times then switches roles.</td>
</tr>
<tr>
<td>7. Try a different membrane material and repeat the testing process.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment with layering materials.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facilitate CREATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remind campers of first steps</td>
</tr>
<tr>
<td>Watch out for loosely inserted/crooked cones; these may fall off during bubble blowing and can make a mess if they fall in bubble solution</td>
</tr>
</tbody>
</table>
**Facilitate TEST & REDESIGN**

- Remind campers to place second cup on slowly if membrane falls off before they can get cup on; help campers as necessary
  - Have TL write names with Sharpie on the cardboard cones as campers build

- You should be monitoring the testing station at all times once testing starts
  - Have TL facilitate for campers not at testing station

- Before you direct pairs to an available spot make sure they’ve decided who is testing and who is watching first

- Help campers with dipping technique as necessary
  - May have trouble dipping the membrane evenly into the solution
  - May be dipping too deep/not deep enough

- Enforce the 3 blows rule and make sure partners trade

- Remind campers to pat bubble blowers dry before walking back to workstations

- Make sure partners go back to workstations after they’ve both gotten a chance to test to make space for others waiting to test

- Make sure campers are blowing bubbles safely
  - Remind if they feel tired/dizzy, they should take a break
  - Have them take a break if they cough or wheeze
  - Make sure they are breathing in before putting blower to mouth

- Ask guiding questions to support redesign:
  - Tell me about what membrane your blower has now.
  - What new material might you try next?
  - Will you and your buddy try the same material or different ones?

**★ Support BEING COLLABORATIVE**

- If campers are struggling to collaborate, give them specific directions about how to work together
  - Ex: You can help your partner by holding the cup so she can put the cardboard cone in.

- Recognize collaborative campers; be specific about how they are being collaborative:
  - Ex: I love how you are taking turns and helping each other so you can both blow as many different kinds of bubbles as possible. Way to be collaborative!

- Ask guiding questions that support being collaborative:
  - How can you help your partner build/test right now?
  - (To test-watchers) What interesting things can you share with your partner about his/her bubbles?
  - What material suggestions do you have for your partner?

**Use an attention-getter to transition to the next Demo & Discussion**

- When ready to introduce the next section allow campers currently testing to finish but don’t let new groups start testing

- Announce everyone will take a break to learn about a way to design their own membranes

- Reassure they’ll get a chance to keep testing in a bit
Have campers leave bubble blowers at workstations and join you in circle when ready

➤ Have TL help with this transition by managing campers finishing up tests

### Demo & Discussion

#### Debrief and Foil Membranes (10 min)

<table>
<thead>
<tr>
<th>Go over each material and allow campers to share observations</th>
<th>For each material ask:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Who tested this material?</td>
</tr>
<tr>
<td></td>
<td>• What kind of bubbles did it make? Many, few, small, big?</td>
</tr>
<tr>
<td></td>
<td>• Why do you think it makes those types of bubbles?</td>
</tr>
<tr>
<td></td>
<td>• Does the membrane have small or big holes? Are the holes close together or far apart?</td>
</tr>
<tr>
<td>Group should come to following conclusions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Felt: very tiny holes with very little space in between; makes tiny bubbles that are very close together (like foam snakes!)</td>
</tr>
<tr>
<td></td>
<td>• Burlap: small holes, not as tiny as felt; makes lighter foam</td>
</tr>
<tr>
<td></td>
<td>• Doily: has big holes; makes big, diamond-shaped bubbles</td>
</tr>
<tr>
<td></td>
<td>• Denim: too thick for air to pass through; no bubbles</td>
</tr>
</tbody>
</table>

| Introduce foil as a new material and show hole-poking tools   | Place a piece of foil over the bubble blower and enclose it |
|                                                             | Ask: *Will foil work just by itself? Can air pass through it?* (No!) |
|                                                             | Ask: *How can we make foil into a membrane that will work?* |
|                                                             | • Poke some holes so air can pass through |
|                                                             | Show golf tees and pipe cleaners campers will use to make holes in their foil |
|                                                             | • Emphasize these are tools, not toys |
|                                                             | • Should only be used to poke foil and not be directed at anybody |
**Discuss different hole-poking options (size, placement, number)**

Explain cool part about this is they get to decide what holes membrane has
- Could be big, small, many, few, close together, or far apart
- Can even mix and match (ex: some big and some small)
- Can invent totally new ways to make bubbles

Ask: *Which tool might I use if I want to make small bubbles? How about big?*
- Pipe cleaner for small holes
- Golf tee for big ones

Alert about not making holes too big or creating giant rips through the foil
- This doesn’t work
- If foil rips they can throw it away and get a new one

Ask: *Do I always have to poke a lot of holes?*
- No! Could poke just 3
- Up to them to decide what to try

| ★ Model BEING COLLABORATIVE while attaching a foil piece and poking holes |
| ➤ Have TL help with this demo again |
| Tell campers that they’ll keep collaborating with buddies to create holes |
| Demo how to attach a foil piece the same way that material swatches are attached; remind campers to slowly slide the upper cup on |

Have the TL hold cone while you poke holes with a golf tee and/or pipe cleaner
- Verbalize as you make small, quick pokes through the foil

Switch roles to remind campers they’ll take turns helping each other

| Review the testing procedure (same as before) |
| Wait until buddy is done; go to station together |
| One tester and one test-watcher |
| 3 dips then switch |
| Go back and redesign/try something else when both have had a chance |

| ★ Review what campers can do to practice BEING COLLABORATIVE today |
| Hold bubble blower while partner pokes holes |
| Keep taking turns and sharing ideas when testing |
### Creating Foil Membranes (10 min)

<table>
<thead>
<tr>
<th>What campers will do: Create and test custom foil membranes</th>
<th>CREATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Attach a foil piece onto the bubble blower.</td>
</tr>
<tr>
<td></td>
<td>2. While a partner holds the bubble blower, poke holes using available tools.</td>
</tr>
<tr>
<td></td>
<td>3. Help the partner attach a foil piece and hold his/her bubble blower while s/he pokes holes.</td>
</tr>
<tr>
<td>TEST &amp; REDESIGN</td>
<td>4. Test with the building partner at the testing station.</td>
</tr>
<tr>
<td></td>
<td>5. Share observations of bubbles.</td>
</tr>
<tr>
<td></td>
<td>6. Create new foil pieces after testing.</td>
</tr>
</tbody>
</table>

**Extension**
Partners can make foil membranes for the other person to try.

<table>
<thead>
<tr>
<th>Facilitate CREATE</th>
<th>Remind campers to try not to rip large holes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Encourage campers to experiment with a small number of holes; tell campers to pick a small number (such as 5) and then count up to that when poking</td>
</tr>
<tr>
<td></td>
<td>Before starting a new piece, have campers close their eyes and picture what they want the foil piece to look like; this will encourage them to put additional thought into their designs</td>
</tr>
<tr>
<td></td>
<td>➤ Have TL pass out Ziploc bags with campers’ names on them; inform campers that they’ll keep their foil pieces in this bag</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facilitate TEST &amp; REDESIGN</th>
<th>Continue to monitor testing station</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Remind campers of testing protocol</td>
</tr>
<tr>
<td></td>
<td>➤ Continue to have TL facilitate construction</td>
</tr>
<tr>
<td></td>
<td>Ask guiding questions that support testing and redesign:</td>
</tr>
<tr>
<td></td>
<td>• <em>What kind of bubbles did your membrane make?</em></td>
</tr>
<tr>
<td></td>
<td>• <em>How might you make a different kind of bubble?</em></td>
</tr>
<tr>
<td></td>
<td>• <em>What if you make holes bigger/smaller/closer/more spread out? What if you make more/fewer holes?</em></td>
</tr>
<tr>
<td></td>
<td>• <em>Will you add to the membrane you have or start a new one?</em></td>
</tr>
</tbody>
</table>

**Support BEING COLLABORATIVE**
Use same strategies listed previously
## Clean Up (5 min)

**Clean Up**

<table>
<thead>
<tr>
<th>Store the bubble blowers on a dry towel to let them dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have campers put foil pieces into Ziploc bags and put bags next to blowers</td>
</tr>
<tr>
<td>• If foil is wet, have them gently shake them dry near the plastic bins</td>
</tr>
<tr>
<td>► If time have TL refill bubble solution for next rotation</td>
</tr>
<tr>
<td>Gather two or three campers’ blowers with different holes to discuss during the Wrap Up</td>
</tr>
</tbody>
</table>

## Lesson Wrap Up (15 min)

**Celebrate bubble blowers and review what campers learned today**

| Recognize campers for innovating on the normal bubble blower and making their own unique toys today! |
| Call out how many different ways to blow bubbles campers discovered/invented |
| Hold up blowers you picked during clean up so campers can see different hole patterns in foil |
| Ask: |
| • What do you notice about how this person designed the holes? |
| • What kinds of bubbles do you think they made? (Confirm with project designers) |
| Have campers share their favorite types of bubbles/membranes today; campers can give me-too signal if they liked something similar |

**★ Summarize the importance of BEING COLLABORATIVE and have campers recall if/how they practiced this today**

| Highlight effect of practicing Mindset during today’s project |
| • Ex: One thing that helped us make bubble blowers and let us try so many different ideas was the power of collaboration! |
| Have campers high-five their bubble buddies if they practiced being collaborative today by: |
| • Helping their partners with a building step that was hard to do alone |
| • Helping their partners by sharing an idea or helpful observation |
| If applicable recognize specific campers for exhibiting above behavior |
| Review why collaboration is important for innovation |
| • Ex: When innovators use their powers of collaboration to help each other they can get the job done faster and better. Plus, building with a buddy is way more fun than building alone! |
Get Ready!

Lesson Materials

* (starred) materials appear multiple times in this list

General/Adhesives/Tools
- bin, 41 qt., LWH 34-7/8 x 16-5/8 x 6-1/8", for blowing bubbles into (2 per classroom)
- pan, pie, aluminum, 9", for holding bubble solution (4 per classroom)
- tray, lunch, for storing camper supplies (1 per 6 campers)
- paper towels, for clean up (1 per camper)
- towel, dish, for clean up (1 per 4 campers)
- marker, Sharpie, fine pt., black, for writing camper names on projects and bags (2 per classroom)
- bag, plastic, Ziploc, sandwich, for storing foil pieces (1 per camper)

Required Materials
- straw, milkshake, for demo (1 per classroom)
- soap, dish, liquid, 20-25 oz., for bubble solution (1 per classroom)
- water, for bubble solution (not provided, secure at site)
- container, plastic, clear, 98 oz., for mixing and storing bubble solution (1 per classroom)

Bubble blowers
- cone, cardboard, pointed tip, 7" (1 per camper)
- cup, paper, 9 oz., double coated (2 per camper)

Premade membranes (all but doily will be reused)
- felt, acrylic, asst. colors, 9 x 12" (one 4.5 x 6" piece per 2 campers)
- paper, doily, asst. colors, 4" (1 per 2 campers)
- fabric, burlap, asst. colors, 9 x 12" (one 4.5 x 6" piece per 2 campers)
- fabric, denim, 5 x 5" square (1 per 6 campers)

Foil membranes
- foil, sheet, aluminum, 12 x 10.75" (4 quarter-pieces per camper)
- pipe cleaners, assorted colors, for poking holes (1 per 2 campers)
- golf tee, wood, asst. colors, for poking holes (1 per 2 campers)

Spotlight Prep

Lucky you! A prep fairy will be doing the following prep for you. You need to be ready to hand off the materials listed below when your prep fairy arrives.

Prep fairies have these materials and directions listed in their prep guide. They are listed here for you as well so you can double-check that your prep fairy understands what to do and has everything s/he needs.

Materials:
- cup, paper, 9 oz., double coated (2 per camper)

Directions:
Cut the bottoms off the 9 oz. paper cups using a box cutter; make sure that you cut off the bottom rim of the cup, as well as the actual bottom (2 cups per camper).
## Materials Preparation

1. Cut felt into fourths to create 4.5 x 6" swatches. Exact measurements aren’t necessary here. Just fold the material into fourths and cut along the folds (1 piece per 2 campers, can be reused each rotation).

2. Cut burlap into fourths to create 4.5 x 6" swatches. Exact measurements aren’t necessary here. Just fold the material into fourths and cut along the folds (1 piece per 2 campers, can be reused each rotation).

Cut foil into fourths to create 4.5 x 6" swatches. Exact measurements aren’t necessary here. Just fold the material into fourths and cut along the folds (4 pieces per camper, cannot be reused each rotation).

Sort the paper doilies so that you are using only the gold and silver. These will be used as the first membranes. The white ones do not have holes in the middle and so cannot be used.

Prepare bubble solution. (This solution will be poured into pie pans on the day of the activity.) One measurement of this should be adequate for up to two rotations.  

- Using a 9 oz. paper cup as a measurement, use the ratio of one 9 oz. cup of dish soap to six 9 oz. cups of water. Mix in a large bowl and stir gently.  
- If you find yourself needing a smaller amount, you can use the ratio of ½ of a 9 oz. cup of soap to three 9 oz. cups of water.

Make a bubble wand out of a pipe cleaner for your demo.
Create a sample bubble blower for your demo.

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

Setup the classroom so it meets the following specifications:

• A central space for general class instruction
• Two testing stations away from the central space and workstations, ideally not in campers’ vision during classroom instruction
• Space for working (can be the floor or tables); lunch trays with needed bubble blower construction materials are supplied after first Demo & Discussion
• Materials table that includes all membrane materials

Set up two testing stations. Place an extra testing station for the Demo & Discussion (this can include one pie tin). Each testing station should include the following:

• Two pie tins filled up 1/5 with bubble solution (each pie tin allows one pair of campers to test)
• A towel folded on the edge of the middle of a bin so campers can pat bubble blowers dry
• An “X” created with blue tape; the “X” should be 3 feet away from a testing station and indicates where the line for that station starts
Prepare a space for finished bubble blowers. Cover the space in paper towels to accommodate wet or damp bubble blowers.

Set the bubble blower materials at each workstation:
- cardboard cone (1 per camper)
- 9 oz. paper cups with bottoms removed (2 per camper)

Set the first set of membrane materials on a lunch tray at the center of each workstation. Each lunch tray should accommodate six campers and include the following:
- felt, acrylic, asst. colors, 9 x 12" (three 4.5 x 6" pieces)
- paper, doily, gold and silver only (three pieces)
- fabric, burlap, asst. colors, 9 x 12" (three 4.5 x 6" pieces)
- fabric, denim, 8 oz., dark blue (one 5 x 5" square)

Set up foil membrane materials on lunch trays to be handed out during the second part of the activity; again, each lunch tray will accommodate six campers:
- foil, sheet, cut into fourths (4 pieces per camper)
- pipe cleaners, for poking holes (1 per 2 campers)
- golf tee, wood, asst. colors, for poking holes (1 per 2 campers)

Gather materials for the Demo & Discussion:
- Premade bubble blower
- Pipe cleaner bubble wand and large straw
- Sample of each material

**Morning Of Preparation**

Pour bubble solution in aluminum pie pans and place them inside bins.
Notes

Materials Management
Don’t throw away membrane materials in between rotations (doilies are an exception). Campers will use the same ones; you can just pat them dry. The only exception is paper doilies. These may become soggy and you may need to replace them during rotations if they break.

Suggestions for Large Classes
Set up a third testing station and have one of your TLs (or an SI) monitor and support testing.

On the Board

Mindset of the Day
BE COLLABORATIVE – I use my strengths to support the work 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:
  • Help you demo how campers will collaborate with a partner to build and test
  • Facilitate for campers not testing so you can be stationed at the testing area