



Simple Machines: Toy Factory

Toys that Spin

A LEGO® Education Program
Introductory STEAM Program

Toy Factory: Toys that Spin

LEGO® Education Simple Machines Program

Elementary STEAM Program Overview:

This outline will provide students with STEAM focused, hands-on activities to promote 21st century skills as well as design engineering. Each day, students will participate in team building activities, engage in opportunities for physical activity, and receive a briefing for daily challenges aligned to standards. Daily challenges will help students develop skills and knowledge to complete the culminating project, which is to design a toy that spins.

Program at a Glance		
Day	Essential Questions	Daily Activities
Day 1	Welcome to the Toy Factory: Toys that Spin: Gears How are toys made? How do toys move? What kind of toys spin? What is a gear? Toys that Spin: Introduction to Gears	Principle Model – Gears Toy: Make a spinning top
Day 2	Toys that Spin: More Gears How do toys move? What kind of toys use gears?	Guided lesson: Merry-Go-Round Problem Solving Activity: Popcorn Cart Toy: Make a Cartoon
Day 3	Toys that Spin: Pulleys How do toys move? What is a pulley? What kind of toys use pulleys?	Principle Model – Pulley Guided Lesson – Crazy Floors Problem Solving Activity: Crane Toy: Make a Yo-Yo
Day 4	Culminating Project: Automata How do toys like automata move? How can I use gears and pulleys to create an automata?	Design and build an Automata Automata showcase

Prior to First Day of the Program:

1. Sort the sets. One suggestion is to sort the sets as follows.
 - a. place all the red elements (except the longest beams) in one tray compartment.
 - b. place the longest beams in the bottom of the bin.
 - c. place the yellow elements and the minifigures in another tray compartment.
 - d. place the white and green elements in a third tray compartment.
 - e. place the black weight brick, the tires, the large 40-tooth gears, and the brick separator in the bottom of the bin.
 - f. place all the remaining pieces in the fourth tray compartment.
 - g. because they are not used in every lesson, the yellow rubber bands and the string with ends can be kept in a separate zippered bag and only given out when needed – usually with the pulley lessons.
2. Determine a naming convention for each set.
Suggestions include school initials and a number (Example: Millcreek Elementary kits names could be MES1; MES2; MES3).
3. Write the name of the set on the box.
4. Gather any consumable materials needed for the week.
5. Determine a procedure for when a LEGO® piece is dropped (everyone freeze; say LEGO® down/LEGO® found) and where to place LEGO® pieces if found and does not belong to the finder.

Information for the teacher:

If you are unfamiliar with simple machines gears and pulleys, you can find some background information in our activity pack, which is available at https://le-www-live-s.lego.com/downloads/MachinesAndMechanisms/MachinesAndMechanisms_Activity-Pack-For-Simple-Machines_1.0_en-US.pdf

Background information for teachers on the topic of simple machines can be found on the following pages in the document listed above:

- General overview of simple machines: page 10
- Gears (used in this program): pages 14-18
- Pulleys (used in this program): pages 95-99
- Classroom Management Tips: page 8
- LEGO Element Survey (list of all the pieces in the set): page 126-128
- Assessment Tools: page 6

In addition to the background information, the page number for any activity used from the activity pack will be provided in the program document.

Toy Factory: Toys that Spin Day 1

Welcome to the Toy Factory

Big Questions:

How are toys made? How do different toys move? What kind of toys spin? What is a gear?

Materials needed for the day:

- Simple Machine sets
- Chart paper
- Student notebooks or journals (could be paper stapled together with students creating the outside of the journal using construction paper and other consumable materials)
- Various craft materials
- Cardstock or heavy paper
- Pens
- Crayons
- Pencils
- Markers
- Team badge templates
- Book or videos about toys, inventing toys, or familiar toys

Outline of Day	Tasks	Time	Materials
9:00 - 10:30	Introductions	30 min	<ul style="list-style-type: none">● LEGO® bricks
	Establishing Group Rules and Expectations	15 min	<ul style="list-style-type: none">● Chart paper● Markers● Pens
	Team Building Activity	15 min	<ul style="list-style-type: none">● LEGO® bricks
	Morning Huddle	5 min	<ul style="list-style-type: none">● None
	Partner Selection, Team Name and Team Badge	25 min	<ul style="list-style-type: none">● Varies, based on the activity selected● Team badge templates

			<ul style="list-style-type: none"> • Markers • Pencils • Scissors
10:30 - 10:35	Break		
10:35 - 11:25	Workplace Wellness (physical activity)	10 min	<ul style="list-style-type: none"> • Varies, based on the activity selected
	Design a Journal	20 min	<ul style="list-style-type: none"> • Student journals (see note in materials section) • Markers • Scissors • Construction paper • Other craft materials
	Reading and Wondering	20 min	<ul style="list-style-type: none"> • Book or videos about toys
11:25	Get ready for lunch		
11:30 - 12:00	Lunch		
12:00 - 2:10	Afternoon Huddle	5 minutes	<ul style="list-style-type: none"> • None
	Challenge 1 - Tower Building	30 min	<ul style="list-style-type: none"> • Student journals • Simple Machines sets
	Challenge 2 - Principle Model: Gears	60 min	<ul style="list-style-type: none"> • Student Journals • Simple Machines sets • Student worksheets • Teacher notes
	Break	5 min	<ul style="list-style-type: none"> • None

	Challenge 3: Spinning Top	30 min	<ul style="list-style-type: none"> • Student Journals • Simple Machines sets • Markers • Crayons • Colored pencils • Cardstock or paper • Scissors
2:10 - 2:30	Daily Debrief and Wrap Up	20 min	<ul style="list-style-type: none"> • Student journals

Introductions

Time: 30 minutes

Materials:

- Loose LEGO® bricks

Purpose: For students to get to know each other

Using the LEGO® bricks, have students build a model that shows something they really like to do and one thing they hope to learn during the STEAM program. When it's time to share, have students say their name and share their model. The teacher can record what the group hopes to learn on a piece of chart paper.

Group Rules and Expectations

Time: 15 minutes

Materials:

- Chart paper
- Markers

Using a piece of chart paper, establish group rules and expectations for the week as a class. You can have students sign the chart paper and then place the rules and expectations in a location that can be reviewed each day.

Team Building Activity

Time: 15 minutes

Materials:

- Loose LEGO® bricks

Explain to students that each day will include some kind of team building challenge. Working together is an important skill and just like other skills, we can practice it to get better and better.

Build the tallest tower

Have students work in pairs. Make sure each group has the same type of bricks or give a constraint of using a specific number of bricks. Challenge students to build the tallest tower they can within 5 minutes. At the end of the 5 minutes, encourage students to reflect on:

- What was challenging?
- How did you overcome the challenge?
- What was successful?
- How did you work together?
- If you were to do this tower build again, what would you change?

Morning Huddle:

Time: 5 minutes

Materials: None

Welcome to the Toy Factory! This week we will be exploring toys and how they work. Your first task is to complete the following:

- *Determine a partner for training exercises*
- *Work with partner to determine a team name and design a team patch*
- *Design a journal for keeping important records this week*
- *Explore different kinds of toys and toys that move*

Partner Selection, Team Name and Team Badge

Time: 25 minutes

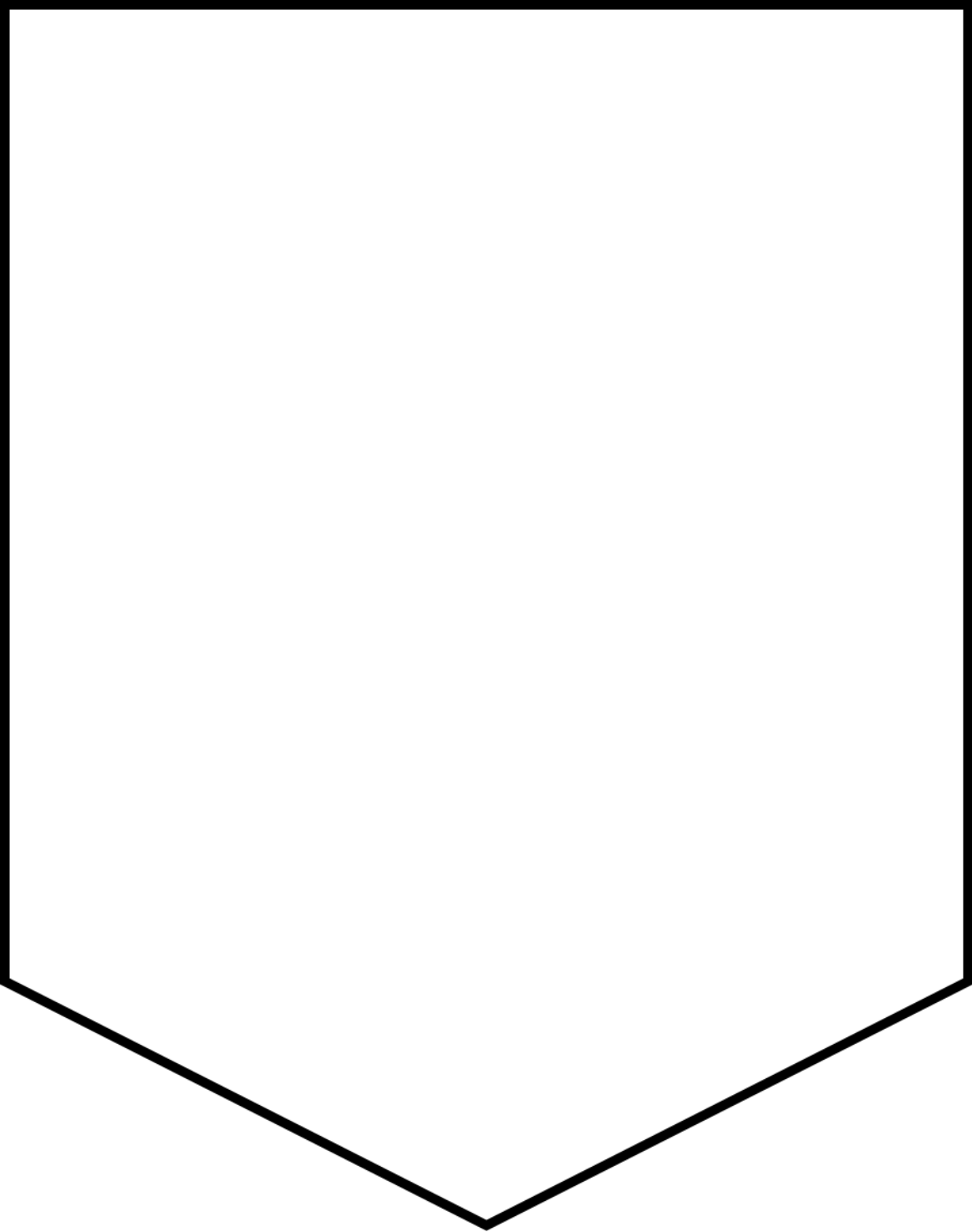
Materials:

- Student journals (see note in materials section)
- Markers
- Scissors
- Construction paper
- Other craft materials

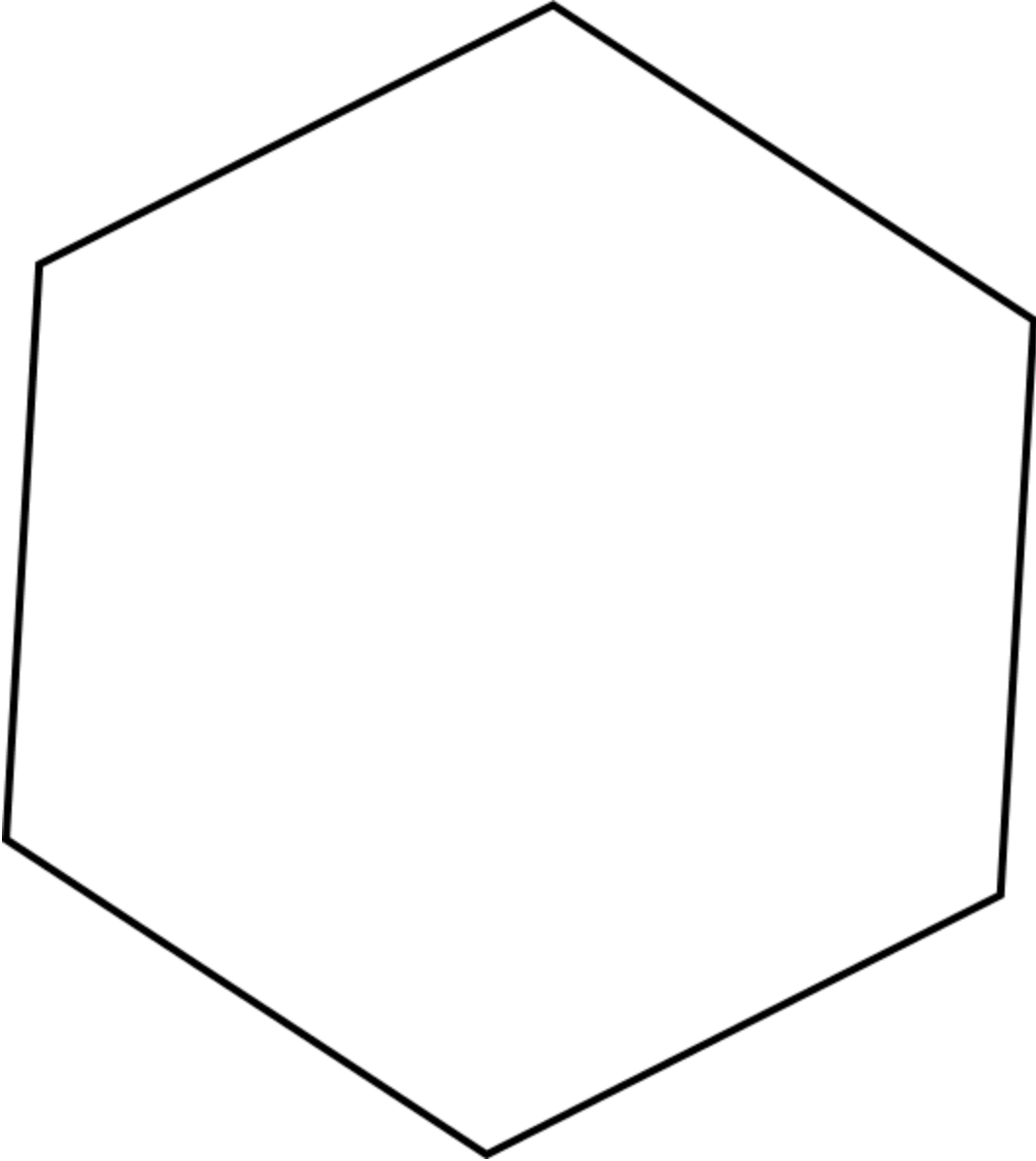
You can use several different activities to help students find a partner to work with for the week. Some ideas can be found through a quick internet search. After partners have been established, student teams can determine a name for their team and design a badge.

While teams are working, assign each group a Simple Machines kit to use for the week.

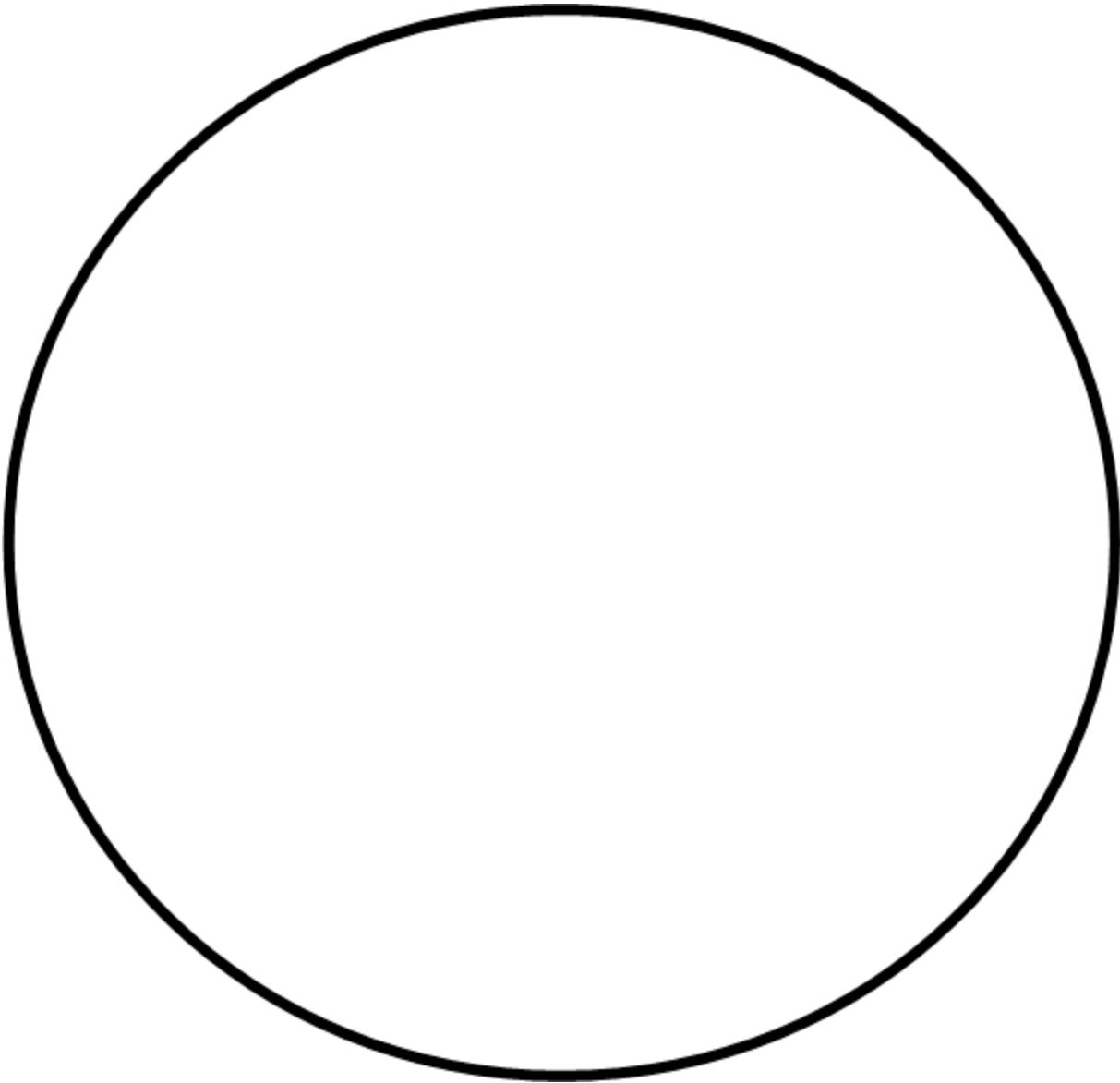
Badge Template



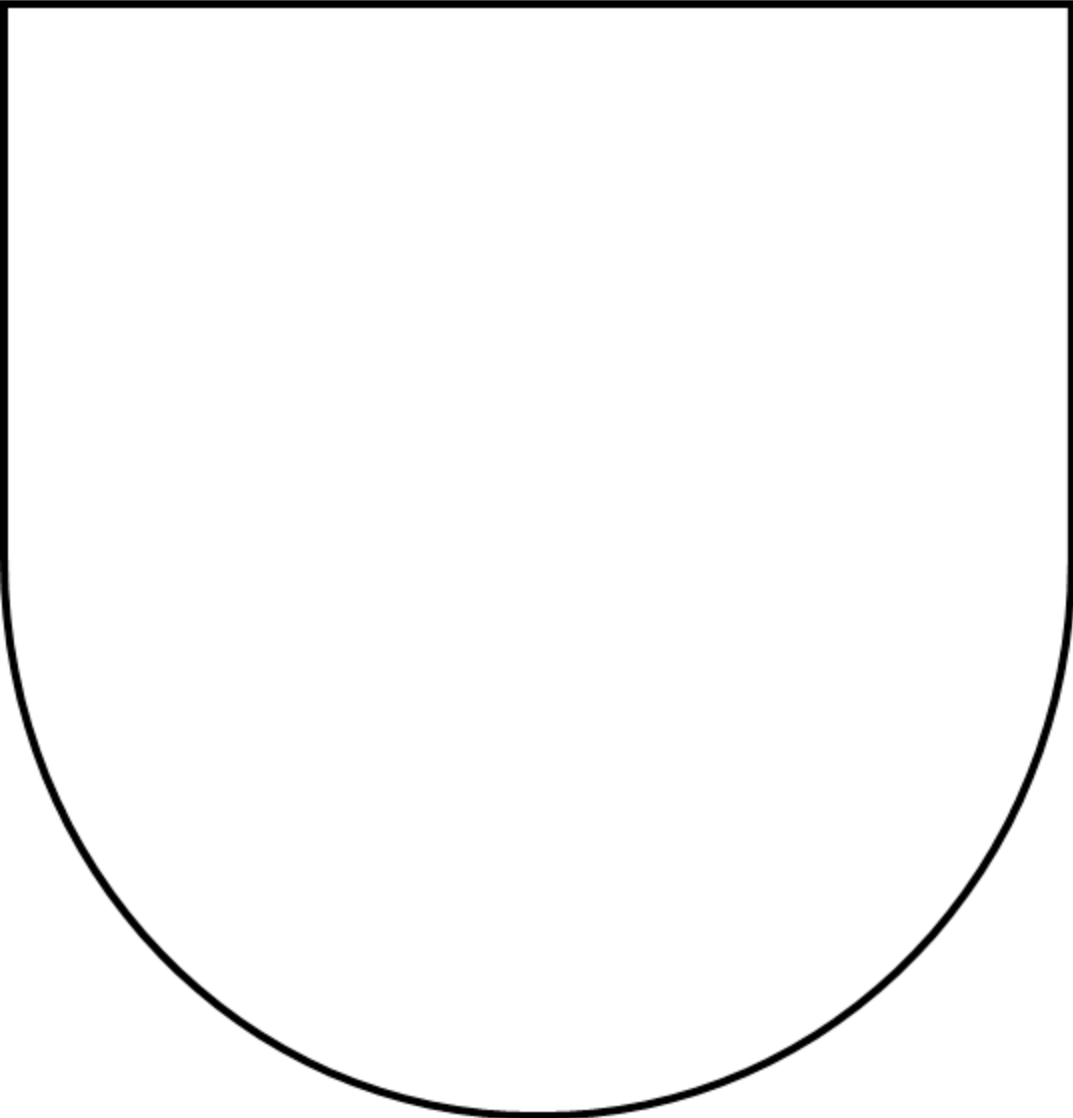
Badge Template



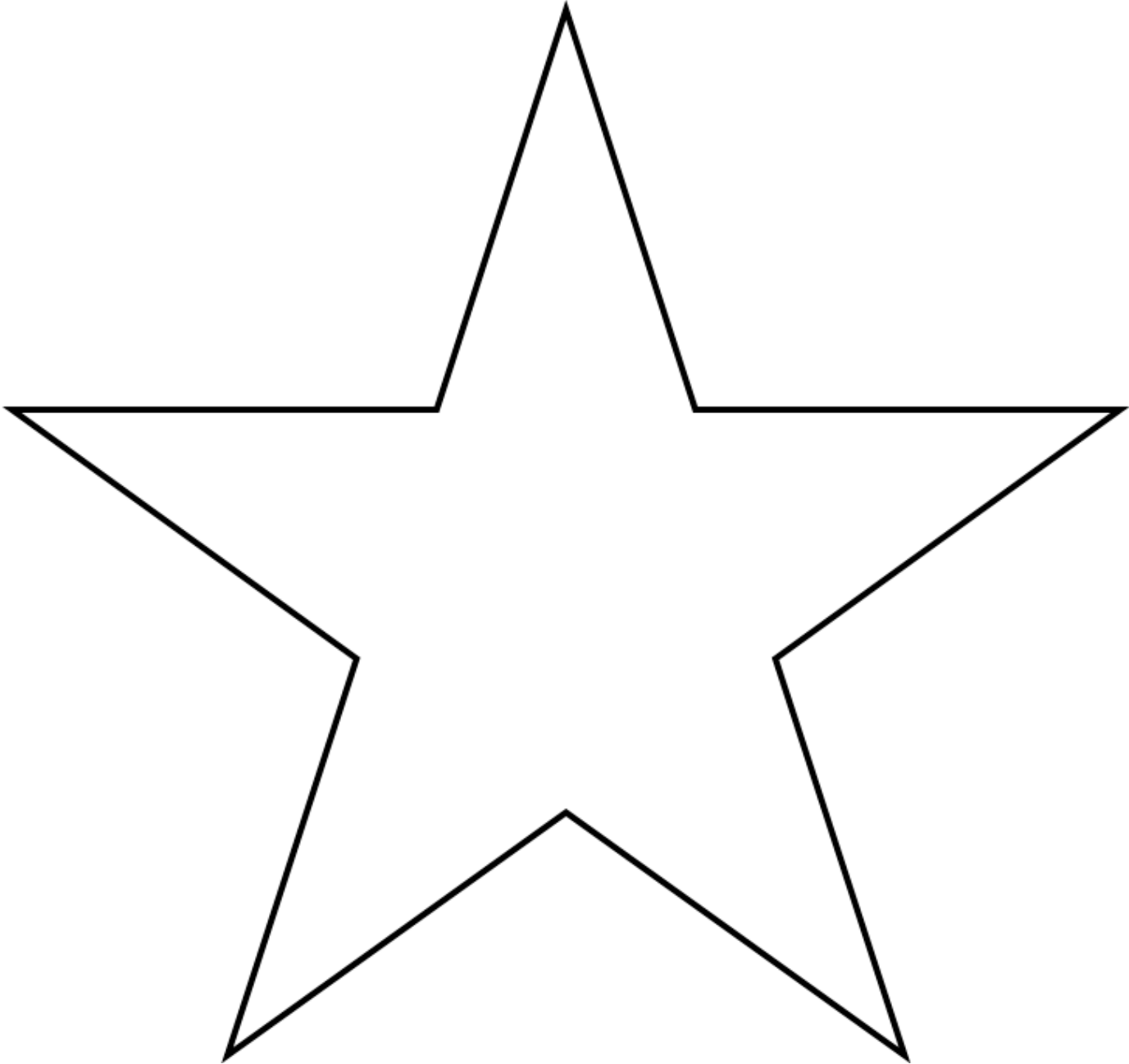
Badge Template



Badge Template



Badge Template



Break

Time: 5 minutes

Workplace Wellness

Time: 10 minutes

Materials:

- May vary depending on what activity is selected

Take a minute to complete a short physical activity. You can find several ideas for quick physical activities designed for kids through an internet search.

Design a Journal

Time: 20 minutes

Materials:

- Student journals (see note in materials section)
- Markers
- Scissors
- Construction paper
- Other craft materials

Have students create a journal to take notes, share wonderings, write reflections, and collect ideas. Ideas for types of journals can be found online.

Readings and Wonderings

Time: 20 minutes

Materials:

- Book or videos about toys or inventing toys

Read a book, an age appropriate journal article, or watch a quick video about toys or inventing toys. Have students write things they wonder about toys in their journals.

Lunch

Time: 30 minutes

Afternoon Huddle:

Time: 5 minutes

Materials: None

Now that you have your team and have some background information about toys, you have a new challenge. To be better prepared for the days ahead, you will need some basic training on the tools we will use this week. Your mission this afternoon is to:

- *Explore technic LEGO® bricks and elements to become familiar with how they fit together.*
- *Learn about gears and what happens when gears mesh.*

- *Apply what you learn about gears by designing a spinning top.*

Be sure to work together, take good notes and have fun!

Go over a few general guidelines for using the simple machines sets (what to do if you drop a piece on the floor, where do you put a piece you have found, what does sharing look like, etc.).

Exploring the Simple Machines Set

Time: 30 minutes

Materials:

- Simple Machines sets
- Student journals

Students will:

- Explore different ways of connecting things together using LEGO® bricks and elements.
- Work in pairs to use as many pieces as possible to build a tower that has connected moving parts.

Sam and Sally are really interested in learning all about simple machines. They haven't had a lot of experience putting LEGO® technic bricks and elements together, so they want to learn more about how to connect them together to build ideas. They noticed some of the pieces in this box look different from the LEGO® bricks they are familiar with. There are connector pegs, gears, bricks with different types of holes, and even rods. To better understand how these pieces fit together, Sam and Sally decide they are going to build a tower that has moving parts. Can you help Sam and Sally build a tower that has moving parts?

Have students work in pairs to explore how the LEGO® elements in the Simple Machines sets fit together to build a tower with moving parts. Once the students have built their towers, ask them to think about the parts of their tower that move and the pieces they used to create that movement. Students can take notes in their journals.

They should be able to answer questions like:

- What part of the tower moves?
- What LEGO® elements did you use to make that part of the tower move?
- What did you discover when connecting LEGO® elements together?
- What LEGO® elements are you still wondering about?

Extension: As time allows, challenge students to take the tower (vertical building) apart and build a long, flexible worm (horizontal building).

Have students reflect in their journals:

- What was easy about this challenge?
- What was difficult about this challenge?
- What did I learn from this challenge?

Gears: Principle Model Lesson

Time: 60 minutes

Materials:

- Simple Machines sets
- Student worksheets ([activity pack](#) pages 22-24)
- Teacher notes for lesson ([activity pack](#) pages 19-21)
- Student journals

Complete the principle models for gears, which is available at <https://le-www-live-s.legocdn.com/sc/media/files/building-instructions/mm/9689-gears-principle-af7db614d74187b8f573644b78812384.pdf>. This site contains the building instructions for the principle models for gears or you can use the building booklet provided with the set. Choose a large gear from one of the simple machines sets. Have each student find the same gear.

Ask students:

- What do you know about this simple machine?
- Where do we use this simple machine?
- Why do we use this simple machine?

Have students write down some things they think they know about gears and things they are still wondering about.

Have students work through the Principle Model Gears activity to investigate gears and how gears work. Provide students with the correct terminology used when talking about gears. When they have completed the activity, students should have a better understanding of the following vocabulary:

- Drive gear
- Driven gear
- To mesh

When done, take the principle design models apart and have students put the pieces back correctly. Have students write a brief reflection on the activity in their design journals.

- What was easy about this challenge?
- What was difficult about this challenge?
- What did I learn from this challenge?

Break

Time: 5 minutes

Spinning Tops Challenge

Time: 30 minutes

Materials:

- Simple Machines sets

- Toy tops
- Cardstock or heavy paper
- Markers
- Crayons
- Colored pencils
- Student journals

Sam and Sally have been approached by a toy company to design a spinning top and top launcher kit. It should be made using only LEGO® bricks and elements. Help them design this toy by:

- Building a LEGO® top and launcher
- Using gears to make the top spin
- Decorating the top to show patterns or colors as it spins

Have students design, build, and test their spinning tops. For inspiration and ideas around constructing a LEGO® spinning top, you may modify the [build in this lesson](#) from Early Simple Machines, replacing the LEGO® DUPLO® bricks in the image with the LEGO® elements from the Simple Machine set.

Once the students have designed, built, and tested their spinning tops, ask them to think about and explain the use of gears in their design.

They should be able to answer questions like:

- What type of gears did you use in your design?
- How do the gears make the top spin faster?
- Which is the drive gear and which is a driven gear?

Extension

Have students investigate how weight can change the way their top moves. Students can also change gears to see explore how a larger or small drive gear changes the way the top spins.

Take the tops and launchers apart and put materials away. Have students reflect in their journals:

- What was easy about this challenge?
- What was difficult about this challenge?
- What did I learn from this challenge?

Daily Debrief and Wrap Up

Time: 20 minutes

Materials:

- Sticky notes
- Student journals
- Pencils
- Pens
- Markers

Have students take a quick inventory of the set for just the following materials:

- Rubber bands
- Minifigs

Have students use sticky notes to write down three things they really enjoyed about the day. Have students use a different sticky notes to write down one thing they are still wondering about. Place sticky notes in their student journals.

Toy Factory: Toys that Spin Day 2

Toys that Spin: More Gears

Big Question:

How do toys move? What kind of toys use gears?

Materials needed for the day:

- Simple Machines sets
- Chart paper
- Student journals
- Various craft materials
- Pens
- Pencils
- Markers
- Book, articles, and/or videos about gears and toys that use gears

Outline for Day	Tasks	Time	Materials
9:00 - 10:30	Welcome	5 min	<ul style="list-style-type: none">• Student journals
	Team Building Activity	15 min	<ul style="list-style-type: none">• LEGO® bricks• Bricktionary Cards
	Review Group Rules Chart	5 min	<ul style="list-style-type: none">• Group Rules Chart
	Morning Huddle	5 min	<ul style="list-style-type: none">• None
	Readings and Wonderings	20 min	<ul style="list-style-type: none">• Book or journal article about exploration; satellites• Student journals
	Workplace Wellness (physical activity)	10 min	<ul style="list-style-type: none">• Varies, based on the activity selected
	Challenge 1: Merry-Go-Rounds part 1	30 min	<ul style="list-style-type: none">• Simple Machines sets• Student journals

			<ul style="list-style-type: none"> • Student worksheets • Building Instruction Booklet A • Teacher notes
10:30 - 10:35	Break		
10:35 - 11:25	Challenge 1: Merry-Go-Rounds part 2	20 min	<ul style="list-style-type: none"> • Simple Machines sets • Student journals • Building Instruction Booklet A
	Afternoon Huddle	5 min	<ul style="list-style-type: none"> • None
	Inventory	10 min	<ul style="list-style-type: none"> • Simple Machines sets
	Challenge 2: Problem Solving: Popcorn Cart	15 min	<ul style="list-style-type: none"> • Simple Machines sets • Student journals • Student worksheets • Teacher notes • Craft materials
11:25	Get ready for lunch		
11:30 - 12:00	Lunch		
12:00 - 2:10	Challenge 2: Problem Solving – Popcorn Cart	60 min	<ul style="list-style-type: none"> • Simple Machines sets • Student journals • Craft materials
	Break	5 min	<ul style="list-style-type: none"> • None
	Challenge 3: Make a Cartoon	60 min	<ul style="list-style-type: none"> • Bulletin board paper • Craft supplies
	Clean Up	5 min	<ul style="list-style-type: none"> • None

2:10 - 2:30	Daily Debrief and Wrap Up	20 min	<ul style="list-style-type: none"> • Student journals
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Welcome

Time: 5 minutes

Materials:

- Student journals

Welcome students back! Have students take a minute to read over the sticky notes placed in their journals from the previous day. Have students share their favorite moments from the previous day with a partner.

Team Building Activity

Time: 15 minutes

Materials:

- Loose LEGO® bricks and cards with objects to build

Place students in groups of 4-5 for team building activity - Bricktionary.

Bricktionary:

Have students play one round of Bricktionary. Students will draw a card from the stack without showing the word to their teammates. Then using bricks, students will build the object while teammates try to guess what it is. The game is over when everyone has had a turn.

Bricktictionary Cards

Truck	Place
Bridge	TV
Flower	Tree
Boat	House

Review Group Rules and Expectations

Time: 5 minutes

Materials:

- Group Rules Chart (from Day 1)

Quickly review the group rules and expectations created on Day 1 by the students. Highlight positive moments from Day 1 (times when students helped each other, asking great questions, teamwork, helping to clean up...)

Morning Huddle

Time: 5 minutes

Materials: None

Welcome back toy makers! Yesterday, we explored gears and how gears move when they are meshed together. Who can share one thing they learned yesterday about gears?

This morning, your job is to continue to investigate gears and how gears are used in different ways. What are some different ways gears are used to build things? How do you think gears are used in toys? You will be building a model of a merry-go-round this morning to explore how you can use gears to make mechanisms turn.

Readings and Wonderings

Time: 20 minutes

Materials:

- Books or journal articles about gears
- Books or journal articles about toys with gears
- Student journal

Read a book or age appropriate journal article about gears. Have students record three things they learned about gears and one thing they are still wondering.

Workplace Wellness

Time: 10 minutes

Materials:

- Varies depending on what activity is selected

Take a minute to complete a short physical activity. You can find several ideas for quick physical activities design for kids through an internet search.

Gears: Merry-Go-Round Lesson Part 1

Time: 30 minutes

Materials:

- Simple Machines sets

- Student journals
- Merry-Go-Round Student worksheets ([activity pack](#) pages 32-35)
- Teacher notes for lesson ([activity pack](#) pages 25-31)
- Building Instruction Booklet A

In this activity students will build and test models that use the following techniques associated with gears:

- Decreasing speed of rotation
- Increasing speed of rotation
- Gearing at an angle

Vocabulary:

- Drive gear
- Driven gear
- To mesh
- Gearing

Optional: Share a video or book about merry-go-rounds to build prior knowledge if students may be unfamiliar with a merry-go-round.

Share the following story with students:

Sam and Sally love going to the fair. The ride they enjoy most is the merry-go-round. It's such fun to spin around and around, waving to their friends and families. Do you like merry-go-rounds? What do you enjoy most about them?

*Which simple machine might be needed for a merry-go-round to turn?
Let's go build a merry-go-round!*

Complete the Merry-Go-Round activity, which is available at <https://education.lego.com/en-us/lessons/sm/merry-go-round>. This link to the lesson includes building instructions, teacher notes and student worksheets. Have students complete part 1 of the Merry-Go-Round lesson. Students build and test Model A6 and predict how model A6 is different from Model A7.

Break

Time: 5 minutes

Gears: Merry-Go-Round Lesson Part 2

Time: 20 minutes

Materials:

- Simple Machines sets
- Student Journals
- Merry-Go-Round Student worksheets ([activity pack](#) pages 32-35)
- Teacher notes for lesson ([activity pack](#) pages 25-31)
- Building Instruction Booklet A

This is a continuation of the Merry-Go-Round lesson. Students should build Merry-Go-Round Model A7. Students can then draw a conclusion and check their prediction regarding which merry-go-round turns faster.

Extension:

Students can explore gear ratios. A gear ratio is the relationship between the number of teeth on two gears that are meshed. Students can explore, predict, and test what happens designing the merry-go-round with different gear ratios. Students will need to know the number of teeth on the gears they are using.

After the lesson, have students take apart the merry-go-round models and return pieces to the Simple Machines sets.

Have students reflect in their student journals:

- What was easy about this challenge?
- What was difficult about this challenge?
- What did I learn from this challenge?

Afternoon Huddle

Time: 5 minutes

Materials: None

Now that you have investigated gears a little more and built the merry-go-round, I am presenting you with a new challenge. I would like for you to use what you have learned about gears to complete two design challenges. The first challenge will be to build a popcorn cart. The popcorn cart will have a design brief. The design brief includes elements that need to be included in your finished build. Once you have completed Design Challenge 1, I will provide instructions for Design Challenge 2.

Before we get started on this building challenge, let's do a quick inventory check of our Simple Machines sets.

Inventory Check

Time: 10 minutes

Materials:

- Simple Machines sets

Ask students to find their partner.

Have students place all of the red items from the set on the lid of the box. Then, using the paper insert in the set (the one that is placed under the lid of the box), have students count and replace pieces back to the tray. Teams should be able to complete the inventory count of red pieces in less than ten minutes. If pieces are missing, have

students search other compartments, look to see if the piece is stuck in or on another piece, or check the LEGO® lost and found area in your classroom.

Gears: Problem Solving – Popcorn Cart

Time: 15 minutes

Materials:

- Student journal
- Popcorn Student worksheet ([activity pack](#) page 36)
- Teacher notes ([activity pack](#) page 38-40)

Share the following design brief with students:

When Sam and Sally visit the fair, they always buy popcorn. Sometimes it can be difficult to see where popcorn is being sold. Sam and Sally want to help the popcorn seller by building a sign for the popcorn cart that will turn and attract people's attention.

Let's help Sam and Sally! Build a popcorn cart like the one in the picture.

Your design brief is as follows:

- *Build a popcorn cart.*
- *Make a sign that can turn.*
- *Build a mechanism that makes the sign turn when you turn a handle.*

When you have finished, test your cart. Count how many times the sign spins for every five turns of the handle. Assess how easily the sign can be read at a distance. What makes it easy or difficult to read?

Have students work with their partner to brainstorm and sketch different ideas for the popcorn cart. Students can record ideas in their Student Journals.

After lunch, students will complete the build and share phase of this lesson. Use the teacher notes from the activity pack to help guide the activity.

Lunch

Time: 30 minutes

Gears: Problem Solving – Popcorn Cart

Time: 60 minutes

Materials:

- Simple Machines sets
- Student journals
- Student worksheets for Popcorn Cart ([activity pack](#) pages 36-37)
- Teacher notes for Popcorn Cart ([activity pack](#) pages 38-40)
- Optional Materials
 - Paper

- Cardboard
- Markers

Provide time for students to finish designing and then building their popcorn carts. Remind students to review the principle models they built previously. You may decide to provide additional consumable or craft material for students to use within their models.

When the model is finished, encourage students to reflect on both the product that they have produced and the processes they have used by:

- Carrying out tests to evaluate the performance of their model
- Reflecting on the design brief
- Recording their designs by drawing or taking digital photos

Have students reflect in their journals:

- What was easy about this challenge?
- What was difficult about this challenge?
- What did I learn from this challenge?

When students have finished sharing, disassemble the builds and return the pieces to the Simple Machines set for the next challenge.

Break

Time: 5 minutes

Toys that Spin: Make a Cartoon

Time: 60 minutes

Materials:

- Simple Machines sets
- Student journals
- Teacher Lesson Plan ([link to website](#))
- Paper
- Tape
- Markers
- Colored pencils
- Crayons
- Optional: Fabric or felt
- Optional: Foam, pop-poms or beads
- Optional: Student Worksheet ([link to PDF](#))
- Optional: Maker Design Process ([link to PDF](#))

Share with students:

This morning you have built two different models using gears. We built a merry-go-round and a popcorn cart. Now we are going to build a toy called a Cartoon Spinner. The spinner can make an image look like it is animated by spinning.

For this challenge, we will be combining our LEGO® elements and bricks with everyday materials.

To help students prepare for this challenge, ask them to think about:

- What a cartoon?
- Can you make an animated cartoon without a computer?
- What simple machines can help make an animated cartoon?
- Can you make a machine that can move images?

Have students work through the design process to create an animated cartoon.

Students should

- identify the problem/task
- brainstorm ideas
- choose the best idea
- make their chosen idea
- evaluate their idea
- present their idea

When students have finished sharing their cartoons, be sure to take a picture or video of their models to share on the last day of the program.

Have students reflect in their journals:

- What was easy about this challenge?
- What was difficult about this challenge?
- What did I learn from this challenge?

Clean Up

Time: 5 minutes

Have students disassemble their models, throw away trash, and return the LEGO® pieces correctly to the proper trays in their Simple Machine sets.

Daily Debrief and Wrap Up

Time: 20 minutes

Materials:

- Student journals
- Markers
- Colored pencils
- Crayons

Have students write one word that they feel reflects what they have learned today. Write and illustrate the word in their student journals.

Toy Factory: Toys that Spin Day 3

Toys that Spin: Pulleys

Big Question:

How do toys move? What kind of toys spin? What is a pulley? What kind of toys use pulleys?

Materials needed for the day:

- Simple Machines sets
- Student journals
- Various craft materials
- Pens
- Pencils
- Markers
- Book about pulleys

Outline for Day	Tasks	Time	Materials
9:00 - 10:30	Welcome	5 min	<ul style="list-style-type: none">● Student journals
	Team building activity	15 min	<ul style="list-style-type: none">● LEGO® bricks
	Review Group Rules Chart	5 min	<ul style="list-style-type: none">● Group Rules Chart
	Morning Huddle	5 min	<ul style="list-style-type: none">● None
	Readings and Wonderings	10 min	<ul style="list-style-type: none">● Various books or articles on pulleys
	Inventory Check	5 min	<ul style="list-style-type: none">● Simple Machines sets
	Challenge 1: Investigating Pulleys	45 min	<ul style="list-style-type: none">● Simple Machines sets● Student journals
10:30 - 10:35	Break		

10:35 - 11:25	Challenge 2: Crazy Floors	50 min	<ul style="list-style-type: none"> • Simple Machines sets • Student journals
11:25 – 11:30	Get ready for lunch		
11:30 - 12:00	Lunch		
12:00 – 1:05	Workplace Wellness (physical activity)	10 min	<ul style="list-style-type: none"> • Varies, based on the activity selected
	Afternoon Huddle	5 min	<ul style="list-style-type: none"> • None
	Challenge 3: Problem-Solving Activity: Crane	50 min	<ul style="list-style-type: none"> • Simple Machines sets • Student journals
1:05 – 1:10	Break		
1:10 – 2:10	Challenge 4: Toy Design Make a Yo-Yo	60 minutes	<ul style="list-style-type: none"> • Simple Machines sets • Student journals • Cotton yarn • Scissors • Other craft material
2:10 - 2:30	Daily Debrief and Wrap Up	20 min	<ul style="list-style-type: none"> • Student journals

Welcome

Time: 5 minutes

Materials:

- Student journals

Welcome students back! Have students take a minute to share their word they create the day before with a neighbor. Compile a list of the words as a group. You can create a word cloud to share on the last day of the program.

Team Building Activity

Time: 15 minutes

Materials:

- LEGO® bricks

Place students in pairs.

Build a Bridge

Challenge students to build a LEGO® bridge that spans two tables.

Extensions:

- Build the longest bridge
- Build the tallest bridge
- Build a bridge that can hold the most weight (use a bucket and some weights to test)

Review Group Rules Chart

Time: 5 minutes

Materials:

- Group Rules Chart (from Day 1)

Quickly review the group rules and expectations created on Day 1 by the students. Highlight positive moments from Day 2 (times when students helped each other, asking great questions, teamwork, helping to clean up...).

Morning Huddle

Time: 5 minutes

Materials: None

Hello! This morning, your job is to investigate pulleys.

You will be exploring questions such as:

- *How are pulleys a simple machine?*
- *Where might I find pulleys being used?*
- *Are there toys that use pulleys?*

You will build a model that can help you better understand how this simple machine works.

Readings and Wonderings

Time: 10 minutes

Materials:

- Various books or materials on pulleys

Read a book or age appropriate journal article about pulleys, toys using pulleys, or everyday objects that use pulleys.

Have students record three things they learned about pulleys and one thing they are still wondering.

Inventory Check

Time: 5 minutes

Materials:

- Simple Machine sets

Ask students to find their partner from Day 1.

Have students place LEGO® bricks and elements that are white on the lid of the box. Then, using the paper insert in the kit (the one that is placed under the lid of the box) have students count and replace pieces back to the compartment. Teams should be able to complete this task in five minutes. If pieces are missing, have students search other compartments, look to see if the piece is stuck in or on another piece or check the LEGO® lost and found area in your classroom.

Challenge 1: Investigating Pulleys

Time: 45 minutes

Materials:

- Simple Machines sets
- Student journals
- Student worksheet ([activity pack](#) pages 103-105)
- Teacher notes ([activity pack](#) pages 95-102)
- Building Instruction Booklet D

Complete the principle models for pulleys, which can be found at https://le-www-live-s.lego.com/sc/media/files/building-instructions/mm/9689_d1-d5_pulleys_principle-13ef191ae9466573a59853d378f8bba2.pdf. This link contains the building instructions for the principle models for pulleys or you can use the building instruction booklets from the kit.

Introduce the principle model pulleys to students. Ask students to think about things they learned or questions they have about pulleys from their reading and wonderings earlier.

Things to talk about:

- What do you know about the simple machine - pulley?
- Where do we use pulleys?
- Why do we use pulleys?

Work through the pulley principle model lesson.

Students should understand the following vocabulary following the lesson:

- Drive wheel
- Driven wheel
- Belt

- Slip or slippage

Additionally, students should begin to understand how to change the rotation of pulleys, increase or decrease of speed rotation, and effects of increased turning force.

Challenge students by asking them the following questions:

- How are pulleys similar to gears? How are they different?

Have students share ideas verbally and/or within their journals.

Have students reflect in their journals:

- What was easy about this challenge?
- What was difficult about this challenge?
- What did I learn from this challenge?

Break

Time: 5 minutes

Challenge 2: Crazy Floors

Time: 50 minutes

Materials:

- Simple Machines sets
- Student journals
- Student worksheet ([activity pack](#) pages 113-116)
- Teacher notes ([activity pack](#) pages 107-112)
- Building Instruction Booklet D

Complete the Crazy Floors lesson, which is available at <https://education.lego.com/en-us/lessons/sm/crazy-floors>. This link contains the building instructions, student worksheets, and teacher notes for this lesson.

In this activity, students will build and test models that use the following techniques associated with pulleys:

- Decreasing speed of rotation
- Increasing speed of rotation
- Direction of rotation
- Changing direction of rotation

To perform this activity, students should be familiar with the following vocabulary associated with pulleys:

- Drive wheel
- Driven wheel
- Slip

Share the following story with students:

Sam and Sally love going to the fair. There is a fun attraction where you have to have good balance. The floors are crazy! They move at different speeds of

rotation and in different directions. It is fun turning and trying not to get dizzy or fall down.

Are you good at keeping your balance? Have you ever seen floors move? Which simple machine is needed for Crazy Floors to turn?

Let's build Crazy Floors!

Use the lesson plan and student worksheet to guide students through the following activities:

- Build Crazy Floors Model D6
- Compare Crazy Floor Models D6 and D7
- Predict how the models will turn differently
- Test Crazy Floors Model D6
- Build and test Crazy Floors Model D7
- Draw a conclusion and test predictions

As time allows, have students continue to explore different pulley arrangements and record their observations.

Extensions:

As time allows, ask students to investigate compound belt drives. Pulley wheels of two different sizes on the same axle can be connected to other pulley wheels to build more extensive gearing down (and gearing up) arrangements.

When lesson is complete, have students take the models apart and return pieces to the Simple Machine sets.

Have students reflect in their journals:

- What was easy about this challenge?
- What was difficult about this challenge?
- What did I learn from this challenge?

Lunch

Time: 30 minutes

Workplace Wellness

Time: 10 minutes

Materials:

- Varies depending on what activity is selected

Take a minute to complete a short physical activity. Ideas for different types of short, age appropriate physical activities can be found through a quick internet search.

Afternoon Huddle

Time: 5 minutes

Materials: None

Hello! This morning, you are going to put your detective skills to use and investigate pulleys. This afternoon, you are going to use what you have learned for two different challenges! The first challenge involves building a crane to solve a problem lifting heavy objects. Your final challenge of the day will be to design and build a yo-yo.

Challenge 3: Problem Solving Activity-Crane

Time: 50 minutes

Materials:

- Simple Machines sets
- Student journals
- Student worksheet ([activity pack](#) pages 117-118)
- Teacher notes ([activity pack](#) pages 119-121)

Share the following design brief with students. Students can follow along on worksheet page 117:

When the fair is packing up to leave town, Sam and Sally enjoy watching a large crane lifting some of the heavy attractions. Sam and Sally want to try to build a crane and pretend they are part of the working crew at the fair. Let's help Sam and Sally!

Build a crane like the one in the picture.

Your design brief is as follows:

- *Build a crane that balances well.*
- *Use a fixed pulley on the crane.*
- *Build a mechanism that makes the winding mechanism stay locked.*

When you have finished, test your crane. How well does your lock system work? How much of a load can your crane lift? Assess how easily the crane can move the load and how well it stays stable. What makes the load easy or difficult to move?

Follow the teacher notes on page 119 of the activity pack for the remainder of the lesson. When students have completed the activity, take pictures of their models and then have students disassemble them, replacing pieces to the Simple Machine sets.

Have students reflect in their journals:

- What was easy about this challenge?
- What was difficult about this challenge?
- What did I learn from this challenge?

Break

Time: 5 minutes

Challenge 4: Toy Design-Make a Yo-Yo

Time: 60 minutes

Materials:

- Simple Machines sets
- Student journals
- Cotton or cotton/polyester blend yarn (2.5 oz weight)
- Additional craft material
- Yo-yos (to be used for exploration of how a yo-yo works and is constructed)

Ask students if they have played with a yo-yo. Demonstrate how a yo-yo works. How do you think a yo-yo is designed?

Then, share the following design brief with students.

Sam and Sally have been approached by a toy company to design a yo-yo. It should be made of LEGO® bricks and elements, yarn and whatever decorative elements Sam and Sally would like to add to make it fun for kids of all ages. Can you help them design this toy?

Design needs to include:

- *LEGO® bricks and elements*
- *Cotton string*
- *Fun, decorative elements (made from LEGO® or other materials provided)*

Provide students with a yo-yo so they can see how it is designed and how it works. Have students work with their partner to design and build a yo-yo with the design brief constraints.

Have students test and refine their yo-yo builds.

Have students demonstrate how their yo-yos work. You may want to video tape demonstrations for sharing with other on the last day of the program.

Have students reflect in their journals:

- What was easy about this challenge?
- What was difficult about this challenge?
- What did I learn from this challenge?

Big Question: Is a yo-yo a pulley?

Write in your student journals:

Based on what you have learned about pulleys, do you think a yo-yo is a type of pulley? Include ideas and/or diagrams to help make your case.

Daily Debrief and Wrap Up

Time: 20 minutes

Materials:

- LEGO® Bricks
- Student journals
- Camera or something to take a picture

Have students use LEGO® bricks to build a model that represents two things they learned today. Have students take draw a sketch of the build and take some notes regarding their builds in their journals about their build. Have students take pictures of their builds. Use pictures to create a collage for display for Day 4.

Note: You can leave the models intact for morning activity, if it suits. Place a sticky note on each model with child's name for easy retrieval. If not, you can simply use student journal documentation.

Toy Factory: Toys that Spin Day 4

Culminating Project: Automata

Outline for Day	Tasks	Time	Materials
9:00 - 10:30	Welcome and Team Building Activity	20 min	<ul style="list-style-type: none"> LEGO® bricks
	Review Group Rules Chart	5 min	<ul style="list-style-type: none"> Group Rules Chart
	Morning Huddle	5 min	<ul style="list-style-type: none"> None
	Automata Design and Build	60 min	<ul style="list-style-type: none"> Simple Machines sets Craft materials
10:35 - 10:40	Break		
10:40 - 11:25	Automata Design and Build	45 min	<ul style="list-style-type: none"> Simple Machines sets
11:25 – 11:30	Get ready for lunch		
11:30 - 12:00	Lunch		
12:00 – 12:30	Practice Sharing/Project Wrap Up	30 min	<ul style="list-style-type: none"> Program materials
12:30 – 12:35	Showcase Overview and Expectations	5 min	<ul style="list-style-type: none"> None
12:35 – 12:50	Culminating Project: Set up for Showcase	15 min	<ul style="list-style-type: none"> Simple Machines sets

12:50 – 1:50	Showcase	60 min	<ul style="list-style-type: none"> • Student Projects
1:50 - 2:30	Daily Debrief, Clean Up and Program Wrap Up	40 min	<ul style="list-style-type: none"> • Simple Machines sets • Certificates of Completion

Welcome

Time: 5 minutes

Materials:

- Student journals

Welcome students back! On a piece of chart paper, draw a really large light bulb. Have students write positive things they discovered about themselves during the program.

Team Building Activity

Time: 15 minutes

Materials:

- LEGO® bricks

Create a Creature

Have each student create a LEGO® creature. Have them give their creature a name and a special characteristic. Have students share their creature with their partner. Have the pair create a short story that includes both creatures.

Review Group Rules Chart

Time: 5 minutes

Materials:

- Group Rules Chart (from Day 1)

Quickly review the group rules and expectations created on Day 1 by the students. Highlight positive moments from Day 3 (times when students helped each other, asking great questions, teamwork, helping to clean up...).

Morning Huddle

Time: 5 minutes

Materials: None

Today, you are going to learn a little bit about a toy type called Automata. You are going to work with your partner to design and create an automata to share this afternoon with others!

Culminating Project: Automata Design and Build

Time: 60 minutes

Materials:

- Simple Machines sets
- Additional LEGO® bricks and elements
- Craft materials
- Student journals

Share with students images or video clips of automata. Then share the following design brief with students:

Sam and Sally received an interesting toy in the mail from their aunt! It was an automata of a magician. When you turned the handle, it looked like the magician pulled a different item out of his hat. They could see that the toy used different types of simple machines to make the magician move. Sam and Sally decided they wanted to make another automata and create a carnival show. Can you help Sam and Sally by designing an automata to include in their carnival show?

Your design brief is as follows:

- *Build an automata*
- *Build a mechanism or mechanisms that make at least two things move*
- *Use additional craft materials for decoration*
- *The theme of your automata should be something you might see at a carnival or show.*
- *Create a sign for your automata with the name of your design and the names of the designers*

When you have finished, test your design and modify as needed. If time, create additional scenery items for your automata as part of the display.

Teacher Note: If students are struggling with how to start on this project, suggest they build the model for Merry-Go-Round (gears) or Crazy Floors (pulleys) as a starting point, then modify the design for their automata.

Break

Time: 5 minutes

Culminating Project: Automata Design and Build

Time: 45 minutes

Continue working on project.

Lunch

Time: 30 minutes

Practice Sharing and Project Wrap Up

Time: 30 minutes

Have students finish their automata projects and then practice sharing their designs with other groups of students.

Have students clean up their work areas to get ready for guests.

Showcase Overview and Expectations

Time: 5 min

Materials: None

Go over your expectations for the showcase in the afternoon so students are prepared for guests.

Today, we are going to share what you have learned and built with others. You will need to be prepared for our guests. Working with your partner, you will need to do the following:

- *Make sure your automata is complete.*
- *If you have built or created additional scenery for your automata, make sure it is complete and ready for display.*
- *Have a plan for how you will demonstrate your automata.*
- *Be prepared to answer questions from our guests (Note: As a group you might brainstorm potential questions for students to answer.)*

Culminating Project: Set up for Showcase

Time: 15 minutes

Materials:

- Student Automata Designs

Have each pair of students display their automata, any additional scenery items and sign for their guests.

Showcase

Time: 60 minutes

Materials:

- Student work

Students should be set up and ready when guests arrive. Other materials you might have on display:

- Pictures of other toys created during the week
- Background music
- Wonderings from the week

Daily Debrief, Clean Up and Wrap Up

Time: 40 minutes

Materials:

- Student projects
- Certificates of Completion

Have students disassemble their simple machine models. If additional LEGO® bricks and elements were used, have students take time to sort the Simple Machine sets to make sure it is complete and ready for another week of the program.

Have students clean up materials from the showcase.

Students can take home their journals. You can present each student with a Certificate of Completion.