

## STEM AT HOME ACTIVITY GUIDE:

# Simple Machine Playground Challenge



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## STEM AT HOME GUIDE: Simple Machine Playground Challenge

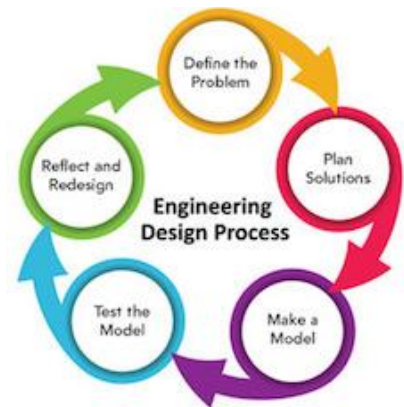
### Background Knowledge

**Aim:** Design functioning playground equipment prototypes made from the different simple machines designed with household materials.

**Problem & Career Focus:** Who doesn't love a great playground? Did you know that the playground equipment you enjoy use forces of motion, energy and simple machines to make your day fun? Using the engineering design process, your task is to work with your team of architects, surveyors, and welders to design, model, and prototype working playground equipment using the 6 simple machines (wedge, pulley, screw, inclined plane, lever and wheel and axle).

**Educational Standards Correlations:** Engineering Design, Motion, Energy, Simple Machines, Physics, Mathematics

**Engineering Design Process:** STEM professionals use the engineering design process as steps to help solve real-world problems. With your team: define the problem, discuss solutions, design, build, test, and improve a prototype of your solution. One of the most important steps of the engineering design process are reflect and redesign- if your team notices your playground equipment prototypes aren't working- improve the design! Use the engineering design process steps to guide your exploration during the Simple Machine Playground Challenge.



#### Investigating Questions

- What do you know about how playground equipment is designed? What are some ideas you and your team can try as you design your playground?

#### Materials

- Construction paper, Poster board or cardboard
- Masking tape and plastic tape, scissors
- Paper Plates
- Craft sticks, toothpicks
- Coffee stirrers
- Rubber bands

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<ul style="list-style-type: none"> <li>• What combinations of materials can you use to create your working equipment designs?</li> <li>• How do your equipment prototypes act like simple machines?</li> </ul>	<ul style="list-style-type: none"> <li>• Pipe cleaners, wooden dowels</li> <li>• Legos</li> <li>• Any other household item you desire</li> </ul>
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### Background Knowledge

#### Vocabulary:

*Simple Machines:* mechanical devices that help people do work; there are 6 simple machines (wedge, lever, pulley, inclined plane, screw, and wheel and axle)

*Force:* the measurement of a push or a pull on an object. Force is measured in newtons.

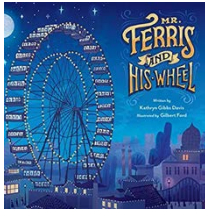
*Energy:* the ability to do work. The standard unit of measure for energy is the joule

#### STEM Career Connections:

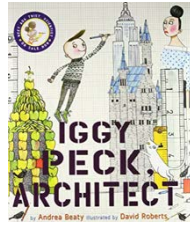
<p style="text-align: center;"><b>Architect</b></p> <p>Are professionals that design buildings to be functional, safe, and sustainable. Check out Hector Garcia talking about his career as an architect: <a href="#">Architect Career Video</a></p> <p><b>They:</b> are responsible for the drawing up of detailed plans for structures and can even specialize in landscaping design, plumbing, and communication systems.</p>	<p style="text-align: center;"><b>Surveyor</b></p> <p>Are professionals that make precise mathematical measurements to determine property boundaries.</p> <p><b>They:</b> provide data relevant to the shape and contour of the Earth's surface for engineering, mapmaking, and construction projects.</p>	<p style="text-align: center;"><b>Welder</b></p> <p>Are professionals that join metal parts together using math, equipment, and blueprints</p> <p><b>They:</b> work on the metal components of different structures including pipelines, bridges, power plants, buildings, cars, or ships.</p>
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**Literacy Connections:**

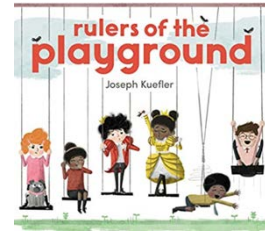
**Mr. Ferris and His Wheel**  
by Kathryn Gibbs Davis



**Iggy Peck, Architect**  
by Andrea Beaty



**Rulers of the Playground**  
by Joseph Kuefler



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## STEM AT HOME GUIDE: Simple Machine Playground Challenge

### Background Knowledge

#### Real World Applications

Playgrounds are an important part of a child's life. But did you know they are a great example of force, motion, energy, and simple machines through engineering. Take a trip to the nearest playground to research and see for yourself or watch the video links provided to see engineering in action.

#### Simple Machines

Simple machines help us make work and play more enjoyable. They have few or no moving parts which help us do work by changing the direction of force needed to do something.

There are six simple machines: lever, pulley, wedge, screw, inclined plane, and wheel and axle.

**Pulley:** can move things from a low area to a higher one (examples: flagpole, crane, elevators).

**Lever:** helps move heavy objects (examples: seesaw, wheelbarrow, scissors, mop, shovel).

**Wedge:** used to split, cut, or hold together materials (example: knife, axe, staples, doorstep)

**Inclined Plane:** help move heavy objects, such as a ramp (examples: bathtub, wheelbarrow, moving truck ramp).

**Wheel and Axle:** a wheel attached to a smaller axle that rotates to transfer force (examples: bicycle wheel, ferris wheel, electric fan, clock)

**Screw:** a slender, sharp-pointed metal pin with an inclined plane thread (examples: picture screw, jar lid, light bulb)

#### Everyday Science: Playgrounds

The first playground in the United States was built in San Francisco's Golden Gate Park in 1887. The park key feature is a carousel that was built in 1917, which guests can still ride today! The park covers three miles and has museums, gardens, and water activities.



#### Playground Fun Facts!

- There is a Tire Park in Japan, a playground made of tires.
- The Fruit and Scent Playground themed in Sweden features a banana slide, strawberry spinners, a pair of cherry swings and more.
- There is a park in Germany that is only for grandparents. It's a park to encourage older citizens to get out and exercise more.

#### Check out these video links

#### Science Max: Simple Machines

<https://www.youtube.com/watch?v=e1nEUFYsell>

#### 10 Most Amazing Playgrounds in the World

<https://www.youtube.com/watch?v=AQCVkhZp8bk>

#### 5 Coolest Inside Slides

<https://www.youtube.com/watch?v=6IIZAFsJ13I>

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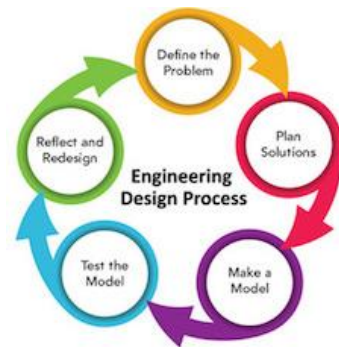
### Activity Directions

**Aim:** Design functioning playground equipment prototypes made from the different simple machines designed with household materials.

**Instructional Video:** <https://youtu.be/o4CYi5ZsK0>

#### Investigating Questions

- What do you know about how playground equipment is designed? What are some ideas you and your team can try as you design your playground?
- What combinations of materials can you use to create your working equipment designs?
- How do your equipment prototypes act like simple machines?



#### Materials

Construction paper, Poster board or cardboard  
 Paper Plates  
 Coffee stirrers  
 Pipe cleaners, wooden dowels  
 Any other household item you desire

Masking tape and plastic tape, scissors  
 Craft sticks, toothpicks  
 Rubber bands  
 Legos

#### Criteria & Constraints:

Engineering design challenges (EDCs) are great opportunities for open-ended activities to grow critical thinking and problem-solving skills. EDCs do not use a list of directions to build a specific design, rather suggest a framework of designing a solution based on the problem and goal. How your team chooses to address the problem and goal is entirely up to you.

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- Go to a playground to make observations on the different types of simple machines that you can find! Discuss as a family how each simple machine helps make play at the playground easier. (*Define the Problem*)?
- Lay out all materials and items available for the challenge. Plan to give time for your team to discuss the problem relating to your background knowledge. What materials will you use to create the different playground equipment for your playground? (*Define the Problem*)?
- Discuss, sketch, and determine what materials your team will use to create the simple machines for your playground equipment (*Plan Solutions*).
- Using your sketches and discussions, begin creating the simple machines from your model from materials available. Family adults: allow your child(ren) to experiment with the materials and help them build problem-solving skills (*Make a Model*)
- As you are building your playground equipment, test out the models to make sure they can move/work. (*Test the Model*)
- With your team, continue to discuss and work through problems with your designed models along the way. What adjustments can your team make to improve your design? If you were to make a new playground with different equipment, what materials would you use or how would your model be different? (*Reflect and Redesign*)

**Ideas to Increase Difficulty:**

-Add amusement park equipment! What different rides at an amusement park use simple machines?

-Limit the number of materials that will be used.

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### Sample Ideas



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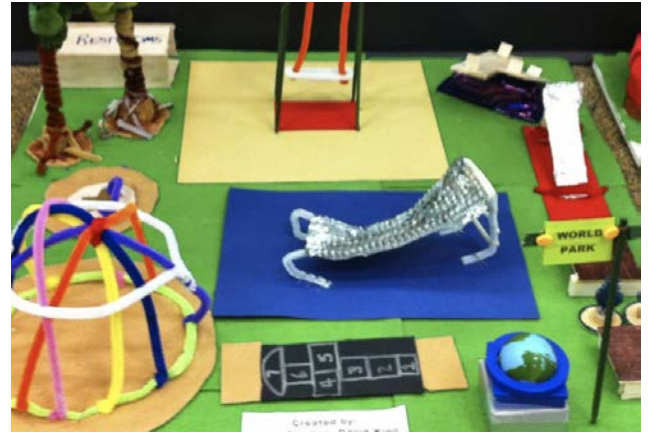
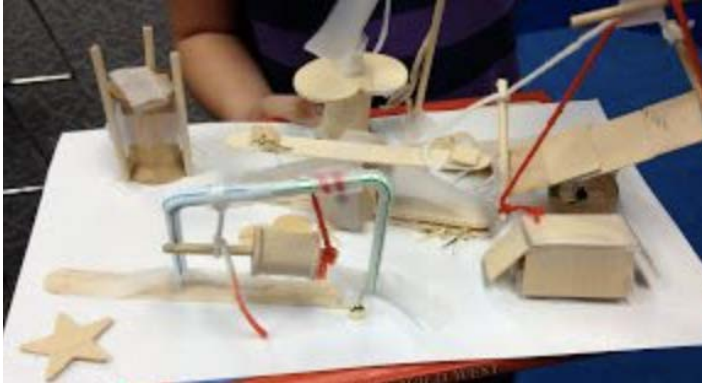


**MATHNASIUM**  
The Math Learning Center



National  
**PTA**  
every child, one voice®





Photo's courtesy of: Shapes School Project Model, The Show Me Librarian, Ms. E's Classroom

## STEM AT HOME GUIDE: Simple Machine Playground Challenge

### Extension Activity

### Zipline Challenge

#### Materials:

Index cards  
 Binder clips  
 Cups/bowls  
 Toilet paper rolls

Paper/Pencil/Crayons  
 Paper  
 Tape/glue  
 Paperclips

Cardboard  
 String/yarn  
 Scissors  
 Legos

\*Other household materials

#### Criteria & Constraints:

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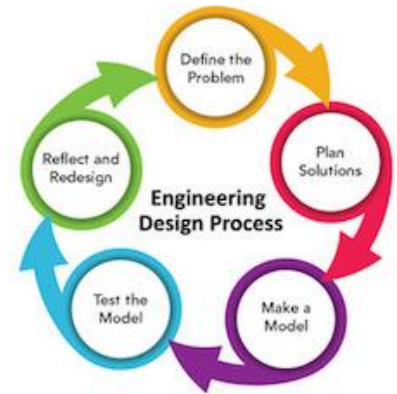


design, rather suggest a framework of designing a solution based on the problem and goal. How your team chooses to address the problem and goal is entirely up to you.

-In this challenge you are designing a zipline car that will transport small toys from one point in a room to another. A zipline is actually a combination of several simple machines (inclined plane, pulley, and lever)

-To increase level of complexity- add more distance for the zipline car to travel.

- Research and brainstorm designs of ziplines and zipline cars. How do they work? What materials can you use to create solutions to the problem (*Define the Problem*)?
- Sketch your prototype and design of key aspects of the zipline, your zipline car, and how to ensure your zipline car will move by itself (*Plan Solutions*).
- Use research and the sketches to start brainstorming your prototype (What will the zipline car be made of? What materials can you combine to make the simple machines?) (*Plan Solutions and Make a Model*)
- Plan your prototype: draw or sketch the design. Watch some videos on zipline mechanics! (*Plan Solutions and Make a Model*).
- Use your household materials to make a prototype of your zipline and zipline car (*Make a Model*).
- Test your design! Will you have to modify it? Talk with your team about ways you could improve the design of your models (*Reflect and Redesign*).



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