



Rapunzel Needs Your Help!

Submitted by: Kellene Colin, STEM
Kay Carl Elementary, Las Vegas, NV

Target Grade: K-2nd Grade

Time Required: 50 minutes

Standards:

- K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Lesson Objectives:

Students will:

- create a blueprint
- share ideas with a partner
- replicate a working design
- follow the engineering design process

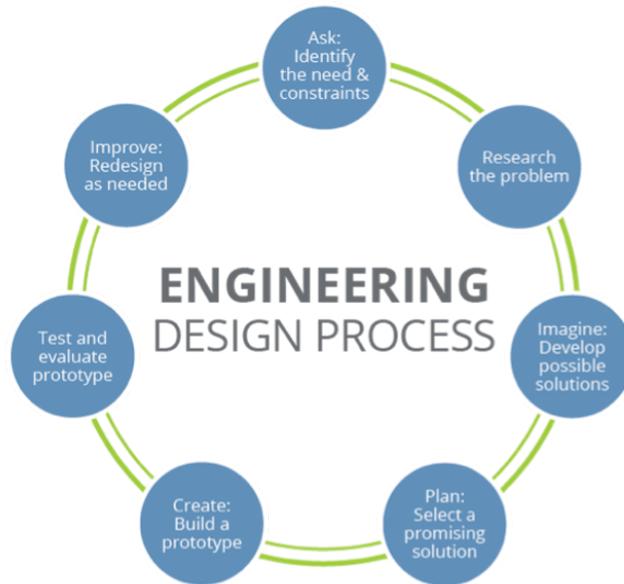
Central Focus:

Rapunzel has been trapped in a tower and she needs your help! In this interactive STEM lesson that combines engineering with literacy, students will work in teams to create a pulley system to help the princess escape the tower. The students will learn about simple machines, pulleys, and working parts. By working through the design thinking process, students will discuss ideas, draw blueprints, create a working model, and develop modifications after testing their designs.

Key words: machine, designs, build, creative, reading



Background Information:

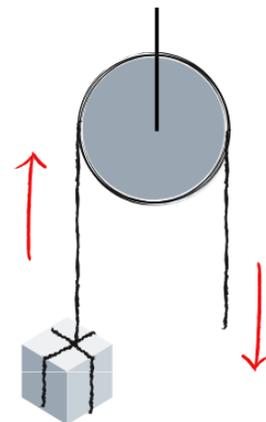


<https://i2.wp.com/media.premiumtimesng.com/wp-content/files/sites/2/2017/02/Engineering-Design-Process.png>

The engineering design process is a cycle of asking questions, researching, designing, building, testing, modifying, retesting, and repeating. The cycle allows students to recognize the problem, develop the solution, sketch a blueprint, create a prototype, test and evaluate the prototype, and modify and redesign the prototype as needed.

A simple machine is a basic, mechanical device that changes the direction or magnitude of force. Simple machines use mechanical advantage, or leverage, to perform work (the energy required to move an object). The further the object is moved, the more work is performed.

There are six types of simple machines: lever, wheel and axle, inclined plane, wedge, screw, and pulley. The focus of this lesson is a simple pulley system. A pulley is a wheel and axle combined with rope to change the direction of the force necessary to do the work. This reduces the force needed and allows objects to be more easily lifted or lowered. An example of a simple pulley would be a flag raised and lowered on a flag pole. When you pull down on one side of the rope, the flag raises, and the flag lowers when you pull down on the other side of the rope.





Materials

- *Keep it Simple Rapunzel, The Fairy Tale Physics of Simple Machines* by Thomas Kingsley Troupe
- Pringle cans (1 per partner group)
- Popsicle sticks (large and small)
- Binder clips (various sizes)
- Paper clips
- Yarn
- String
- Rope
- Scissors
- Rulers
- Pencils
- Design page
- Rubric

Instruction

Introduction (20 minutes)

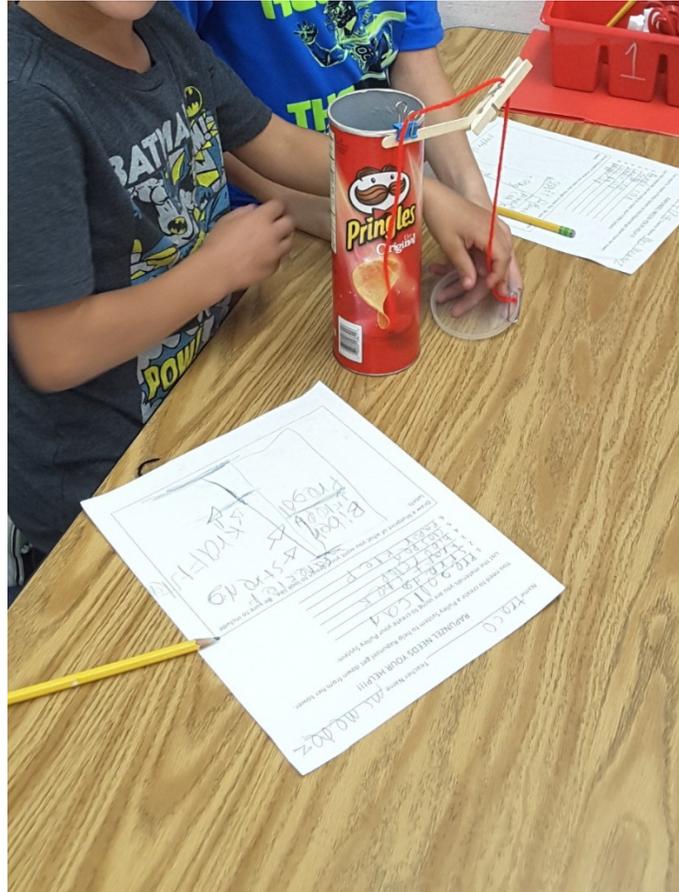
- Introduce simple machines to the class.
- Have the students brainstorm their knowledge of simple machines with their shoulder partner.
- After the students have brainstormed ideas, discuss simple machines and pulley systems. If students need more information, the teacher may choose to show the following video: <https://youtu.be/LiBcur1aqcg>. Explain to the students how a pulley works by lowering the force needed to do work.
- Read the book *Keep it Simple Rapunzel, The Fairy Tale Physics of Simple Machines* by Thomas Kingsley Troupe, stopping to share and discuss story.
- Introduce the challenge that Rapunzel is stuck in her tower (the Pringles can) and she needs a pulley system to help her get down.
- Explain the various materials to be used during the challenge. Depending on the grade and skill levels, the teacher may need to share how to use the materials (ex: how to open a binder clip).

Activities (30 minutes)

- Provide the students with the attached rubric and design sheet.
- Review the rubric with the students, making sure to emphasize the requirements for full credit.
- Students should begin by working individually to come up with an idea they would like to try. The students will need to fill in the materials needed and sketch and label an initial blueprint drawing on the design sheet.
- Assign the students a partner. Allow students time to discuss their ideas and to collaborate on a design for the pair.



- Partners should start creating a pulley system using the materials needed, checking for working parts, and making modifications as needed.
- As students work, they should be sure to note any modifications they make when creating their pulley.
- The teacher should walk around to observe the groups and assist with questions and concerns.
- Have the students draw a picture with labels of the final working design.



Closure (5 minutes)

- Students should meet with another group to present their design and model for helping Rapunzel escape.
- Students should discuss their design process, key elements, and modifications.

Differentiation

- Structure groups so that students who have difficulty building are with students who excel in that area. Create group jobs as necessary (ex: builder, tester, data recorder). The activity is designed to have differentiation built in as students can use their individual strengths when brainstorming and building.
- English language learners may use a bilingual dictionary or translator to communicate with group members or work on documentation, as appropriate.



Assessment

Formative Assessment:

- While the students work on their pulleys, the teacher will walk throughout the classroom and monitor student comprehension and the engineering design process.

Summative Assessment:

- The teacher will collect and grade the design sheets based on the attached rubric. Students will be graded based on the blueprint sketches, modifications, the final pulley, the successfulness of the pulley, and participation.

Name _____ Teacher Name _____

RAPUNZEL NEEDS YOUR HELP!!!

You need to create a Pulley System to help Rapunzel get down from her tower.

List the materials you are using to create your Pulley System:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Draw a blueprint of what you want your design to look like. Be sure to include labels.

Choose a partner: Partner's name _____

Share your blueprint design with your partner.

Together, use the given materials to create a Pulley System.

Does it look like the one you designed on your blueprint? Yes or No

Did you get your Pulley System to work? Yes or No

Did you need to make modifications to your Pulley System? Yes or No

Draw a picture of the Pulley System that you and your partner created. Be sure to include labels.

Rapunzel Needs Your Help! Design Sheet Rubric

Total: _____/100

	0 Points	5 Points	10 Points	15 Points	20 Points
Blueprint	Did not sketch a blueprint.	Sketched some, but lacking an overall blueprint.	Sketched a basic blueprint. Some items are missing.	Sketched a blueprint, but may be missing a few things.	Sketched a high quality blueprint. All needed items are included.
Modifications	Modifications needed, but not included.	Minor modifications included. Major modifications not included.	Some modifications included. Student cannot explain the modifications and why they were necessary.	Original pulley modified and retested. Student can generally explain the modifications and why they were necessary.	Original pulley modified and retested. Student can explain the modifications and why they were necessary.
Final Pulley	Pulley was not created.	Pulley was created with major flaws or did not follow the blueprint at all.	Pulley was created but had some flaws or did not follow the blueprint.	Pulley was created but did not entirely follow the blueprint.	Pulley was created exactly from the blueprint.
Successful	Pulley did not work.	Pulley did not work, but was able to be tested.	Pulley somewhat worked.	Pulley worked with minor flaws.	Pulley worked and was able to rescue Rapunzel.
Participation	Did not participate.	Low participation; did not contribute significantly to the group.	Participated in about half of the project.	Did an adequate amount of participation and contribution.	Did fair share or more of work for the group; was a main contributor.