by WorldStrides®

Family Lab:
Complex Machines Challenge

LESSON PLAN

Welcome to Envision by WorldStrides Family Labs!

For over 35 years, Envision by WorldStrides has empowered extraordinary students to become their best selves through programs that enable them to discover their passion, explore a career, and positively impact their world. In 2018, Envision became part of the WorldStrides family. The largest provider of educational travel and experiences in the United States, WorldStrides works with over 50,000 educators each year to help more than 550,000 students see the world—and themselves—in new ways.

Recently, students, families, and teachers have been challenged to quickly shift to new ways of learning and interacting. At Envision, we believe in providing hands-on educational experiences to foster critical thinking and innovation. We created Family Labs to share our instructional philosophies with you and your students at home.

The Family Labs provide student-guided activities that can be completed independently or as a family. These activities enhance creativity and critical thinking and are fun! The goal is to safely transform your home into an innovation lab, allowing your child the opportunity to learn, grow, and explore their power of potential as they navigate through the activities. While the Family Lab is designed for certain grade levels, each lab can be enjoyed by most age groups.

While participating in Family Labs, encourage your child to embrace challenge, think outside of the box, and most importantly, have fun!

Yolanda Golden

Yolanda Golden
Vice President, Educational Experience
National Youth Leadership Forum: Pathways to STEM

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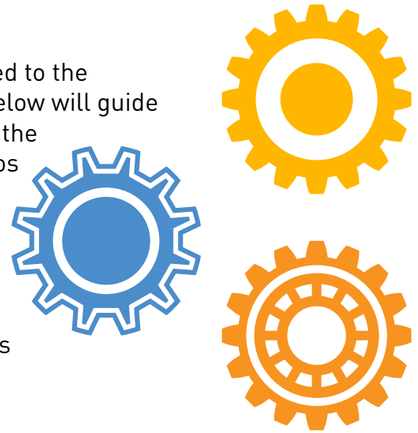
Family Lab: Complex Machines Challenge

Lesson Plan Introduction



In the Complex Machines Family Lab, your child will be exposed to the intricacies of simple and complex machines! The materials below will guide you through how to help them be successful as they complete the challenge. There are resources for your child to read and videos for them to watch that will give them the knowledge that they need to complete the challenge. Once they learn the content, then they will plan, design, build, and test their complex machine using materials found from around the house.

Make sure to give your student guidelines on the types of items they can and cannot use for safety and to ensure nothing gets broken!

Complex Machines Challenge	
Lesson Overview	**Grade Levels:** 3rd – 7th **Essential Questions:** What are simple and complex machines and how can you demonstrate your knowledge of them through the development and building of your own complex machine? **Objectives:** By the end of the challenge, your child will be able to: • Define the six simple machines, what a complex machine is, and cause-and-effect relationships • Illustrate how simple machines work together in a complex machine • Demonstrate knowledge of simple machines, complex machines, engineering basics, and cause-and-effect relationships by building a complex machine **How to measure success:** Your child is successful if they build a complex machine meeting all of the required guidelines of the challenge.

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Materials & Resources	Item	Quantity/Link
	Complex Machines Challenge Lab Manual	1 per child
	Device	Computer, iPad, tablet
	Online Resources *(see resources page for video names and URLs)*	Simple Machines Video 1 Simple Machines Video 2 Simple Machines Video 3 Complex Machines Video 1 Complex Machines Video 2 Complex Machines Video 3 Complex Machines Video 4 Design Thinking Process Video
	Simple Machines	1 of each, found around the house (during lesson)
	Various Materials	Various materials found around the house (list of suggested materials Page 9)

Preparation	
	To prepare for this lesson: • Get your child set up with a device to watch the videos on simple and complex machines. • Help them find materials around the house that they can use to build their complex machine. There is a suggested list of materials on Page 9. • Give them guidelines on where they can and cannot build their machine to ensure no broken items. • We encourage you to review the student materials and watch the complex machine videos to get an idea of what your child will be creating. • Ensure that your child follows the steps of the *Complex Machines Challenge Lab Manual* to successfully complete the challenge.

Standards Addressed	**This family lab was created based on the following national engineering standards:**	
	Abbreviation	**Standard**
	NGSS 3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
	NGSS 3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
	NGSS 3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
	NGSS ETS1.A	Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
	NGSS ETS1.B	Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2) At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3- 5-ETS1-2) Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

Challenge Guidelines

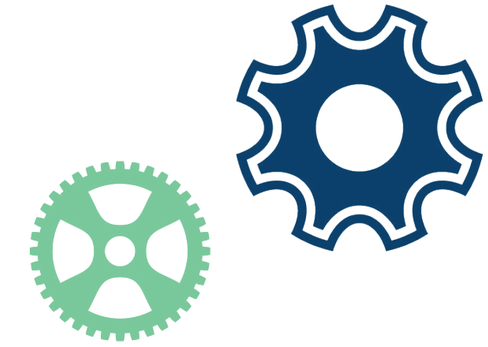
Your child will be challenged to build their own complex machine based on the guidelines below. They will use the guidelines to identify the required parts of their complex machine and what they need to do to successfully complete the challenge.

Before the build, they will first learn about simple machines, cause-and-effect relationships, and complex machines by reading the information in the *Complex Machines Challenge Lab Manual* and watching videos independently. The lab manual will guide your child through the complex machine challenge. It is recommended that they complete the challenge by following all steps, to ensure they have the necessary foundational knowledge to build their complex machine The rules for the challenge are listed below. You can encourage your child to complete the challenge independently or work with them to complete it!

A complex machine is a machine built by combining simple machines together in cause-and-effect relationships.

The Complex Machine Challenge:

- Must use 4 of the simple machines that your child finds around the house
- Two of the simple machines used must be an inclined plane and a lever
- Must have 5 different cause-and-effect relationships
- Must use materials found around the house
- Must solve the problem that your child defines



Getting Started

Print out or pull up the *Complex Machines Challenge Lab Manual* for your student to use. The interactive PDF is optimized to be used on a tablet or computer. You will also see video links to help your child understand the challenge that you can pull up before they get started.

Have your child collect their materials and then lay them out. This will help them have a clear view of the materials that they have available to work with and will help them brainstorm.

Help your child group their materials by type, such as items that roll, items that are ramps, items that move, items for building, items that connect/secure, etc. This will help them with their brainstorming of how to connect the parts of their machine.

Don't put high expectations on your child. Encourage them and remain enthusiastic throughout the process and remind them to have fun! You can work collaboratively with them as needed.

Supporting Your Child

Have your child try a few cause-and-effect relationships between different objects and simple machines prior to them starting to design or build. This will give them a better understanding of how the parts work and will allow them to design better. An example of this would be a ball rolling down a ramp into another object causing a reaction or an object falling onto one side of a seesaw causing a reaction to something on the other side of the seesaw.

Ask them probing questions: What is the problem that you are trying to solve for? What do you want to happen? How do you think you can make that happen? Did it work? Will it work every time? Are there variables that will affect how well it worked? What other materials do you think you could use instead?

Evaluate their progress and give a helpful tip or suggestion to help them move forward. You want them to complete the challenge independently as much as possible, but this is a family lab and family participation is encouraged!

Extend the Learning

Challenge your child to consider other materials that could be used to solve the same problem. They can also try creating a complex machine solving the same problem, but using different materials, simple machines, and cause-and-effect relationships.

Another way to challenge your child is to create another complex machine solving a different problem. For example, if the first complex machine rang a bell, have the second one pop a balloon.

Lastly, your child can create a complex machine solving a different problem with different materials.

Suggested Materials

Your child can use any materials found around the house. Here is a list of suggested items to use if they need some ideas.

- Aluminum foil
- Books
- Marbles
- Tape
- Balls
- Silverware
- Bottles
- Funnels
- Boxes
- Rubber Bands
- Pieces of cardboard
- Paper
- Toy cars
- Fan
- Small toys
- Items that roll
- Cups
- Dominoes
- Cardboard tubes
- String
- Mouse trap
- Cans
- Rulers
- Popsicle sticks
- Hammer
- Clothes pin
- Paper or plastic bowl
- Paper or plastic plate

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Resources Page

Simple Machines YouTube Videos

Video 1: Learning Junction. (2018 June 22). *Learn about Simple Machines* [Video]. YouTube. https://www.youtube.com/watch?v=aoXnhyY5RTk

Video 2: Scratch Garden. (2018 November 27). *The Simple Machines Song* [Video]. YouTube. https://www.youtube.com/watch?v=iQu3GY509ZM

Video 3: Clarendon Learning. (2019 May 25). *Simple Machines for Kids* [Video]. YouTube. https://www.youtube.com/watch?v=LSfNYpCprw4

Complex Machines YouTube Videos

Video 1: SciShow Kids. (2018 December 19). *The Coolest Machine Ever!* [Video]. YouTube. https://www.youtube.com/watch?v=5mGn6mrlrfw&t=30s

Video 2: BJ 초딩TV. (2018 July 28). *Easy Rube Goldberg Machine* [Video]. YouTube. https://www.youtube.com/watch?v=vn-g1Mn2_3g

Video 3: Delos Santos, Arthur. (2013 March 10). *Simple Rube Goldberg Machine* [Video]. YouTube. https://www.youtube.com/watch?v=w_12tenPbxM

Video 4: Dunn, Kelly. (2017 October 27). *Rube Goldberg Easy Examples* [Video]. YouTube. https://www.youtube.com/watch?v=0HwDf8njVfo&feature=youtu.be

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Design Thinking Process YouTube Video

Crash Course Kids. (2015 May 29). *The Engineering Process: Crash Course Kids #12.2* [Video]. YouTube. https://www.youtube.com/watch?v=fxJWin195kU&list=PLhz12vamHOnZ4ZDC0dS6C9HRN5Qrm0jHO&index=2

Note: *These videos are created and owned by third parties and this is only a curated set of examples that your child can use to build background knowledge. They are subject to be removed without notice at any time. Need help finding other resources? Reach out to Envision for help.*

Answer Key

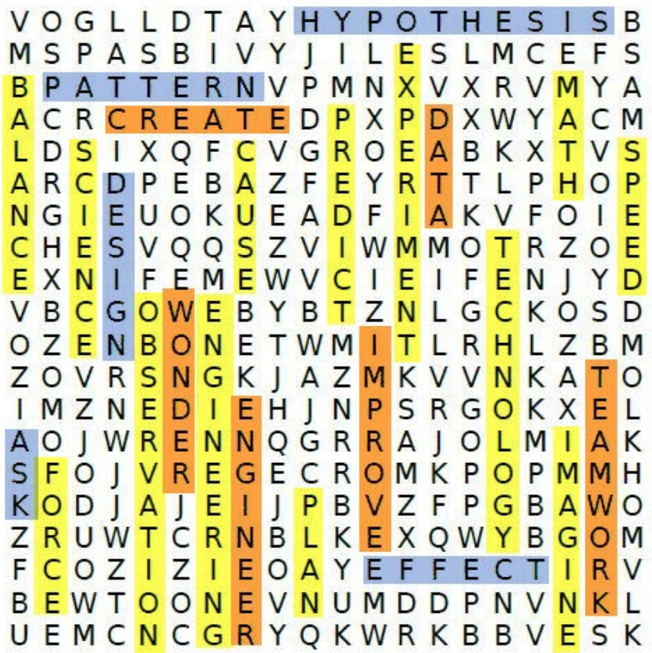
RIDDLE TIME ANSWERS - Lab Manual Page 5

Answer: There were no stairs - it was a one-story house.
Answer: A clock.

SIMPLE MACHINES AT HOME ANSWERS - Lab Manual Page 9

Door Stop = Wedge
Tape Dispenser = Pulley
Door Knob = Wheel & Axle
Light Bulb = Screw
Scissors = Lever
Slide = Inclined Plane

WORD SEARCH KEY - Lab Manual Page 17



WORD SCRAMBLE ANSWERS - Lab Manual Page 23

Motion
Challenge
Physics
Prototype
Brainstorm
Force
Combination
Load

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