See Like a Designer, Think Like an Engineer

KiDSPARK EDUCATION

STEM-Maker CURRICULUM

v2.3

STEM Fundamentals: Engineering Basics | Teacher Lesson Plan

Introduction

This Kid Spark lesson will give students confidence in their ability to see like a designer and think like an engineer. Students will discover there are many different ways to solve a problem and anyone can contribute towards a design.

Click here **to explore the entire Kid Spark Curriculum Library.**

NGSS Learning Dimensions

This Kid Spark lesson engages students in the following learning dimensions of the Next Generation Science Standards:

Scientific/Engineering Practice:
Asking questions and defining problems

Crosscutting Concept:
Patterns

Learning Objectives

- Gain comprehension of what it means to see like a designer, and think like an engineer.
- Recognize how a small amount of technical information can improve a design.
- Develop ability and confidence to solve problems by using technology.
- Understand how to integrate values, such as empathy and cost, when developing a design.

Learning Steps

This Kid Spark lesson will use the following steps to help students see like designers and think like engineers.

1. Learn
- See like a designer
- Think like an engineer
- Use technical information
- Improve a design

2. Build & Modify
- Build a hammer
- Test a hammer
- Improve a hammer

3. Design & Engineer
- Build a strong hammer
- Build a cost-effective hammer
- Build a hammer that is easy to use

Activity Time: 120 Minutes

Educational Standards

NGSS

K-5-ETS1-3 Engineering Design

MS-ETS1-4 Engineering Design

ITEEA

STL8- Attributes of Design

STL9- Engineering Design

STL10- Invention and Innovation

Resources

ROK Blocks Mobile STEM Lab
***Up to 4 students per lab**

See Like a Designer

Complete the following steps to demonstrate what it means to see like a designer.

1. Review Key Term (1 Minute)

Designer: A person who sees something in their mind, and plans how something new will look and be made.

2. Build a Hammer (5 Minutes)

Instruct students to use any engineering materials in the lab to build a hammer.
Each member of a team will have five minutes to build a hammer of their own design.

Tip: *Prime students to think of what a hammer looks like in their mind before they begin to build.*

3. Test the Hammer (1 Minute)

Instruct students to take their hammers and tap them firmly on the table like a real hammer.

Tip: *Many students will gently tap their hammers. Encourage them to use a small amount of force so the components of their hammers detach, but not so much that they break the plastic. Explain to students there is a difference between testing a design and being destructive.*

4. Discuss Results with Team (2 Minutes)

Instruct students to take a few minutes to share what happened to their hammers with the other members in their team.

Guiding Question: Did your hammer work well or did it fall apart?

Explaining The Purpose (2 Minutes)

The purpose of this experience was to demonstrate that we all see like designers. In almost every case, students are successful in envisioning and building a hammer without any additional instruction. The experience also demonstrates that it is important to understand how a design will be used.

Tip: *Ask a couple students what they think the purpose of this exercise was and then discuss it as a class.*

Think Like an Engineer

Complete the following steps to demonstrate how to use a small amount of technical information to improve a design.

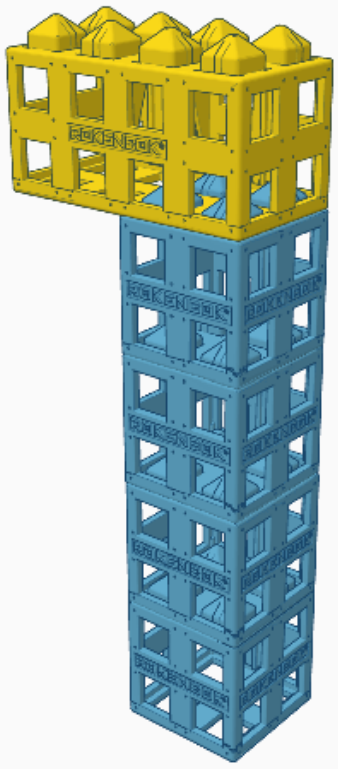
5. Review Key Term (1 Minute)

Engineer: A person who applies their technical knowledge and design experience to help people solve problems.

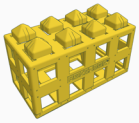
6. Build This Hammer (2 Minutes)

Assemble the hammer pictured below to use as a model. Instruct each team to build one hammer that is exactly the same as the model that was assembled.

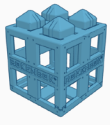
1



1x
Yellow ROK Block



4x
Blue ROK Block



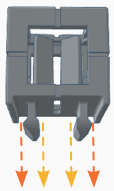
7. Present Technical Information (5 Minutes)

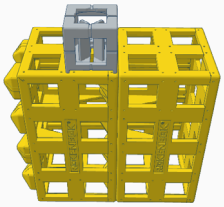
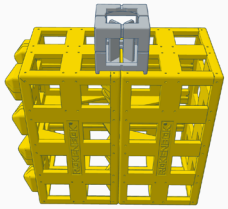
Present and demonstrate the following technical information.

Snapping Across Openings:
The tabs on smaller engineering materials can be snapped into openings or across openings. Snapping across openings can increase the structural stability in a design.

Tip: *Have each student examine the tabs on a single snap block. Can they identify what allows the tabs to connect into and across openings? Have each student practice snapping into and across openings.*

Single Snap Block



Snapping Into Opening	Snapping Across Openings
	

8. Use Technical Information to Improve a Design (5 Minutes)

Instruct students to use the new technical information (snapping across openings) to strengthen the hammer they built in step 6.

9. Test the New Hammer (2 Minutes)

Instruct students to take their hammers and tap them firmly on the table like a real hammer.

10. Discuss Results with Team (2 Minutes)

Instruct students to take a few minutes to discuss how the new hammer was improved and how it performed.

Guiding Questions:

1. How did the new hammer perform compared to the first hammers that were built? Was it stronger?

2. How did your team use the new technical information (snapping across openings) to improve the design?

Explaining The Purpose (2-3 Minutes)

As students continue progress through Kid Spark units of instruction, new technical information will be presented in increments that are easy for students to understand. Students will learn how this information can be used to improve designs and create new solutions.

11. Build a Stronger Hammer (5 Minutes)

Once students have experienced how to learn new technical information and apply it to a design, they should feel confident in their ability to develop a custom solution to a problem. Present each team with the following challenge.

Challenge:
As a team, use any engineering materials in the ROK Blocks Lab to build a stronger hammer.

Specifications:
1. Hammer must be a different design than hammers previously built.
2. Hammer design must include the technical information presented (snapping across openings).
3. Students should feel free to experiment to see how other engineering materials might help make a stronger hammer.

12. Present Hammers to Class (5 Minutes)

After teams have completed their builds, have them briefly share the new hammers with the class.

Tip: *Encourage students to demonstrate the hammer in action as well as give a brief explanation of how the hammer was built and made stronger.*

ATTENTION: If class period is only 60 minutes long, use steps 13 & 14 as a midway stopping point in the lesson. Otherwise, proceed to steps 14-20 to complete the lesson.

13. Cleanup (10 Minutes)

Have students locate the ROK Blocks Inventory and Organization Guide that was included in the lab. Instruct students to pack the lab back exactly as it shows in the guide.

Tip: *Offer a small prize to the group that can correctly organize their module the quickest!*

14.Content Review (5 Minutes)

Use the following questions to review the content presented in the first part of this lesson.

Guiding Questions:
1. What does it mean to see like a designer?

2. What does it mean to think like an engineer?

3. Compare the first hammer you built individually to the last hammer you built as a team. How much stronger were you able to make the last one? Why were you able to make it stronger?

15. Designing for Cost (15 Minutes)

Instructor should explain to students that when engineers are developing a design, they must consider the cost of supplies and materials. Often times, engineers are required to develop a design that performs consistently well, at the lowest possible cost. This is called a **cost-effective** design. Present each team with the following challenge.

Challenge:
As a team, design and engineer a strong, cost-effective hammer.

Specifications:
1. Hammer must be a different design than hammers previously built.
2. With each engineering component costing **$2**, the total cost of the hammer shouldn't exceed **$20**.
3. Teams will have 10 minutes to design and engineer a strong, cost-effective hammer.

16. Present Hammers to Class (5 Minutes)

After teams have completed their builds, have them briefly share the new hammers with the class.

Tip: *Encourage students to demonstrate the hammer in action as well as give a brief explanation of how the team produced a cost-effective hammer.*

17. Designing with Empathy (15 Minutes)

Instructor should explain to students that a well engineered design works great, is cost-effective, and provides the person that will be using it with a great experience. A good engineer will understand how a design will be used and who will be using it. This is called designing with empathy.

Empathy: The ability to understand and share the feelings of another.

Present each team with the following challenge.

Challenge:
As a team, design and engineer a hammer that is strong, cost-effective, easy to grip, and comfortable to use.

Specifications:
1. Hammer must be a different design than hammers previously built.
2. With each engineering component costing **$2**, the total cost of the hammer shouldn't exceed **$20**.
3. Hammer must be **easy to grip** and **comfortable to use**.
4. Teams will have 10 minutes to design and engineer a hammer that is strong, cost-effective, easy to grip, and comfortable to use.

18. Present Hammers to Class (5 Minutes)

After teams have completed their builds, have them briefly share the new hammers with the class.

Tip: *Encourage students to demonstrate the hammer in action as well as give a brief explanation of how the team designed with empathy.*

19. Cleanup (10 Minutes)

Have students locate the ROK Blocks Inventory and Organization Guide that was included in the lab. Instruct students to pack the lab back exactly as it shows in the guide.

20. Lesson Review (5 Minutes)

Use the last five minutes of class to review the lesson.

Guiding Questions:

1. What does it mean to design for cost? Why is it important to be able to develop a cost-effective design?

2. What does it mean to design with empathy? Why is it important for an engineer to design a product with empathy?