

21ST CENTURY LESSON

Building Bridges: Problem Solving in the 21st Century

LESSON DURATION

55 minutes

ESSENTIAL QUESTION

How does the engineering design process help me solve a problem?

LESSON OBJECTIVE

I can use the engineering design process while working with others to solve a problem.

ASSESSMENT DESCRIPTION

Teacher observations, design plan, student reflection



Lesson Snapshot

Introduction 5 MINS

- Introduce topic and design process

Model, Practice, and Apply 35 MINS

- Introduce Scenario
- Building Bridge Challenge

Wrap-Up and Assessment 15 MINS

- Bridge Displays
- Student Reflection

21ST CENTURY LEARNING COMPETENCIES

Life and Career Skills

(Aligned to each episode)

- Flexibility and Adaptability
- Productivity and Accountability
- Leadership and Responsibility

Learning and Innovation Skills

- Critical Thinking
- Creativity
- Collaboration
- Communication

MATERIALS

- Design Process Poster
- *Building Bridges Challenge* Graphic Organizer
- *Building Bridges Reflection*
- Assessment Rubric
- 25 Popsicle sticks : group
- 3 feet of masking tape : group
- Small cup per group
- Pennies (small weights)
- Chart Paper
- 2 Student Desks : group (to connect the bridges)
- Rulers

ESSENTIAL VOCABULARY

Engineer – a person who designs or builds

EDUCATOR PREP

- Display Design Process Poster.
- Gather all needed materials (Popsicle sticks, tape, cups, pennies).
- Print Student Materials.
- Optional: Create student groups prior to lesson.

Common Core State Anchor Standards

Production and Distribution of Writing

CCSS.ELA-LITERACY.CCRA.W.4

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Comprehension and Collaboration

CCSS.ELA-LITERACY.CCRA.SL.1

Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

Presentation of Knowledge and Ideas

CCSS.ELA-LITERACY.CCRA.SL.4

Present information, findings, and supporting evidence so that listeners can follow the line of reasoning, and so that the organization, development, and style are appropriate to task, purpose, and audience.

Support



- Explain that a limit or control are factors of the problem that we can not change. (Ex. You want to buy something, but don't have enough money.)
- Provide students with a concrete example as you explain the design process and display answers on chart paper. (Ex. You have trouble with fractions, so you design a study guide.)

Tech Tip

For more information on the Engineering Design Process, visit:



INTRODUCTION (5 mins)

- **Introduce the skill and its purpose.** **Say:** *There will be many times in our lives when we encounter a problem. Finishing a challenging homework assignment, resolving an argument with a friend, or saving money to buy something you want are all problems we may have faced. Turn to your partner and share a problem you have faced and how you solved it. After a minute have a few students share their problems and their solutions.*
- **Say:** *Learning to problem solve is an important life skill. Today you will learn what the Engineering Design Process is and then put it into action to solve a challenging problem.*
- Display Engineering Design Process and explain how each step helps students solve problems. **Say:** *The Engineering Design Process is a series of steps engineers follow to come up with a solution to a problem.*
- **Step 1: Ask.** **Say:** *In the first step you ask yourself, what is the problem? What do you already know? What are the limits or controls of the task?*
- **Step 2: Imagine.** **Say:** *In the second step you ask yourself, what are some solutions? Brainstorm ideas. Try the best one.*
- **Step 3: Plan.** **Say:** *Next you draw a diagram. Make a list of materials you will need and steps you will take.*
- **Step 4: Create.** **Say:** *Then you follow your plan and create something. Test it out!*
- **Step 5: Improve.** **Say:** *After you test, you need to learn from your mistakes and make your design even better. Ask yourself, what worked? What didn't work? Continue to modify your design, and test it again until it solves your problem!*

MODEL & PRACTICE (5 mins)

Support

Share images of bridges to help students brainstorm possible designs.



Tech Tip

For specific information on different types of bridges (types, images, facts, famous examples) visit:



- Pass out Student Building Bridges Challenge. **Say:** *Let's practice the engineering design process to complete the Building Bridges Challenge.*
- Review the first step. **Say:** *As I read the challenge, keep the first step in mind. Ask yourself what the problem is and what you already know.*
- Read aloud the challenge. Have students discuss with their partners what the problem is and what they already know based on the scenario. Have a few volunteers share and record on chart paper. Point out that the constraints of the problem are the limited materials and time allowed.

Support



- Rotate around the room and ask groups questions (ex. How does it work? Why did you decide to do this? How does this fit together? How big is this part? Why isn't this working?).
- Assign jobs to each team member to facilitate collaboration (ex. Head engineer, designer, material management, timekeeper).
- Work with students to create guidelines for successful teamwork and participation (ex. Allow everyone a chance to speak, listen actively, be respectful).

APPLY (30 mins)

- Group students in teams of 3–5 members. You may do this randomly, or teacher may assign groups prior to instruction.
- Distribute building supplies to each team.
- Review guidelines for the activity, including rules for participation. Students may use materials in any way, and they don't have to use all of the materials.
- Instruct students to complete the ASK, IMAGINE, and PLAN sections of their *Building Bridges Challenge* resource before building.
- Make sure students are testing the durability of their bridges with pennies and improving upon their designs. Students should complete the CREATE, IMPROVE, and FINAL DESIGN sections while building.

WRAP-UP AND ASSESSMENT (15 mins)

- Rotate groups around the classroom to view everyone's bridges.
- Students complete reflection forms independently or in pairs.
- Reflect as a whole class through discussion. Have students build on what the previous student said (ex. I agree with _____ because; I disagree with _____ because). **Ask:**
 - *What was the most challenging part of building your bridge?*
 - *How did working as a team help you?*
 - *Engineers aren't the only ones who can use the Engineering Design Process. What are some other occupations where people have to come up with solutions to problems? What problems do they have to solve?*
 - *The ability to problem solve is a characteristic that all leaders should have. Do you agree or disagree? Why or why not?*
 - *In this game, you're going to be the director of a community clinic. What kinds of problems might you encounter as the leader in a community clinic?*
 - *Using what you learned today, how might you solve these problems at the community clinic?*

DESIGN PROCESS

ASK

What is the problem?
What do you already know?
What are the constraints?

IMAGINE

What are some solutions?
Research to find out more.
Brainstorm some ideas.
Choose a way to solve the problem.

PLAN

Draw a diagram.
What supplies will you need?
Who will do the jobs?
List the steps you will take.

CREATE

Follow your plan.
Collaborate with your team.
Work steadily and manage your time.
Test your design.
Draw and label what you made.

IMPROVE

Learn from your mistakes.
How can you make your design better?
Test it again.
Re-design and test again as needed!



BUILDING BRIDGES CHALLENGE

Problem Solving

Scenario:

You are the lead engineer living in the small town of Port Douglas. Yesterday, a category 5 hurricane demolished the town. A bridge connecting a small neighborhood of low-income houses to the center of town was destroyed. These families are unable to get food, water, or medical supplies needed to help them, as many of their homes were destroyed. Your job is to build a bridge to get supplies to these people in need. The stronger the bridge, the more supplies they will be able to receive.

Challenge:

Plan, build, and modify a bridge that spans a two-foot gap. You can use only 25 Popsicle sticks and 3 feet of masking tape. However, you do not need to use all of the materials. The bridge should be built between two desks of equal height. The bridge that holds the most weight (pennies) has successfully delivered the most food to the people in need in Port Douglas.

Materials:

- 25 Popsicle sticks
- 3 feet of masking tape
- Ruler
- Two student desks
- 50 Pennies
- Small cup (to hold “supplies,” or pennies)



BUILDING BRIDGES CHALLENGE

Problem Solving

Group Members:

_____	_____
_____	_____
_____	_____

ASK:

What is the problem?

What do you already know?

What are the constraints?

IMAGINE:

What are some solutions?
Brainstorm some ideas.

PLAN:

Draw a diagram.
List the steps you will take.



BUILDING BRIDGES CHALLENGE (CONTINUED)

Problem Solving

CREATE:

Follow your plan and test your design. Draw and label what you made. Did it work?

IMPROVE:

How can you make your design better?

FINAL DESIGN:

RESULTS: How many “supplies” was your bridge able to hold?

Design 1: _____ pennies

Design 2: _____ pennies

Design 3: _____ pennies



DESIGN PROCESS POSTER

Problem Solving

ASK

What is the problem?
What do you already know?
What are the constraints?

IMAGINE

What are some solutions?
Research to find out more.
Brainstorm some ideas.
Choose a way to solve the problem.

PLAN

Draw a diagram.
What supplies will you need?
Who will do the jobs?
List the steps you will take.

CREATE

Follow your plan.
Collaborate with your team.
Work steadily and manage your time.
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BUILDING BRIDGES REFLECTION

Problem Solving

1. Was your first design successful? Why or why not?

2. What was the most challenging part of working with your team?

3. What is something your team did well together?

4. What is one thing you learned about problem solving?

CONNECTION TO GAMEPLAY:

1. In this game, you're going to be the medical director of a community clinic. What kinds of problems might you encounter as the leader of a community clinic?

2. Using what you learned today, how might you solve these problems at the community clinic?



ASSESSMENT RUBRIC

Problem Solving

Directions: Place an X in the appropriate box to reflect on how well you and your group performed on this assignment.

SELF REFLECTION:	I could do this better	I did this adequately	I did this really well
I participated in the design and creation of my bridge.			
I respectfully listened to my group members' ideas.			
I worked well with my group during the entire challenge.			

GROUP REFLECTION:	We could do this better	We did this adequately	We did this really well
We successfully created a bridge that held "supplies."			
We followed the steps of the Engineering Design Process.			
We respectfully listened to each other when we were speaking.			
We completed the assignment in the time given.			