BRIDGE UP! ENGINEERING

LESSON 1 – GRADES K-2

LESSON 1 – GRADES K-2: Engineering Bridges

Big Idea

There are differences between human-made and natural components in our world. An engineer uses human-made materials for constructing a bridge and needs to consider the natural surroundings.

Essential Questions

What are natural things we find in our world?

What materials do engineers use to make bridges?

What are human-made things we find in our world?

How are they different? How are they alike?

Background Information

Our world is a mixture of natural and human-made objects. Natural objects are found in nature and have always been around. Human-made objects are created by humans. Humans sometimes make human-made items from things they find in nature.

Standards & Benchmarks

Minnesota Science Standards

K.1.1.2. Inquiry

Scientific inquiry is a set of interrelated processes used to pose questions about the natural world and investigate phenomena.

Benchmark: K.1.1.2.1 Descriptions of Observations

Use observations to develop an accurate description of a natural phenomenon and compare one's observations and descriptions with those of others.

K.1.2.1 Practice of Engineering

Some objects occur in nature; others have been designed and processed by people.

Benchmark: K.1.2.1.1 Comparing Natural & Human Made

Sort objects into two groups: those that are found in nature and those that are human made.

Wisconsin Science Standards

ENG1.a.1.e Design is a creative process.

ENG1.a.2.e Everyone can design solutions to a problem.

Connections with Multimedia Program

Bridge Up! iBook

Activity Description

Students will identify natural and human-made items using photos.

Vocabulary

World – The Earth and all the people and things upon it.

Natural – Not made or changed by humans.

Human-made – Made by people rather than nature.

Materials

- Several natural objects: rocks, water, plants, dirt, bugs, etc.
- Several human-made objects: pencil, paper, book, cup, etc.

Procedure

- Ask the students if they know what we mean when we say "our world." Lead the discussion so that the students understand that we mean where we live and all the things that surround us.
- Project or draw two columns and label one natural and the other human-made.
- Randomly hold up natural and human-made items one at a time and ask the students whether they thing it is human-made or natural. Ask them to tell you why they think it's natural or human-made. Write (or place if possible) the item in the category the students choose.
- After all items are sorted, ask the students if they can tell you how the natural items are alike (made by nature, free)
- Ask how all the human-made items are alike (not made by nature, you buy them, made by people or robots)

Assessment

Teacher observation

Extensions

Divide the students into groups (3-4). Give each group or member of the group a picture of a bridge over a river. Ask them to work together to decide which things in the picture are natural and which are human-made. Provide time for them to share with the class.

Other Resources

Minnesota STEM Teacher Center. K.1.2.1 Practice of Engineering
http://scimathmn.org/stemtc/frameworks/k121-practice-engineering

Wisconsin Standards for Technology and Engineering
http://cte.dpi.wi.gov/sites/default/files/imce/cte/pdf/te_standards.pdf

Name:

Directions: Circle natural objects. Put an X over human-made objects.

Arch bridge in Eden Township (Pipestone County, MN) Photo credit: Minnesota Department of Transportation

Name:

Directions: Circle natural objects. Put an X over human-made objects.

Truss bridge in Maine Township (Otter Tail County, MN) Photo credit: Minnesota Department of Transportation

LESSON 1 – GRADES K-2 : Engineering Bridges

Big Idea

Communication is important when working with others. You must be able to listen and to ask questions.

Essential Questions

Why do we ask questions?

Why do we need evidence when answering questions?

Standards & Benchmarks

Minnesota Science Standards

1.1.1.1 Scientists

Scientists work as individuals and in groups to investigate the natural world, emphasizing evidence and communicating with others.

Benchmark: 1.1.1.1.1 Observations for Questions

When asked "How do you know?," students support their answer with observations.

Benchmark: 1.1.1.1.2 Descriptions & Comparisons

Recognize that describing things as accurately as possible is important in science because it enables people to compare their observations with those of others.

Wisconsin Science Standards

ENG1.a.1.e Design is a creative process.

ENG1.a.2.e Everyone can design solutions to a problem.

ENG1.a.3.e Discuss the design process is a purposeful method of planning practical solutions to problems.

ENG1.a.4.e Requirements for a design include such factors as the desired elements and features of a product or system or the limits that are placed on the design.

Connections with Multimedia Program

Bridge Up! iBook

Activity Description

Are you my match? – Students will practice asking questions and listening to descriptions given by their peers to locate the person with a matching bridge.

Vocabulary

Description – An account that presents a picture to a person who reads or hears it.

Question – Something asked or an instance of asking.

Bridge – A structure carrying a road, path, railroad, or canal across a river, ravine, road, railroad, or other obstacle.

Shapes – Outward appearances.

Materials

- Pictures of various bridges on card stock (2 to 3 copies of each bridge to form pairs). Pictures of Minnesota bridges can be found at: **http://www.dot.state.mn.us/historicbridges/**
- Hole punch
- String/yarn

Procedure

- Prior to class, make copies of pictures so that there are pairs of pictures enough for your class. If you have an odd number of students in class, one set could have 3.
- Explain to the students that engineers work with many people when building bridges. It is important that they are able to describe what the bridge will look like and how it will be built so that others know what to do.
- Tell the students that today they will practice describing what they see so they can find the classmate with the same picture they have. (You may want to show one picture of a bridge to practice describing as a whole group before playing the game. Have them look for shapes, wires, etc.)
- Hang one bridge picture on the back of each child. Tell them that they may not look at their picture, but may ask their classmates to look and tell them something about their bridge. It's important that they listen to what others tell them so that they can find the person with a matching bridge.
- Allow the students to circulate and describe each other's bridge.
- Alternative Method: Post several pictures of bridges on the wall, keeping the matching pictures in a stack. Divide the class into two teams. Show one picture from the stack to team one and have them give verbal clues to the team two until they can pick the matching bridge from the pictures on the board. Repeat with teams reversing roles.

Assessment

Teacher observation

Extensions

Students can work together in pairs or small groups to draw or build bridges with blocks or Legos and then they can tell the class about their bridge.

Other Resources

Minnesota STEM Teacher Center. *1.1.1.1 Scientists*

http://www.scimathmn.org/stemtc/frameworks/1111-scientists

LESSON 1 – GRADES K-2 : Engineering Bridges

Big Idea

Engineers identify problems and look for ways to solve those problems.

Essential Questions

What is the Engineering Design Process?

Why are certain materials used for various products?

How can you design a successful bridge?

Background Information

The Stillwater Lift Bridge between Minnesota and Wisconsin slowed traffic and caused long back-ups of vehicles in downtown Stillwater when the bridge went up to let vessels through. Traffic congestion can result in pedestrian and traffic safety problems. People in the community and engineers from Minnesota and Wisconsin worked together to determine what the new bridge needed to help solve this problem. They designed and built a four-lane bridge that better met the needs of the traveling public to connect Minnesota and Wisconsin.

Standards & Benchmarks

Minnesota Science Standards

2.1.2.2 Practice of Engineering

Engineering design is the process of identifying a problem and devising a product or process to solve the problem.

Benchmark: 2.1.2.2.1 Objects to Meet Needs

Identify a need or problem and construct an object that helps to meet the need or solve the problem.

Benchmark: 2.1.2.2.3 Benefits of Engineered Items

Explain how engineered or designed items from everyday life benefit people.

Wisconsin Science Standards

ENG2.a.1.e Discuss the engineering design process includes identifying a problem, looking for ideas, developing solutions and sharing solutions with others.

ENG2.a.2.e Explore when designing an object, it is important to be creative and consider all ideas.

ENG2.b.1.e Expressing ideas to others, verbally and through sketches and models, is an important part of the design process.

ENG2.b.2.e Discuss how models are used to communicate and test design ideas and processes.

Connections with Multimedia Program

Bridge Up! iBook

Activity Description

Students will work together in pairs or small groups to create a two-foot bridge that will allow a small car to cross without crumbling.

Vocabulary

Abutment – The part of a bridge that stands at either end and transfers the loads of the bridge back to the ground.

Arch bridge – A bridge made from one or more arches and abutments.

Beam bridge – Beam bridges are made of a flat piece, or beam, laid across two or more supports.

Civil engineering – The field of engineering concerned with the design and construction of public structures, such as buildings, bridges, roads, and water systems.

Engineer – A person who uses his or her creativity and understanding of mathematics and science to design things that solve problems.

Engineering design process – The steps that engineers use to design something to solve a problem.

Load – A heavy or bulky thing that is being carried or is about to be carried.

Materials – The matter from which a thing is or can be made of.

Prototype – A model of a design that is made to help engineers understand and test the design.

Suspension bridge – A bridge made of a platform that is held up by wires or ropes strung from the tops of piers.

System – A set of things working together as parts of a mechanism or an interconnecting network.

Technology – A thing, system, or process that people create and use to solve a problem.

Materials

- Toilet paper or paper towel tubes
- Cardboard boxes/shoeboxes
- Legos
- Masking tape
- Blocks
- String
- Small car (If possible, have multiple so groups can use them to test their bridge)
- Roll of pennies
- Worksheets

Procedure

- Divide students into pairs or small groups.
- Introduce or review the engineering process and tell the students they are to use these steps in solving the problem you will give them.
- The problem is that they need to design and create a bridge that will support a car. Allow them to hold the car so they know how heavy it is.
- Show them how long their bridge needs to be to span a 10-inch space by separating two tables or by putting tape on the floor.
- Distribute the worksheets and answer any questions.
- Allow them to work in their groups to create their bridges from materials provided by you.

Assessment

- Teacher observation
- Worksheets
- Completed bridge

Extensions

Allow students to add pennies to increase load.

Other Resources

Minnesota STEM Teacher Center. 2.1.2.2 Practice of Engineering

http://www.scimathmn.org/stemtc/frameworks/2122-practice-engineering

Name: _____

Engineering Design Process

Name: _____

Test/Analyze two objects you can use to make bridges. Compare strengths and weaknesses of materials.

(ex. toilet paper tubes, paper towel tubes, blocks, string, etc.)

Material	Description	Rate the Strength	Would you use this in your design?

Problem: _____

Engineer's Name: _____

Engineering Design Challenge #1:
Recording Sheet for Second Grade

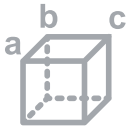
Design a bridge that would hold a "load."

ASK: What is my problem?

_____

IMAGINE: I'm thinking

_____



PLAN: My project needs

_____

CREATE: It looks like

_____

IMPROVE: It could work better if

_____

Name: _____

Design Challenge #2 for Second Grade:

Draw and color your bridge. Check and make sure the toy truck can cross safely. If successful, add your Dixie cup, filled with sets of 10 pennies, up to 100, as the "load." How much can your bridge handle?

Did the truck make it? (Yes/No)	How much "load" this trip? (10 pennies, 50 pennies, etc.)

Name: _____

Material	Good or Bad for Bridge Building? Why?