Be A Scientist:

DESIGN LIKE AN ENGINEER

ENGINEERING DESIGN CYCLE

museum of science+industry chicago

CONTENT

KEY CONCEPTS

Civil Engineer: designs structures like roads, bridges and skyscrapers, and supervises construction and inspection.

Span: the distance a bridge extends between supports.

Load: the weights and forces acting upon a bridge or structure.

Beam Bridge: a horizontal structure with supports at each end.

Truss Bridge: uses triangles to allow the load to be evenly spread throughout the bridge, making it stable, rigid and strong.

Arch Bridge: uses a curved structure to spread the downward force of the load from the middle of the bridge along its sides and base.

YOUR CHALLENGE

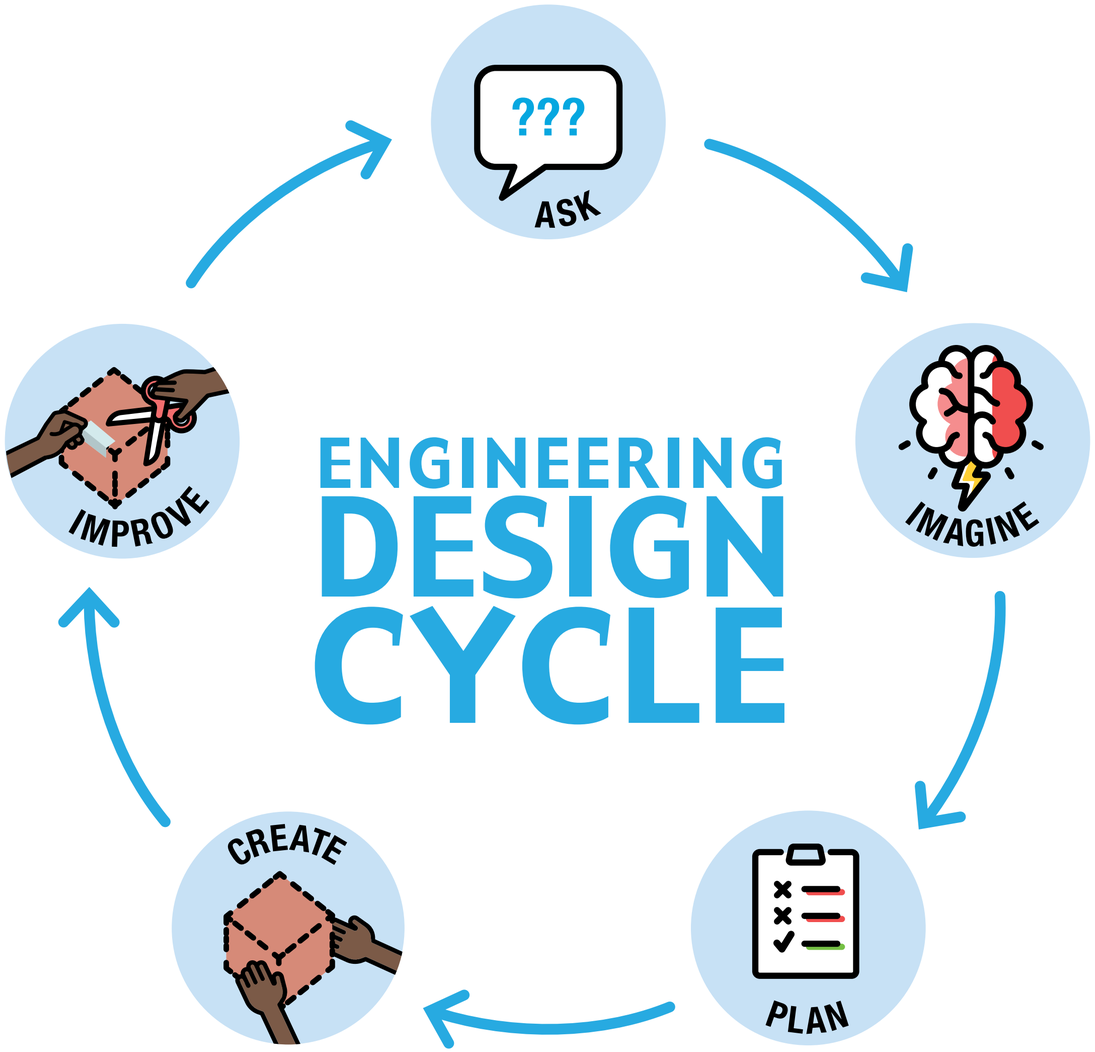
Design a bridge to connect both sides of the Chicago River.

Your model should have:

Span: 12 inches (minimum)

Load: One can (15 - 20 oz.)

The bridge must support itself and be stable.


???
ASK
IMAGINE
PLAN
CREATE
IMPROVE
ENGINEERING
DESIGN
CYCLE

DESIGN LIKE AN ENGINEER

WHAT TYPE OF BRIDGE WILL YOU BUILD?

Do you plan to make a beam, truss or arch bridge? What about a bridge that combines two types?

WHAT MATERIALS WILL YOU USE?

Be creative using what you have available at home. If you can, help the environment and recycle!

HOW DOES YOUR BRIDGE HOLD UP?

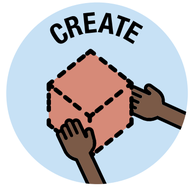
You can test the load with a 15–20 oz. can using two other cans separated by 12 inches as a testing station.

DESIGN LIKE AN ENGINEER

WHAT TYPE OF BRIDGE WILL YOU BUILD? WHAT MATERIALS WILL YOU USE?

WHAT WILL YOUR BRIDGE LOOK LIKE? WHAT DESIGN FEATURES AND ARTISTIC TOUCHES WILL IT HAVE? DRAW YOUR BRIDGE BEFORE BUILDING.

HOW WILL YOU MAKE IT? WRITE THE STEPS YOU NEED TO TAKE TO MAKE YOUR BRIDGE.



TESTING: USE ONE CAN (15-20 OZ.) FOR YOUR LOAD.

IS YOUR BRIDGE STABLE? IF YES, HOW DID YOU MAKE IT STABLE?

WHAT WOULD YOU IMPROVE ABOUT YOUR BRIDGE?

CAN YOU IMPROVE IT SO THAT IT CAN HOLD A GREATER LOAD?

YOUR MODEL

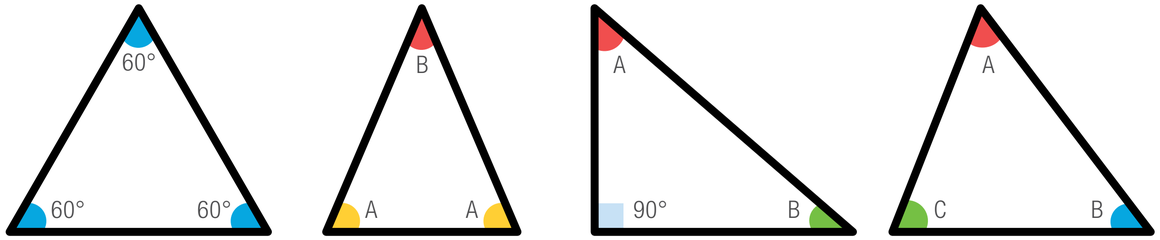
Include a drawing or photo of your finished bridge.

MATH EXTENSION

Bridges can be made of different geometric shapes and patterns (repeated shapes).

You can explore those shapes by their dimensions (length and height) and by measuring the angles.

TYPES OF TRIANGLE



EQUILATERAL
3 EQUAL SIDES
3 EQUAL ANGLES

ISOSCELES
2 EQUAL SIDES
2 EQUAL ANGLES

RIGHT
1 RIGHT ANGLE (90°)
A + B = 90°
THE LONGEST SIDE IS CALLED THE HYPOTENUSE.

SCALENE
ALL SIDES ARE DIFFERENT.
ALL ANGLES ARE DIFFERENT.
A + B + C = 180°

MAKE OBSERVATIONS ABOUT YOUR BRIDGE

What types of triangle do you you see?

What other geometric shapes do you see?

Can you find any other patterns?

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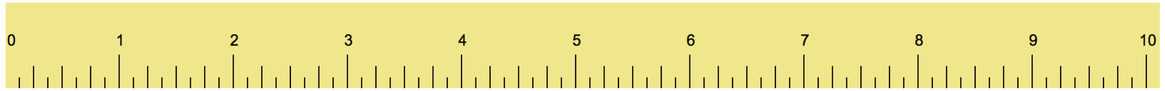
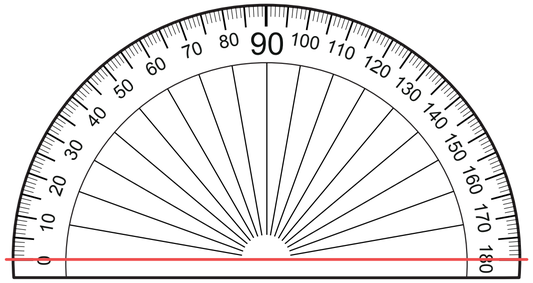
MEASURE THE LENGTH AND HEIGHT.

Don't forget to note the units!

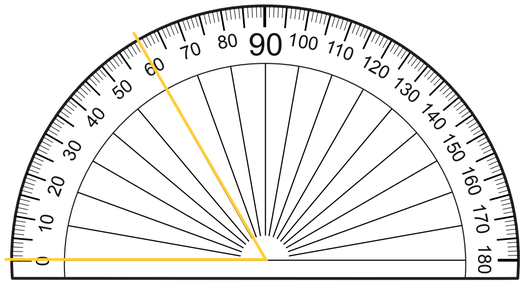


INCHES

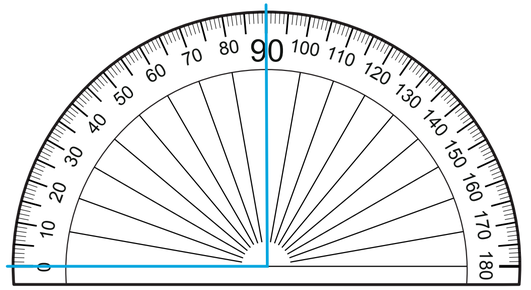
LABEL, MEASURE AND NAME THE TYPES OF ANGLES.



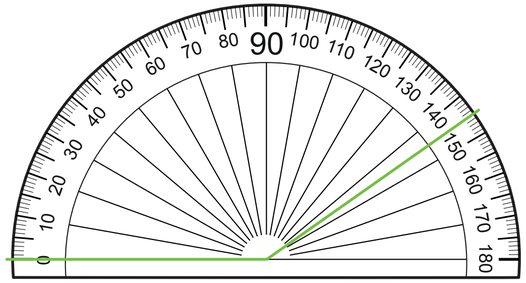
STRAIGHT ANGLE
A STRAIGHT ANGLE IS EXACTLY 180°



ACUTE ANGLE
AN ACUTE ANGLE IS LESS THAN 90°



RIGHT ANGLE
A RIGHT ANGLE IS EXACTLY 90°



OBTUSE ANGLE
AN ACUTE ANGLE IS MORE THAN 90°
AND LESS THAN 180°

PHYSICS EXTENSION

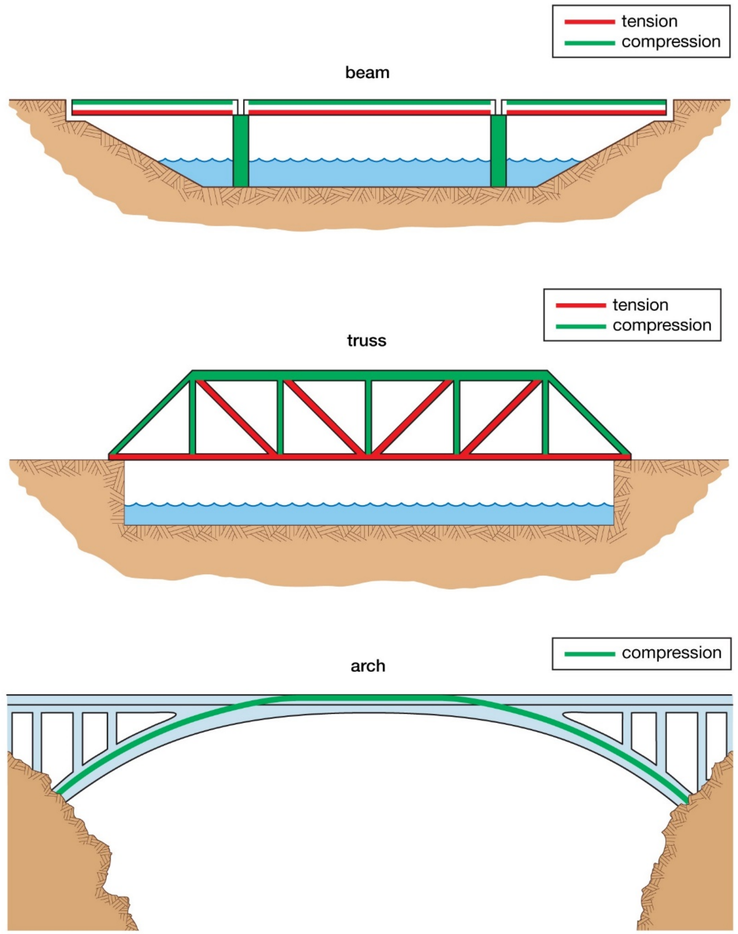
Bridges are designed to endure **forces** like:

Tension: A force that stretches an object. Materials in tension tend to become longer and thinner.

Compression: A force that squeezes an object together. Materials in compression tend to become shorter and fatter.

CAN YOU IDENTIFY AREAS OF TENSION AND COMPRESSION FORCES ON YOUR BRIDGE?

Use your drawing or make a diagram that highlights where you see compression and tension in your bridge.



MY ENGINEERING REPORT

Name:

Date:

Type of bridge:

Function or purpose:

Load tested:

Notes:

NEXT GENERATION SCIENCE STANDARDS

Our lesson has connections to the following standards:

Science and Engineering Practices:

Asking questions and defining problems

Developing and using models

Planning and carrying out investigations

Constructing explanations

Crosscutting Concepts:

Cause and Effect

Systems and system models

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SHARE YOUR EXPERIMENTS WITH US:

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