BUILDING BLOCKS
2.0
Combining Science, Building Blocks and Fun

“Curiosity is the wick in the candle of learning” William Ward
Sections of this resource were adapted from the 4-H Ontario—Building Blocks Engineering project. They were used with the permission of the Ontario 4-H Council.

A limited supply of building blocks are available for Clubs and Area Councils to borrow. Please send your request to M4HC. 204-726-6136 Dawn Krinke - DKrinke@4h.mb.ca

This resource is for 4-H educational purposes only.

LEGO® is a trademark of the LEGO Group, which does not sponsor, authorize, or endorse this resource.
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Available Resources

Pinterest – The Visual Discovery Tool
Pinterest is a social media bulletin board for you to virtually pin pictures of things that interest you to your own personal boards – Pin-Explore-Discover! 4-H Manitoba has a Pinterest account. Each project series has a board full of fun and interesting ideas. There are also boards for 4-H Awesome, Community Service, Volunteers, Communications and Building Blocks.
Check it out at www.pinterest.com/4hmanitoba/

The following may be borrowed from M4HC (204-726-6136):

- 1 Medium Sized Tub of LEGO® DUPLO®
- 15 Green Base plates
- 4 Tubs of Large Mega Bloks®
- 1 Large Tub of LEGO® Bricks
- 12 LEGO® Cars
- 2 LEGO® Idea Books
  To borrow contact Joanne: 204-851-2481

Gearing Up - Explore how gears work by experimenting with different combinations. Using actual gears, this activity shows members how by working together. As one unit things can get done faster and with less effort!

To borrow contact Shirley:
204-726-6613
Pkgs: #28 or #29
The Amazing LEGO® Brick Factsheet

1. The LEGO Group was founded in 1932 by Ole Kirk Christiansen. He made wooden toys.

2. In 1949 the first LEGO® bricks were made. They were called “Automatic Binding Bricks”.

3. In 1958, the LEGO® brick was launched with a new coupling principle, the one we know today, opening up endless building possibilities.

4. DUPLO® bricks are designed for preschool age children. However, they are designed so that they can be used with LEGO® bricks.

5. The name LEGO® refers to the brand name and it is never to be used as a plural. e.g. LEGOs.

6. Standard pieces are called bricks, NOT blocks. The bumps on top of the brick are called studs. Everything is referred to by its stud count, so a classic LEGO® brick is referred to as a 2x4.

7. LEGO® is manufactured by a complex process involving a mixture of chemical compounds that is injected into moulded shapes. To view the ‘Chemistry of LEGO’ visit https://jameskennedymonash.wordpress.com/2014/07/15/how-are-lego-bricks-made-the-chemistry-of-lego/

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Chemistry of LEGO

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Oct. 24, 1961

G. K. CHRISTIANSEN TOY BUILDING BEADS

3,005,282

Filed July 26, 1960

2 Sheets-Sheet 1

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

Godtfred Kirk Christiansen

INVENTOR

By E. S. K. Christiansen, Attorney
1. LEGO® comes from the Danish phrase “leg godt” which means “play well”.

2. 55 billion LEGO® elements were produced in 2013. 600 billion have been manufactured since the company began in 1932. 105,000 pieces are made every minute.

3. LEGO® is one of the world’s largest tire manufacturers - they make 500 million LEGO® tires every year.

4. The world’s children spend 5 billion hours each year playing with LEGO® bricks.

5. On average, every person on earth owns 86 LEGO® bricks.

6. A column of 40 billion LEGO® bricks would reach the moon.

7. There are enough minifigures to wrap around the earth at least 4 times. Approximately 4 billion minifigures have been produced making them the world’s largest population.

8. Approximately 7 LEGO® sets are sold every second. During the Christmas season it increases to 34 sets.

9. 2 eight stud bricks of the same colour can be combined in 24 ways. 3 eight stud bricks of the same colour can be combined in 1060 ways. 6 eight stud bricks can be combined in 915, 103, 765 million ways.

10. In 2009, James May of Great Britain built a full scale house entirely of 3.3 million LEGO® bricks. It took 1000 volunteers to build it. It includes a working toilet and shower and a bed made from LEGO®. See this article for more pictures: http://www.dailymail.co.uk/news/article-1214729/James-May-size-Lego-house-wants.html
Building Blocks in Education

Building Blocks provide hands-on tools that develop lateral thinking in a fun environment.
- Enhances 3 dimensional thinking
- Improves literacy as kids work with instructions
- Promotes communication and critical thinking
- Involves fine motor development
- Develops problem solving, organization and planning by construction
- Encourages creativity

Building Blocks are used in the classroom to assist in skill development as well as to assess current knowledge
- Improving hand-eye coordination
- Developing scientific and technological solutions
- Involving geometry, mathematics, and engineering
- Following directions with logic and reasoning
- Duplicating complex patterns
- Planning and evaluating patterns

Play is a key element in children’s growth and development and it stimulates imagination, the emergence of ideas and creative expression. By making things, children explore their ideas and discover how things work. A hands-on approach will help members retain what is learned better than if someone simply gives them the information.

Learn To Do By Doing
“Learn To Do By Doing” is the 4-H motto and is one of the main reasons 4-H has been so widely recognized and respected in the field of informal education. It engages the learner and encourages them to think more. They will ultimately learn more than through traditional teaching methods. Experiential learning is more than just doing activities. It involves planning and discussing the activity, drawing conclusions from the activity, and applying those conclusions to the real world. Hands-on activities expose members to new skills and encourage continuous learning.

About This Resource

Build, play and grow! Introduce yourself to the world of building and designing various basic structures and machines. Working in teams or as individuals, test the strength, efficiency and accuracy of the project you build. Apply real-world concepts in physics, engineering, architecture and art. Challenge yourself to increase the strength, speed, stability and accuracy or efficiency of your project. Learn leadership, communication and team building skills. The sky is the limit as to what you can create.

This resource has been developed to provide you with tools to teach 4-H Members science and leadership skills in a fun learning environment. It is based on the STEAM learning model. Activities can be used on their own at club meetings, project meetings, etc. or can be combined for a larger Area Council event. Activities should be used in combination with the discussion of topic information to teach members in a hands-on, interactive learning environment.

STEAM: Science-Technology-Engineering–Agriculture-Mathematics
Why Science? Why Now?
The percentage of students who are very or somewhat interested in Science decreases as students age.

- 12-13 yrs  78%
- 14-16 yrs  67%
- 17-18 yrs  58%

72% of teens think science is fun! BUT only 22% express an interest in pursuing science at the post secondary level.

Kids are natural scientists.
Alan Alda
What Youth Are Doing With Science and Building Blocks

Toronto Teens Send LEGO® Man Into Space

In January, 2012, two teenagers from Toronto, Mathew Ho and Asad Muhammad, achieved their goal of putting a plastic astronaut in space. Together, they built a Styrofoam capsule that could carry 4 cameras, a GPS-enabled cell phone, a hand sewn parachute, and a LEGO® man with a Canadian flag. The capsule was launched using a weather balloon which carried the Lego-naut 24 km above the earth. That’s more than double the altitude of commercial airline flights. They captured the journey on video as the LEGO® man transitioned from a view of the skyline to darkness. Later, the balloon popped and the mission landed safely more than 120 km away from the launch site.

Braille Printer Made of LEGO®

In May, 2015, 13 year old Shubham Banerjee began a partnership with Microsoft as the youngest entrepreneur ever to receive venture-capital funding. Banerjee has developed a solution to relieve the stresses of expensive Braille printers for those who are visually impaired. He constructed a printing device out of LEGO® upon reading about how blind people read using Braille. Using LEGO®, Banerjee is able to print in raised dots (Braille). He chose to name the machine Braigo, a combination of Braille and LEGO®. As of June, 2015, the printer was not yet available, but hopefully will be printing soon. DIY instructions are also available.
4-H Hands-on Science

Explore the world of science and dive into hands-on projects and activities that let you discover how science affects everyday life!

ENGAGE in the science & technology world
EXPLORE ideas you may have brewing
EXPLAIN your plan
EXTEND your mind and reach for the sky

4-H Canada recently entered an exciting partnership with Youth Science Canada (umbrella organization for Canada-Wide Science Fairs) in order to create and deliver fun, informal STEAM (Science, Technology, Engineering, Agriculture and Math) activities within local 4-H clubs. This resource will provide 4-H leaders with the tools to engage in STEAM activities, and help to foster a new appreciation of science and technology in 4-H members.

By adding science to club and area council programming 4-H leaders will help 4-H members to develop twenty-first century thinking skills. These include:

• Creativity and innovation
• Critical thinking and problem solving
• Teamwork and collaboration
• Initiative, self direction and entrepreneurialism
• Effective oral and written communication
• Digital competence

4-H Hands-on Science Powered By Smarter Science

Smarter Science [https://smarterscience.youthscience.ca/](https://smarterscience.youthscience.ca/) is part of Youth Science Canada's program for engaging youth in science and providing a curricular connection to project-based science and science fairs. Smarter Science is a framework for teaching and learning science and for developing the skills of inquiry, creativity, and innovation.

Thinking like a Scientist
What do scientists do?
- They ask questions and make observations of things in nature.
- They record observations and conduct experiments where possible.
- They use the data they collect to develop models that explain phenomena.
- They test their models repeatedly, and discard, refine, or confirm them.
Smarter Science aims to teach students the process scientists use to learn about the world.

Building Blocks 2.0 uses the PEOE Inquiry Technique.
P.E.O.E STEPS

1. PREDICT
Write a prediction statement for the event.
“IF ___________ THEN ________________.”
o Draw a well labeled diagram of your prediction.

2. EXPLAIN
Write an explanation of your prediction drawing from your understanding, experiences, theories, models and/or insights gained from your research on the topic (background info may be provided or your own research may be required) – point form.
o Share your predictions with your group and/or class.
o Modify your prediction or explanation based on the group discussion.

3. OBSERVE
Decide what evidence you can collect or what measurements you will take to check your prediction.
o Carefully collect evidence and take measurements. (You may use scientific equipment and techniques)
o Record your observations.

4. EXPLAIN
Write an explanation for your observations. Use theories or models to help explain your evidence and measurements. (background info may be provided or you may need to complete your own research to support or refute your findings)
Believe your observations – don’t worry about what you were supposed to see. Excellent opportunity for a group note.
o answer any follow up questions from the activity.

Sometimes the questions are complicated and the answers are simple.
Dr. Seuss

I have not failed.
I’ve successfully discovered
10,000 things that won’t work.

Thomas Edison - Inventor of the phonograph, electric light bulb, and motion picture camera
**Situation:**
If ________ is changed, what will happen to ________?

**Predict**
What will happen? Include a labeled diagram to help show your prediction.

**Observe**
Record all of your observations in detail.

**Explain**
Support your prediction. Why do you think this will happen?

**Explain**
What are the differences and similarities between “Predict” and “Observe”? What have you learned?
4-H Hands-on Science activities develop thought processing skills. Members move from Beginning through Proficient as they explore 4 different stages.
Jobs of the Future **NEED** Science

Highest labour demand categories:
- Technical
- Scientific
- Engineering
- Healthcare

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Employment Growth
In Science Related Sectors

- **35%** Health Occupations
- **20%** Natural & Applied Science
- **10%** Trades & Related Occupations
Inquiry Technique:

PEOE

Stretch Your Skills:
Observing, Predicting, Hypothesizing, Modeling, Designing, Constructing, Analyzing, Reflecting, Constructing, Analyzing, Reflecting

Dream it!

Forces and Structures

The primary force that affects a structure is the vertical force of gravity. According to Newton’s First Law of Motion, in order for objects at rest to stay at rest, the forces acting on them must be balanced. The two forces (gravity pulling down and the strength of the structure pushing up) balance themselves at zero and there is no movement. If the structure is not strong enough to exert a force upward, gravity will prevail and the structure will collapse.

All forces that act on structures are either a push or a pull. The forces that act on structures are all pushes and pulls tending to pull apart or push pieces together. Through pushing and pulling, a building must retain its stability.

Reference material is from the Scientists in Schools program. For more information on forces and engineering concepts for young people visit: www.scientistsinschool.ca

The pull of gravity creates a downward force on the structure. This downward force consists of the weight of the structure itself (the dead load), plus whatever sits, hangs, or walks on the structure (live load). As such, the lower layers must be stronger than the one above it. As you move down the structure, each layer shoulders more of the weight. Think of a building as being divided into layers. As you move down the structure, each layer supports a little more weight than the one above it.

WWW.4-H.MANITOBA.CA

Hands-on Science of Building

4-H Hands-on
Open-Ended Inquiry Questions:
- Can you name some famous towers? For example: Eifel, CN
- Which method of building will give you the strongest tower? Staggered Stacked
- Why is it important to think about tension and compression when designing a building?

Do it! Challenge #1
Design and construct a building block tower that can withstand movement (wind, earthquake) without falling down. Build the tower and place it on a trampoline or an unstable surface. How high can you make the tower before it topples? Experiment with the base width, the height, and the weight on the top of the tower. Use the PEOE technique to conduct your experiments.

Dig It!
- Which structure used for your tower was the most successful?
- What would you do differently? Give it a try.

Do it! Challenge #2
Using Building Blocks, construct a replica of a famous tower landmark. Experiment to find the best building technique. Will it pass the movement test? Use the PEOE technique to conduct your experiments.

Dig It!
- What building techniques were used to build your tower?
- What would you do differently? Give it a try.
World’s Tallest LEGO® Tower
Guinness Book of World Records

The tallest LEGO® Tower in the world was built on May 25, 2014 in Budapest, Hungary. It took 4 days and 450,000 bricks to build the tower. It measured 34.76 metres high. Photos were taken by Getty Images.

You can see a video of the tower at:
If You Can Dream It
You Can Build It

Today is a great day to learn something new!

www.wallpowper.com
Inquiry Technique: PEOE

Stretch Your Skills: Observing, Predicting, Hypothesizing, Modeling, Designing, Constructing, Analyzing, Reflecting

Dream It!

Do It!

Open-Ended Inquiry Questions:

What would you do differently? Give it a try.

What was the difference between launching a heavy and a light weight?

Did moving the fulcrum change how the weight was launched?

Levers are simple machines. They make it easier to lift a heavy load or pull large objects over a long distance. Using a lever is an example of a machine.

A catapult is a simple machine that is used for throwing or launching large objects.

A seesaw is an example of a lever. Lever is a straight bar that turns around a fixed point. When it is pushed or pulled, the weight is pulled or pressed on the end opposite the weight. The pushing or pulling is called effort. A seesaw is an example of a lever.

Inquiry Card

CATAPULT

Inquiry Card

Science of Building

4-H Hands-on
Somewhere, Something Incredible Is Waiting To Happen.
Carl Sagan

Carl Sagan was an American astronomer, cosmologist, astrophysicist, astrobiologist.

Www.redhoop.com/blog
Inquiry Technique: PEOE

Stretch Your SKILLS: Observing, Predicting, Hypothesizing, Modeling, Designing, Constructing, Analysing, Reflecting

Dream It!

What would you do differently? Give it a try.
What happened when you changed the slope of the inclined plane? Why?
What changes to the car affected the distance it traveled? Why?

Dig It!

Experiments:
• Improve your car. Use the PEOE technique to conduct your experiments. Choose the slope of the ramp and make necessary changes to improve the performance of your car. Try different designs and materials to enhance your car’s performance. Use building blocks to build a race car using the inclined plane. Race it against others’ cars and make changes to improve your car’s performance. Experiment with different designs and models to build a car that travels as far as possible.

Do It!

• How do inclined planes make work easier?
• When have you used an inclined plane? For example, ramps, chutes, slides.
• What are some examples of inclined planes?

Open-Ended Inquiry Questions:

What is an inclined plane?

An inclined plane is a simple machine. It is a flat surface set at an angle.

4-H Hands-on Science of Building

Inquiry Card

CAR RACE

Downward Force of Gravity

Net Force = Acceleration

Upward (Normal) Force
Ideas are the Building Blocks of Ideas.
Jason Zebehazy

To develop a complete mind:
Study the science of art;
Study the art of science.
Learn how to see.
Realize that everything connects to everything else.

- Leonardo da Vinci

Www.addicted2fun.com
Inquiry Card

BRIDGES

Open-Ended Inquiry Questions:

- Why are compression and tension important when you are designing a bridge?
- What are the effects of compression or tension on a bridge?
- What structure is most likely to buckle?
- What types of bridges are built around the world and why?

Dream It!
Modelling, Designing, Constructing, Analyzing, Reflecting

Stretch Your Skills:
Observing, Predicting, Hypothesizing

Inquiry Technique: PEOE

Science of Building
Hands-on 4-H Manitoba

A bridge is a structure that is built to provide passage over physical obstacles such as bodies of water, valleys or roads. You depend on the strength and mechanics of bridges as you travel. Two types of stress act on bridges—compression and tension. Compression results from the weight of the load on the bridge pushing the upper surface of the bridge more tightly together. If the force of compression becomes too great for the bridge structure to support, it can cause the bridge to buckle. Tension is the force pulling on the lower surface of the bridge as it is stretched apart. This force can result in the bridge snapping. A bridge can be strengthened by transferring stress to spread the force evenly over a greater area.

The Akashi-Kaikyo Bridge in Japan measures 1991m between supporting structures and is the longest single span bridge in the world. It was designed based on the Akashi-Kaikyo Bridge and was able to support a moving model train.

The world record longest LEGO® bridge was 32.32m long with a central supporting structure and is the longest single span bridge in the world.

Inquiry Technique: PEOE

example, beam, truss, movable.
**Do it!**

Design a bridge that can be constructed using Building Blocks. Develop a plan to build a bridge that can span a distance of 30 cm between two tables or chairs of the same height while supporting a cup of marbles. Consider using different shapes in your building plan to add strength to your structure. Use Building Blocks to build your bridge. Once your bridge is complete, test the strength of your bridge by placing a container on the middle of the span and by adding marbles until the cup is full or the bridge snaps. Experiment by making changes to your bridge until it can support the entire load. Try to adapt your bridge to span a greater distance while supporting weight. Use the PEOE technique to conduct your experiments.

**Dig It!**

- What features of the bridge contributed to the strengths and weaknesses of the bridge?
- How else might you experiment with bridges?
- What would you do differently? Give it a try.
Inquiry Technique: PEOE

Stretch Your Skills: Observing, Predicting, Hypothesizing, Designing, Constructing, Analyzing, Reflecting

Why is the force of air pressure important?

What are some examples of things that are powered by air? For example, blimp, tools, air-powered car.

What are some new power sources being developed? Example: Balloon Car

In the case of the Balloon Powered Car, the action is the air rushing from the balloon, the air escapes from the balloon opposite reaction. In the case of the Balloon Powered Car, the action is thrust. Newton's Third Law of Motion states that for every action, there is an equal and opposite reaction.

The air pressure inside the balloon is much higher than the air pressure outside the balloon. The result is the balloon is pushed upward.

The car moves forward because the air pressure inside the balloon is much higher than the air pressure outside the balloon.

Thrust = object moves forward by air pressure from air movement from the balloon.

Open-Ended Inquiry Questions:

- What are some examples of things that are powered by air? For example, glider, tools, air-powered car.
- What other new power sources are being developed? Example: Balloon Car
- Why is the force of air pressure important?

Many cars are powered by gasoline, diesel, or other combustible fuels.

Open-Ended Inquiry Questions:

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- Why is the force of air pressure important?

Many cars are powered by gasoline, diesel, or other combustible fuels.
Do it!

Use Building Blocks to design and build a balloon powered car. Develop a system to attach the inflated balloon to the Building Blocks car. Leave a single space in your design to thread the balloon through. Test your car’s performance. Experiment by making changes to the structure of the car and to the position and inflation of the balloon to improve your car. Use the PEOE technique to conduct your experiments.

Dig It!

- What factors caused the car to stop?
- What happened when you changed the position of the balloon? Why?
- What would you do differently? Give it a try.
Inquiry Technique:
PEOE

Stretch Your Skills:
Observing, Predicting, Hypothesizing, Modeling, Constructing, Analyzing, Reflecting

Dream it!

Open-ended Inquiry Questions:

- How do engineers choose which building materials they will use?
- What makes a building strong? Weak?
- What are some examples of very strong structures? For example,

Build it!

- How did each member build their wall differently? What made the walls stronger? Weaker?
- How did each member build their wall differently? What made the walls stronger? Weaker?
- How did each member build their wall differently? What made the walls stronger? Weaker?
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Do it!

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Inquiry Card

STURDY WALL

4-H Hands-on Science of Building
Whatever good things we build end up building us.

Jim Rohn

“\textit{The important thing is to never stop questioning.}”

Albert Einstein
Inquiry Technique:
PEOE
Stretch Your Skills:
Observing, Predicting, Hypothesizing, Modeling, Designing, Constructing, Reflecting, Analyzing

Dream it!

Open-Ended Inquiry Questions:
1. What are some examples of things that are powered by gears?
2. Do all gears always spin at the same speed? Why or why not?
3. Not all gears are manmade. In 2013, scientists discovered a gear mechanism in the hind legs of Issus coleoptratus, a European planthopper species. Not all gears are manmade. In 2013, scientists discovered a gear mechanism in the hind legs of Issus coleoptratus, a European planthopper species.

A gear is a rotating machine that looks like a wheel with teeth around its edge. The teeth on one gear push against the teeth of another gear to make it turn. Gears are used to transfer energy from one place to another. A combination of gear pairs can change the direction of rotation, the speed of rotation, and the torque (rotational force).

Source: China University

Reach Your Skills:
Observing, Predicting, Hypothesizing, Modeling, Designing, Constructing, Reflecting, Analyzing

Inquiry Technique: PEOE

Inquiry Card
4-H Hands-on Science of Building

Gears
Inquiry Card
Do it! Challenge #1:
Use Building Blocks to design and build gears. Set up a series of at least three gears. Challenge yourself to build a longer gear train. Experiment by making changes to the gears’ structures and sizes until they operate smoothly. Challenge yourself to build a longer series of gears. Use the PEOE technique to conduct your experiments.

Challenge # 2:
Use the Gearing Up Resource Materials (#28 & #29) to construct a series of gears. Experiment by designing a longer series of gears and try using different sizes of gears. Use the PEOE technique to conduct your experiments.

Dig It!
- How much overlap do the teeth of the gears need?
- What happened when you changed the position or size of the gears? Why?
- What would you do differently? Give it a try.
Gearing Up

Explore how gears work by experimenting with different combinations. This resource can also be used to show members how working together as one unit things can get done faster and with less effort!

Full Display Contents in each of "Gearbotics Robot" and "Oogly Googly":

1 set of gears and accessories
1 remote motor
1 set of guidelines
1 set of batteries
1 container

Time: 10-45 min.

To borrow contact Shirley:
204-726-6613
Pkg: #28 or #29

#28

#29
NO GREAT DISCOVERY WAS EVER MADE WITHOUT A BOLD GUESS.
Isaac Newton

Sir Isaac Newton PRS MP was an English physicist and mathematician who is widely recognised as one of the most influential scientists of all time and as a key figure in the scientific revolution. (Wikipedia)
The center of gravity of an object is the point where all other forces acting on the object are balanced with the force of gravity. A boat will lean to one side if the center of gravity is moved from the middle of the boat. When you move around in a small boat, you change the center of gravity. If the weight of the displaced water is greater than the weight of the boat, the boat will float. If the weight of the displaced water is less than the weight of the boat, the boat will sink.

Archimedes principle explains why some things float. A boat floats because of buoyancy. Archimedes stated that the upward force (buoyant force) is equal to the weight of the boat displaced by the boat's weight (force pushing down) and sideways forces (moves out of its way) in down-wind and sideways directions. If the buoyant force is greater than the weight of the boat, the boat will float. If the buoyant force is less than the weight of the boat, the boat will sink.
Do it!

Complete a series of challenges to build a boat out of Building Blocks. Begin with a single, small baseplate. Measure how much weight this raft can hold while floating in a tub of water. Gradually add additional Building Blocks to the raft and test it. Build a basic boat design and measure the load it can support. Add more pieces to the boat or redesign it to hold as large a load as possible. Consider the shape of the hull (the body of the boat). Experiment with how the boat is placed in the water and how the load is applied. Try other mechanisms that will affect the force of buoyancy.

Dig It!

- Was the best boat constructed out of the most Building Blocks?
  What else made it the most stable boat?
- What happened when you changed the position of the load?
  Why?
- What would you do differently? Give it a try.
Inquiry Technique: PEOE

Dream it!

Stretch Your Skills: Observing, Predicting, Hypothesizing, Modeling, Designing, Constructing, Analyzing, Reflecting

Science of Building

Open-Ended Inquiry Questions:

Do It!

How does light help photographers take good pictures?

When does the light have to be to create a shadow in a drawing?

Photographs, greenhouses, shadow puppets, etc.

What are some examples of how light and shadows are used?

Inquiry Card

LIGHT & SHADOW

Longer: When the sun gets low in the sky, the stick’s shadow gets smaller. When the stick is in the ground and watch its shadow move and change. Sunlight affects the appearance of shadows. On a sunny day, you can see the shadow of the airplane’s object which prevents the light beam from passing through.

Shadow, this darkness is called a shadow. When an object blocks the light’s path, darkness appears on the other side. The sun is a source of light. As the earth rotates each day, the sun’s cycle of night and day is caused by the rotation of the Earth on its axis. The sun is a source of light. As the earth rotates each day, the sun’s cycle of night and day is caused by the rotation of the Earth on its axis.

Create a drawing by using building blocks. Build a structure/sculpture, and trace the shape of the shadow. Where is the size of the sculpture and where the light is placed—closer or farther away?

Inquiry: How does the size of the sculpture and where the light is placed—closer or farther away?

Stretch Your Skills: Observing, Predicting, Hypothesizing, Modeling, Designing, Constructing, Analyzing, Reflecting

Science of Building

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Inquiry Card

LIGHT & SHADOW

Longer: When the sun gets low in the sky, the stick’s shadow gets smaller. When the stick is in the ground and watch its shadow move and change. Sunlight affects the appearance of shadows. On a sunny day, you can see the shadow of the airplane’s object which prevents the light beam from passing through.

Shadow, this darkness is called a shadow. When an object blocks the light’s path, darkness appears on the other side. The sun is a source of light. As the earth rotates each day, the sun’s cycle of night and day is caused by the rotation of the Earth on its axis. The sun is a source of light. As the earth rotates each day, the sun’s cycle of night and day is caused by the rotation of the Earth on its axis.

Create a drawing by using building blocks. Build a structure/sculpture, and trace the shape of the shadow. Where is the size of the sculpture and where the light is placed—closer or farther away?

Inquiry: How does the size of the sculpture and where the light is placed—closer or farther away?

Stretch Your Skills: Observing, Predicting, Hypothesizing, Modeling, Designing, Constructing, Analyzing, Reflecting

Science of Building

Open-Ended Inquiry Questions:

Do It!

How does light help photographers take good pictures?

When does the light have to be to create a shadow in a drawing?

Photographs, greenhouses, shadow puppets, etc.

What are some examples of how light and shadows are used?
Dig It!

- Which shadow had the most dramatic effect? Why did you choose it?
- What happened when you changed the angle of the light? Why?
- What would you do differently? Give it a try.
Dream It!
Modelling, designing, constructing, analyzing, reflecting
Stretch your skills: Observing, predicting, hypothesizing, reflecting
Inquiry Technique: POE

Inquiry Card
MOSAIC

Open-Ended Inquiry Questions:
What materials could you use to make a mosaic? For example,
- stone, glass, brick
- What elements of design would you use to create a building block mosaic?
  - Texture, perspective, colour, symmetry, line, etc.
- How would you design a mosaic picture?
- What experiments would you use to conduct your mosaic experiments?

4-H Hands-on Science of Building
Dig It!

- How would you make a 3D picture/sculpture? Give it a try.
- What size of bricks worked best in your design?
- What would you do differently? Give it a try.
ART Factsheet
Designing art with LEGO® bricks can be a good way to express new ideas and share information with people in a visual way. By using the design elements of line, colour, shape, and texture, you can design some amazing sculptures.

LEGO® Artist Sean Kenney—
Sean Kenney designs portraits and created a Nature Connects display that is travelling to Botanical Gardens across the United States. His designs are interesting and teach children about nature.

LED® mosaic from a photo.

Bison and her calf.
Made with 16,229 LEGO® bricks.

Hummingbird
Made with 31,565 LEGO® bricks
Brick Artist Nathan Sawaya— Nathan Sawaya creates designs that make you think. What do you think they are saying? His exhibit is called, “The Art of the Brick.” What design elements most describe his work?

LEGO® Artist Mike Doyle — Mike Doyle’s creative thinking and designs encompass all elements of design.

"The Millenial Celebration of the Eternal Choir, K'al Yne, Odan took around 800 hours and over 200,000 pieces to complete. It is 6' high by about 6’ wide and about 3' deep. The work takes the viewer to a mystical planet called Odan in the midst of celebration."