DISCOVERY
Center of Idaho

EDUCATOR RESOURCE GUIDE

BRICKS!

Imagine - Engineer - Build

BRICKS!

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HOW TO USE THIS GUIDE:

This resource guide provides ideas on how to prepare for a meaningful, informative and fun visit to the Discovery Center of Idaho which encourages relevant connection to your classroom learning objectives. *BRICKS!* facilitates open-ended building and engineering experiences to support the development of 21st-century skills.

Ideas for on-site interactions, as well as tried-and-true facilitation techniques for supporting students as they encounter common struggles during the engineering process, follow-up prompts and activities are included. Educators can pick and choose which sections, activities or themes they want to focus on with their students in the pre- or post-visit materials.

BRICKS! was produced in the Discovery Center Micron Innovation Lab to promote student understanding of:

- **Earth & Space Sciences**
- **Engineering**
- **Forces & Motion**
- **Math**
- **Technology**
- **Waves**

EXHIBITION OVERVIEW

BRICKS! is an exhibition dedicated to creative building and participation in the engineering process. Visitors can have fun while they explore essential physics and STEM concepts from aerodynamics to animation. With over a dozen STEM-based, hands-on exhibits and remarkable displays of brick creations from local artists, *BRICKS!* takes an iconic favorite to new heights.

VISITORS OF ALL AGES CAN:

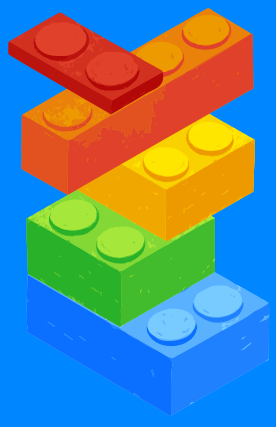
- Use simple machines to power a BRICKS! design
- Build and test structures to withstand an earthquake
- Produce a stop-motion animation
- Compose a song
- Admire impressive feats of BRICKS! engineering and artwork
- Create designs using a digital kaleidoscope...and more!

Exhibition content may vary based on available space and the time of year!
Thank you in advance for your flexibility!

IMAGINE!
Dream first, then build. From movie skits to mazes, what you see in your mind can become reality.

ENGINEER!
Keep trying new things to create your structure. There are endless solutions to any challenge!

BUILD!
Build tall, wide, strong or small! Work with others to push the limits. Brick by brick; what will you create?



IDAHO CONTENT STANDARD CONNECTIONS

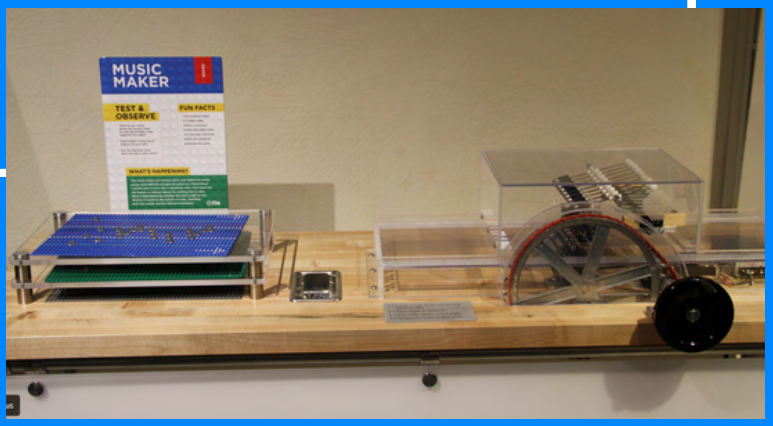
IDAHO SCIENCE STANDARDS & INFORMATION AND COMMUNICATIONS TECHNOLOGY STANDARDS

Elementary School (K-5th)

K-PS-1.1	3-PS-1.1
K-PS-1.2	3-PS-1.2
1-PS-1.1	4-PS-1.1
2-PS-1.3	4-PS-1.3
2-ESS-1.1	4-PS-1.4
ICT.K-2.4.a	4-ESS-3.2
ICT.K-2.4.b	ICT.3-5.4.a
ICT.K-2.4.c	ICT.3-5.4.b
ICT.K-2.4.d	ICT.3-5.4.c
	ICT.3-5.4.d

Middle/High School (6th-12th)

MS-PS-2.1
MS-PS-2.2
ICT.6-8.4.a
ICT.6-8.4.c
ICT.6-8.4.d
ICT.9-12.4.a
ICT.9-12.4.c



The Idaho Content Standards identified here are an overview of some of the Science & Information and Communications Technology Standards addressed through our *BRICKS!* exhibits. Please remember, this is just a place to start! There are many additional connections, including those across disciplines and among many fields of science that can be addressed during a visit to the Center.

CREATIVITY, COLLABORATION, COMMUNICATION & CRITICAL THINKING

BRICKS!
Imagine - Engineer - Build

Science, Technology, Engineering and Math (STEM) is a tool (one of many!) that can be used to help develop students' creativity, collaboration, communication and critical thinking skills. These skills, otherwise known as 21st Century Skills, are critical to student success not only in academic performance in the K-12 classroom but also later in life as they move into professional careers. The open-ended design-and-build experiences available through BRICKS! are the perfect opportunity to build student's STEM content understanding while developing their 21st Century Skills.

Creativity
There is no right answer to an open-ended engineering challenge or building experience; only multiple solutions. Allow your student's creativity to shine as they design and re-design unique solutions to the problems they encounter along the way.

Collaboration
Think of any great scientific breakthrough or feat of engineering. Who was involved? That's right, it takes a team to solve a complex problem. When building and creating together, students, just like engineers and scientists, must cooperatively negotiate ideas and materials to achieve their goals.

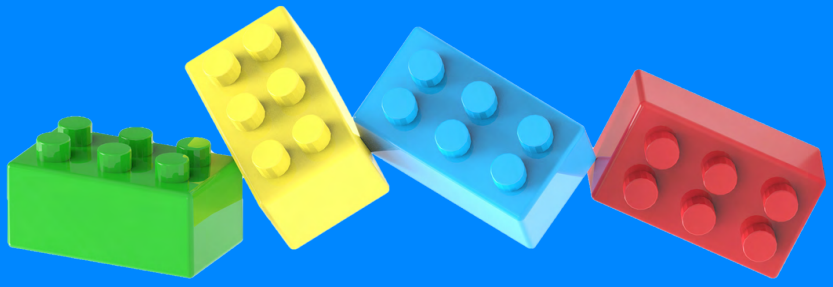
Communication
BRICKS! is the perfect medium to spark enthusiastic conversations about building, design and engineering. Students are excited to share their ideas, offering a powerful place to practice communication skills around STEM concepts, successes and limitations of prototypes, and processes of engineering.

Critical Thinking
Inherently, each step of the engineering design process (identify and research a problem--imagine possible solutions--plan--create--test--improve) requires students to use critical thinking and problem solving skills as they navigate the criteria and constraints of the challenge at hand.

In addition to the interactive exhibits, you can practice these skills at the gallery's open-ended building stations including the giant BRICKS! mural, free-build station, and large BRICKS! building area.

For more information on how open-ended engineering challenges can further support 21st Century Skills, we recommend reading the edweek.org blog post, Engineering Challenges Promote 21st-Century Skills and Engage Youth, written by Natacha Meyer & Tania Tauer (2015).

Meyer, N. & Tauer, T. (2015, April 24). Engineering challenges promote 21st-century skills and engage youth [Blog]. Retrieved from: blogs.edweek.org/edweek/global_learning/2015/04/engineering_challenges_promote_21st_century_skills_and_engage_youth



BUILDING BLOCKS TO LEARNING

From a very young age, we are curious about the world around us. As we grow and develop, we learn to explore and manipulate our environment. Building with block and bricks is a fantastic way to test out new concepts and ideas for curious learners of all ages! Exposure to the engineering process early on allows our children to become better thinkers, resilient problem-solvers and might even eventually develop into a lifelong passion or career.

This exhibition gives visitors the opportunity to explore STEAM concepts through designing, building, testing different strategies and pushing the limits!

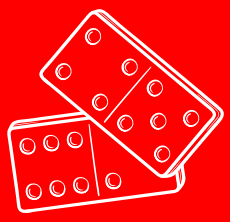
Check out the resources in this guide to ignite the learning spark before your visit!

Recommended Resources:

People all around the world use innovative engineering ideas to build structures! These videos show women-founded engineering projects that divert plastic waste to create sturdy, sustainable, cost-effective building materials.

Rebricks

Trailblazers BBC Earth Lab

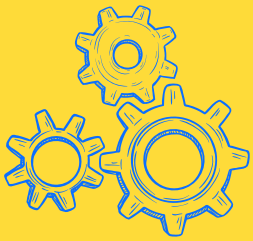


Domino topplers channel their creativity not only into their building, but in the way that their structures will look once they've been knocked down. This video shows elaborate domino constructions being built and then being destroyed in the most amazing way!

Students interested in mechanical engineering can create their own car using this ABCya building game, or those interested in designing wind turbines, farms, or cities can check out PBSKids' Design Squad games.

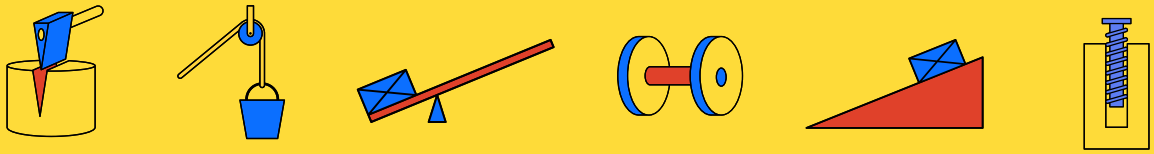
DISCOVERY Center of Idaho

RECOMMENDED RESOURCES (CONTINUED):



Engineer Girl is great site for middle- and high school aged girls to learn more about the options and opportunities available to them in engineering career fields.

A Dutch artist and kinetic sculptor creates art out of electrical tubes and zip ties that must be seen to be believed!



This infographic shows how we rely on simple machines every day!

Humans have been interested in engineering and design for a very long time. Stonehenge is just one example of an ancient monument miraculously built without the help of modern technology.

- How did it get there?
- What purpose did it serve?

n addition to *BRICKS!,* students will have the opportunity to explore our year-round exhibitions during their visit. Find video resources related to other exhibition content at our **YouTube channel**!

FIELD TRIP EXPERIENCE

Each student group will be welcomed by our Education Team and given a breakdown of field trip expectations. Students will break into smaller groups with their assigned chaperone (please assign these chaperone groups before your visit!) and will receive an activity guide to use as they move through the Center. Maximum group size is 50 students per field trip slot.

The on-site student learning experience has two versions you can choose from: a 60-minute, gallery-only exploration or a 90-minute visit which, in addition to the 60-minute gallery time, includes a classroom activity inspired by the exhibition.

PRICING

Base Price: 60-Minute Gallery Exploration
Admission cost:
$4 per student (for schools/districts with over 50% of students receiving Free/Reduced Lunch)
$10 per student (for schools/districts with 0–49% of students receiving Free/Reduced Lunch)
$12 per chaperone/teacher at 1:5 ratio (additional chaperones will pay full price)

Classroom Add-on: 60-Minute Gallery Exploration + 30-Minute Classroom Activity (extra 30 minutes as described above)*
Cost of Classroom Add-on*: **extra $3 per student added to base price listed above

For more information or to book a field trip, contact the Education Department at:
education@dcidaho.org
(208) 343-9895 x224.

PREPARING YOUR STUDENTS (AND CHAPERONES) FOR THEIR VISIT:

Our mission statement: The Discovery Center of Idaho is a space that inspires interest and learning in Science, Technology, Engineering, Math (STEM) and Art concepts through hands-on play, demonstration and activities.

We believe learning is fun, but remember that we are not an indoor playground. Please remind your students to indulge their curiosity in ways that are safe, controlled and don't interfere with others' experiences.

To prepare your students for the best possible experience, we recommend integrating versions of this guide's activities or references into your lesson plans during the week before your visit.

How well you prepare your chaperones can make or break your students' experiences. We created a short video to share with chaperones accompanying your group, so they can better understand their roles.

A Chaperone's Guide to Field Trips

DISCOVERY Center of Idaho

PRE-VISIT ACTIVITY SUGGESTIONS

Pre-visit Activity #1: Paper Building Blocks

Target age: 5+, with adult help cutting and scoring as needed

Standards:
K-PS-1.1
ICT.K-2.4.c
ICT.K-2.4.d
2-PS-1.3

Materials Needed:

- Thick colored paper
- Paper cutter (optional)
- Xacto Knife
- Straightedge
- Cutting mat
- Tape

Notes: These building blocks are based on a 1-inch module, increase the size proportionally to make bigger blocks. Adults should be in charge of Steps 1-4, kids can take over at Step 5

Instructions:

1. Select your first piece of paper and place it on your cutting mat. Score your paper vertically at the 1-inch and 2-inch marks and trim your paper completely at the 3-inch mark. To score paper, lightly drag your Exacto blade along your straightedge, making a light line in the paper. This will make folding easier.
2. Repeat the scoring and trimming process with each color of paper.
3. Trim the lengths of scored paper crosswise into 1-inch strips. If you have a paper cutter this would be the fastest method for cutting (can also use Exacto and straightedge).
4. Cut some paper "planks," 1-inch strips of paper that are not scored. They can be 3 to 6 inches long.
5. Fold your 1-inch strips into thirds along the scored lines.
6. Tape the open edges together to form a triangle.
7. Repeat folding and cutting until you have a bunch of blocks assembled.
8. Start positioning the triangles in a row alternating between triangles that are right side up and upside down. Add a plank or two on top of each layer.
9. When you have a few layers you can test how strong your paper structure is by balancing objects on top of it!

PRE-VISIT ACTIVITY SUGGESTIONS

Pre-visit Activity #2: Toy Car Marker Bots

Target age: Elementary (K-5) with adult assistance, Middle School

Standards:	
K-PS-1.1	K-PS-1.2
2-PS-1.3	ICT.K-2.4.b
ICT.K-2.4.c	3-PS-1.1
3-PS-1.2	4-PS-1.1
4-PS-1.4	ICTT.3-5.4.b
MS-PS-2.2	ICT6-8.4.c

Materials Needed: (1 set per car)

- Hot Wheel or other small race car
- Skinny washable marker
- AAA battery
- 1.5V hobby motor (and a dime if it doesn't have a counterweight)
- Electrical tape
- Wire if the motor doesn't have it already attached
- Craft or art paper
- Hot glue gun

Bot Safety Note: Adult supervision is required when working with electric components and hot glue guns. Ensure that batteries are disconnected when not in use. The exposed ends of wires with a battery connected can shock you and/or heat up and smoke. The fast-moving rotor also poses a safety risk. keep away from eyes and hands when the motor is running.

Instructions:

1. Attach a positive and negative wire to your hobby motor by feeding them through the contact holes/loops and taping them with electrical tape. If your motor doesn't have a counterweight, hot glue a dime to the rotor at about halfway between the center and the edge. You want it to be off-balance.
2. Tape or glue the motor to the top of the car ensuring there is clearance between the motor rotor and any part of the car surface. You can play around with the motor placement as the alignment controls the movement of the car.
3. Tape or glue your marker (or markers!) to the car so that the tip of the marker is level with the bottom of the wheels.
4. Connect your battery to the motor by placing the red wire on the positive terminal end of the battery and securing it with electrical tape. Repeat with the black wire on the negative battery terminal. Then tape the battery to the car.
5. Lay down your craft paper and let the cars loose! Be sure to disconnect the battery when you're done playing with the car.

PRE-VISIT ACTIVITY SUGGESTIONS

Pre-visit Activity #3: Rube Goldberg Machines

Target age: Upper Elementary - High School

Standards:

3-PS-1.1	3-PS-1.2
4-PS-1.1	4-PS-1.3
4-PS-1.4	ICT.3-5.4.a
ICT.3-5.4.b	ICT.3-5.4.c
ICT.3-5.4.d	MS-PS-2.1
MS-PS-2.2	ICT.6-8.4.a
ICT.6-8.4.c	ICT.6-8.4.d
ICT.9-12.4.a	ICT.9-12.4.c

Materials Needed: *During the first part of the activity, which is the design of the machines, tell the students that the following materials will be available for them. Anything else they think of requires teacher approval, for example, dominoes, an egg, a wooden dowel, wheels, etc.*

- Hot glue
- Construction paper
- Marbles
- Small paper cups (such as Dixie cups)
- Paper towel tubes
- String
- Jumbo paper clips
- Rubber bands
- PVC pipe
- Rube Goldberg Activity Worksheet (optional)
- Rube Goldberg Activity Worksheet Answers

VIDEO OVERVIEW

Instructions:

Part 1: Design the Rube Goldberg Machine (25 minutes)

1. In groups of three, have student engineering teams decide on simple tasks to create machines for, intended audiences, and any information they know that will help them solve the problem.
2. With every group member contributing ideas, have students brainstorm ideas about how they will accomplish the simple task (such as getting a marble in a cup one meter away) in an overly complex way. Remind them that they must use at least three simple machines in their final designs.
3. Next, have each team collectively produce machine drawings that include dimensions.
4. Have teams include materials lists, including any special-request materials.
5. Teams show their designs and materials lists to the teacher for approval.
6. Have students make design alterations if not immediately approved. After approval, make the design more specific or the drawing more detailed as other groups finish up their designs.

Part 2: Build the Rube Goldberg (50-60 minutes)

1. Have students spend a few minutes reviewing their drawings from Part 1 before starting to build.
2. Have student teams gather their materials and begin to build their designs.
   - Emphasize that each group member participates.
   - Direct the students to follow the planned design as closely as possible.
3. Once teams have completed their designs, have them test their machines. Evaluate competing design solutions to determine how well they meet the criteria and constraints of the problem.
4. Allow student teams to return to their seats and make adjustments, as necessary. Re-test any re-designs.
5. Have each engineering team display its Rube Goldberg contraptions to the class during the last 10 minutes of the period.

Post-Activity Assessment

Rube Goldberg Worksheet: Use this worksheet to assign students to take a closer look at a Rube Goldberg cartoon and, drawing upon previously learned concepts, develop arguments that say the machine could in fact work.

Activity tips:

- This activity is designed to be used with students who have a basic understanding of simple machines. Consider reviewing basic engineering concepts prior to introducing this project.
- For lower grades, designate a specific function for the machine. Students' machines should include at least three steps to completing the task.
- Have students acknowledge each step of the engineering design process as they are completing them. The steps include: Define the problem, gather information, brainstorm ideas, select the most promising idea, explain your design, build and test your design, and redesign for improvement based on what you have learned from testing.

EXHIBIT DESCRIPTIONS & PROMPTS

Exhibition content may vary based on available space and the time of year!
Thank you in advance for your flexibility!

KALEIDOSCOPE
Content Area: Math

Test & Observe

- How does the pattern change as you spin the turntable backwards?
- What do you think makes a pattern beautiful?
- Try building tall. Does a three-dimensional pattern look different?

What's Happening?

Software divides your BRICKS design into repeating and symmetrical (even) patterns. Handheld kaleidoscopes use tilted mirrors to make patterns. You rotate a kaleidoscope's chamber to spin colored pieces of glass or plastic. Here, spinning the turntable creates a similar effect.

ANIMATION STATION
Content Area: Technology

Test & Observe

- Can you make your character jump, bend or run? Which movement looks the most realistic?
- How many frames does it take to move a character across the stage?
- Can you create actions for two characters at the same time? Three or four?

What's Happening?

Each time you press the capture button, you snap a single image. When you play back the whole sequence, it looks like your character is moving. Stop-motion animation is a film technique that is used to bring static, or motionless, objects to life. It is especially popular for making movies with clay figurines, puppets, or everyday household objects.

EXHIBIT DESCRIPTIONS & PROMPTS

Exhibition content may vary based on available space and the time of year!
Thank you in advance for your flexibility!

BALL MAZE

Content Area: Forces & Motion

Test & Observe

- Is it harder to move your ball through a narrow or wide path? What do you notice?
- What makes a maze easy to navigate?
- Can you beat your best time?

What's Happening?

Moving a ball through the maze takes good hand-eye coordination. Gravity helps, too. The ball speeds up as it rolls down an incline, then stops and loses kinetic energy (the energy of motion) when it hits a wall. The trick is shifting at just the right moment so your ball keeps its speed around the maze's twists and turns.

MUSIC MAKER

Content Area: Waves

Test & Observe

- What do you notice about the sounds made by placing triangles close together? Far apart?
- What makes a song sound pleasant to your ear?
- Can you discover more than one way to play music?

What's Happening?

The music maker uses tempo, pitch, and rhythm to create songs. Each BRICKS triangle you place on a sheet drives a mallet that, in turn, hits a xylophone note. Your hand sets the tempo, or musical speed, by cranking fast or slow. Pitch is determined by whether the note is high or low. Rhythm is made by the pattern of notes, including both the sounds and the silences in between.

EXHIBIT DESCRIPTIONS & PROMPTS

Exhibition content may vary based on available space and the time of year!
Thank you in advance for your flexibility!

SHAKE TABLE
Content Area: Earth & Space Science

Test & Observe

- Does a gentle shake cause damage over time? What do you observe?
- What makes a structure strong?
- How tall can you build and withstand a gentle shake? A strong shake?

What's Happening?

When you spin the dial, you simulate an earthquake's side-to-side motion. All buildings are vulnerable to earthquakes, but the kind of shaking makes a difference. Tall buildings tend to suffer more from slow shaking, while smaller buildings are affected by short, frequent shakes. Engineers often use triangular braces—such as intersecting Xs—across building columns to make them more earthquake resistant.

FREE BUILD PROMPTS
Content Area: Engineering

TRY IT OUT!

- Build a tower taller than your pet
- Craft a home for someone living on another planet
- Try to recreate your own home
- Make a vehicle that could drive in water
- Make a vehicle that could drive on sand

THINK ABOUT IT!

- When you build, how does the purpose of the structure factor into its design?
- How do you think construction workers, architects and engineers might use bricks or blocks to help them plan out something they might build in the future?

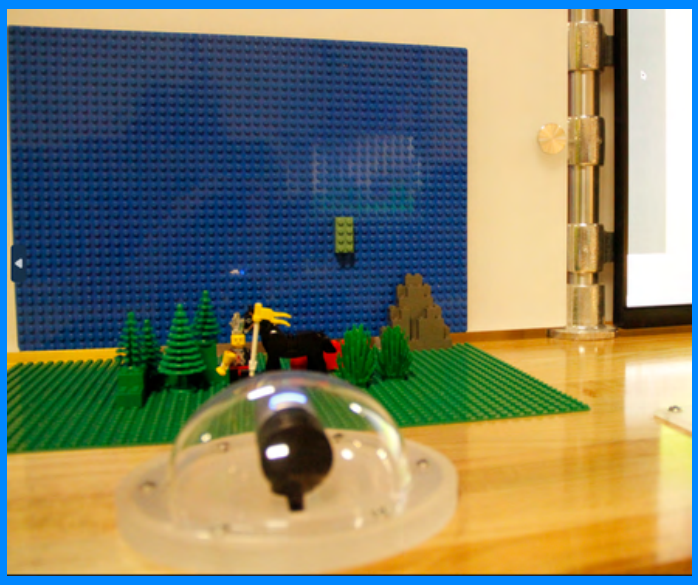
POST-VISIT ACTIVITIES

Your field trip may be over, but this doesn't mean your students' discovery time has to end! Keep the learning going by connecting classroom experiences to their Discovery Center visit.

Reinforcing what they saw and absorbed over the next few days will help your learners retain valuable information.

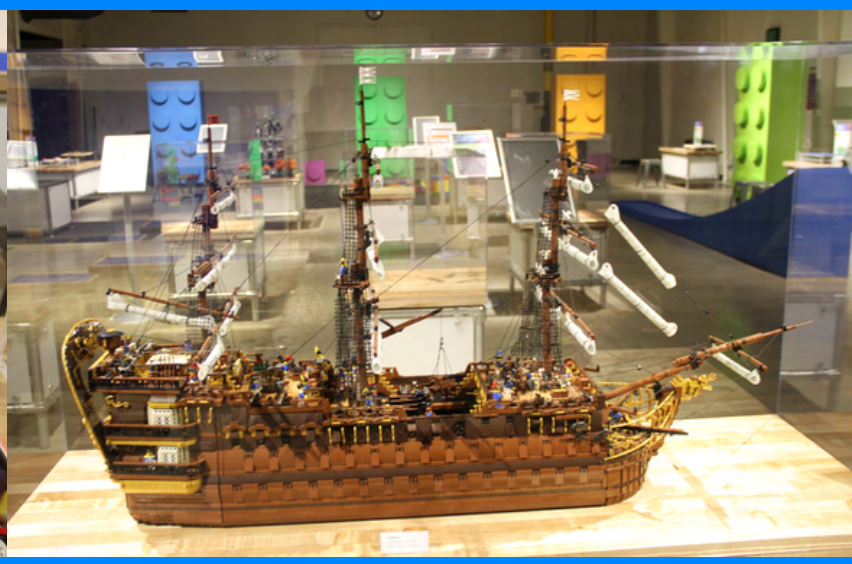
Some tips for maximizing the learning from your Discovery Center of Idaho field trip:

1. Connect what your students experienced with what you are doing in the classroom. Remember that our galleries contain many different elements which can be tied into science, technology, engineering, math (STEM) and art!
2. Incorporate some of the post-visit discussion prompts/activities listed below into an activity.
3. Include examples from the field trip on an upcoming assessment to reinforce what students experienced and relate it to their schoolwork.
4. If you didn't get to do all the pre-visit activities we provided, try them out after your visit! It's a great way to continue building physical memories of concepts that are difficult to understand on paper.
5. Challenge students to design a new exhibit or activity that shows off one or more of the concepts they experienced during their visit.
6. Have your students write us a letter! We love getting student letters about what they learned and remember from their field trip—and it helps us learn what future students will enjoy!
7. Finally, please complete the teacher survey we will email you after your trip. Your feedback is so important in helping us find areas to improve and grow. Please share your thoughts and suggestions with us!



BRICKS! Post-Visit Prompts:

- What was the most interesting exhibit you explored? How do you think it may have been created? Have you seen any similar structures outside of the Discovery Center?
- Design your own structure using bricks or any other material. What purpose does it serve? How can you make sure that your structure is strong enough to withstand any weight or force it might encounter over time?



DISCOVERY CENTER OF IDAHO EDUCATION INFORMATION

The Discovery Center of Idaho's mission is to inspire lifelong interest and learning in Science, Technology, Engineering, Math (STEM) and the Arts because we believe learning is fun and expands minds and lives.

The Education Department at the Discovery Center of Idaho seeks to provide quality educational experiences and programs that reflect excellence in their development and mastery in their delivery, and to offer relevant and sustainable interactions that inspire lifelong interest and learning in STEM and the arts for a diverse local, regional and state-wide community.

If you have any questions or need help while planning your class trip to the Discovery Center of Idaho, please reach out to us at education@dcidaho.org.

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