BRICKS!

IMAGINE - EGINEER - BUILD

EDUCATOR RESOURCE GUIDE

DISCOVERY
Center of Idaho

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BRICKS! Overview

BRICKS! is an exhibition dedicated to creative building. Try your hand at using this timeless building block to explore essential physics and STEM concpets 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
- Harness water power from a dam
- Produce a stop-motion animation
- Compose a song
- Admire impressive feats of BRICKS engineering and artwork
- Create designs using a digital kaleidoscope...and more!

As you explore, we hope you...

IMAGINE

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

ENGINEER

Time your best speed, refine your structure, and try and try again. There are endless solutions to any challenge!

BUILD

Build tall, wide, strong, and small. Team up with a partner to push the limits. Brick by brick, what will you create?

How to Use the Educator Resource Guide

We hope this resource guide provides a starting place for ideas on how to design a meaningful, informative, and fun visit to the Discovery Center. This guide provides insights into how BRICKS!'s open-ended building and engineering experiences can support the development of 21st-century skills and offers tried-and-true Dicovery Center facilitation techniques for supporting students as they encounter common struggles during the engineering process. Next, we have included a field work planning guide to help you set goals and prepare your students for their visit to the Center. We've included a signage guide to help orient you to the exhibit signage and how it might be used as a tool during your visit. Copies of exhibit signage are included to help provide background information about the main concepts covered at each of the interactives. Lastly, there is a list of potential connections between the exhibits and the Idaho Science Content Standards to help draw connections between your visit to the Center and your classroom.

Creativity, Collaboration, Communication & Critical Thinking with BRICKS!

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's 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 students' 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 models, 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 include 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

Facilitating STEM Learning

When presented with an engineering challenge, students may struggle to work collaboratively with one another and to be comfortable with failure. While visiting BRICKS! and interacting with your students during your visit, consider trying out some of DCI's tried-and-true facilitation techniques to support your student's STEM learning:

Collaboration

We've found the following strategies to help with fostering teamwork among students.

- When a student doesn't feel like their team is listening to them: you can ask the group, what is similar about each of their ideas?
- When a group is concerned that another group "is copying them": we introduce the term "Ideation", which is the creative process of generating, developing and communicating new ideas. Engineers, like we are all here today, "ideate" or combine ideas to create an even better solution.
- Often we return to the goal of the activity. Is it teamwork or problem solving? Then we ask how can we accommodate students' needs to achieve the goal. Sometimes that means letting students work individually so that they can experience the engineering design process.
- When needed, assign jobs (materials captain, builder, team captain, etc.) and then after a period of time, ask everyone to switch roles.
- When all else fails, take away student's ability to talk. This forces students to more carefully communicate and "listen" to one another.

Failing Forward

At the Center, we like to remind students that failing is part of the process and a necessary step For Anyone Interested in Learning (FAIL). We've found the following language to be helpful when trying to help students exercise a growth mindset and be comfortable with "failing forward".

- You didn't do it wrong, just differently
- That's a really great solution! I wonder if there is another way we could solve the problem...
- We're all engineers today! That means we collaborate, design, build, AND fail. And when an engineer fails, they just give up....right? Well of course not. They fail forward into a new idea.
- How many of you have had a tower/bridge/structure collapse? Great! We've now found five things that didn't work! What did you find that eventually DID work?
- I said it was going to be a STEM challenge, not a STEM easy. You're going to fail and that's OK! When you fail that means you fail forward into another idea.
- We haven't found the solution...**yet**
- As a student completes a challenge, give them the next "level" or next step up in the challenge. This helps reinforce that you are never really done when engineering as there is always another "level", "challenge", "plot twist" or way to improve your design.

For further reading on how engineering with LEGO® can help students learn about resilience, we recommend checking out the New York Times article, "Building Bots and Confidence."

Williams, J. (2019, February 22). Building Bots and Confidence. New York Times, p. 13. Retrieved from: www.nytimes.com/2019/02/22/education/learning/deilab-baltimore-lego-robots

Discovery Center of Idaho Field Work Planning Guide

From "Field Trip" to "Field Work": Reimagining the Student Experience

Just like scientists, students benefit from spending time in the field making observations, inspiring curiosity, and researching a concept. This planning guide can help identify your goals for your students' field work at the Center and help your students meet those goals.

STEP ONE: IMAGINE THE POSSIBILITIES

In the boxes below, please describe the learning experience you have imagined for your students. What field work will your students do while they are at the Center? What will your students do before and after your field work to connect learning to your classroom?

Before	During	After

STEP TWO: DEFINE YOUR GOALS

What do you hope students will be curious about when they visit the Center? What do you hope students will take away from this experience?

Curiosity Factor	Take-Away

STEP THREE: COLLABORATION

Please contact Discovery Center education staff at education@dcidaho.org with any remaining questions or concerns you have about your upcoming field work. We're here to help!

How to Use the Exhibit Signage as a Tool

Signage, we believe, is a way to help prompt learning and discovery at an exhibit. This section of the resource guide helps explain our intent behind the signage and how you might be able to use the signage as a tool during your visit.

1. Exhibit Name
2. Content Area
3. Test & Observe
4. What's Happening?
5. Fun Facts

The top banner of the exhibit sign includes the Exhibit Name 1 and Content Area 2. The key content areas, and specific topics you may see covered at an exhibit, are represented in the table below. The clearly denoted content areas are inteded to give greater clarity to which concepts are covered at each exhibit and how the exhibit can connect to Idaho Science Standards.

Key Content Areas	Example Exhibit Topics
Forces & Motion	Mechanics, Gyrations, Vibrations, Simple Machines
Electricity & Magnetism	Motors, Electricity, Magnetism
Waves	Sound, Light, Optics, Vibrations, Perception
Matter	Materials Sciences, Chemistry, Thermodynamics
Earth & Space Sciences	Weather, Natural Resources, Earth Systems, Geology, Solar System
Engineering	Design, Build, Test
Life Sciences	Physiology, Memory, Perception
Technology	Robotics
Math	Patterns

The Test & Observe 3 section includes a list of questions to help guide and facilitate deeper learning and engagement at each of the exhibits. This section is modeled after Kolb's Experiential Learning Theory (1984) which uses open-ended questions to prompt students to observe, reflect, build understanding, and test their ideas through further experimentation and conceptualization.

What's Happening 4 explains the scientific concepts behind the exhibit, helping students to better understand what they are experiencing and observing.

Fun Facts 5 are included to give real world examples of the concepts on display. Our intent is to spark a new thought, connection or moment of wonder.

Kolb, David A. (1984). Experiential learning: experience as the source of learning and development. Englewood Cliffs, NJ: Prentice-Hall.

Copies of Exhibit Signage

As you review the exhibit signage, consider what additional experiments, writing prompts, or classroom learning moments could these concepts support before or after your visit to the Center?

AIR POWER

Content Area: **Forces & Motion**

Test & Observe

- What is the simplest BRICKS contraption to power? Why?
- What happens if you connect more than one wheel to the turbine?
- Can you build a contraption that turns the spinning motion of the air turbine into a back-and-forth motion?

What's Happening?

Pulleys are the simple machines that make our work easier. When you hook up a rubber band and wheel to the air turbine, you create a pulley to power your BRICKS contraption. If you hook a large wheel to the air turbine with a rubber band, it will spin more slowly but with greater force, just like changing gears on your bicycle to pedal uphill.

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 used to bring static, or motionless, objects to life. It is especially popular for making movies with clay figurines, puppets, or everyday household objects.

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 patter of notes, including both the sounds and the silences in between.

PARACHUTE LAUNCHER

Content Area: **Engineering**

Test & Observe

- Can you engineer the highest launch? The slowest landing?
- How does shape affect falling speed?
- What happens when you launch two parachutes at the same time?

What's Happening?

It is one thing to float upward in an air stream, and another to come down. An open parachute creates air resistance, also known as drag, which slows an object's falling speed. The larger the area of a parachute, the more drag it creates. The heavier your miniature figurine, however, the harder it is to lift and the faster it falls. When you balance these forces against each other, you can engineer the best launch and landing.

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 patters. You rotate a keleidoscope's chamber to spin colored pieces of glass or plastic. Here, spinning the turntable creates a similar effect.

RACERS

Content Area: **Forces & Motion**

Test & Observe

- How does a racer's shape affect its speed?
- Will the size of the racer's wheel affect its speed? Why?
- How can you redesign your racer to make it go faster?

What's Happening?

As your racer moves down the track, its potential energy turns into kinetic energy, or the energy of motion. The heavier your racer, the freater the friction (resistance) as wheels touch the track. This slows things down. Your racer will also accelerate, or speed up, the fastest when you place it at the very top of the track. That is because gravity overcomes friction.

STREAM TABLE

Content Area: **Earth & Space Sciences**

Test & Observe

- Try building a dam to increase water pressure. What do you notice about water flow?
- Why does water speed up as it flows from high to low places?
- Can you line up the paddlewheels and turbines so they all spin at once?

What's Happening?

The stream table plays with the power of flowing water as it moves against obstacles in its path. When you construct a dam at one end of the table, pressure builds as water rises behind the wall of BRICKS. If you line up the paddlewheels and turbines just right, you can use water power to get them spinning.

SHAKE TABLE

Content Area: **Earth & Space Sciences**

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.

Science Content Standard Connections

The Idaho Science Content Standards identified below are an overview of some of the science 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.

Kindergarten
PS1-K

First Grade
PS-1-1

Second Grade
ES1-2-1, ESS2-2-1

Third Grade
PS1-3-1

Fourth Grade
PS1-4-1, PS1-4-3, PS1-4-4, ES3-4-2, ESS3-4-1

Fifth Grade
ETS1-A, ETS1-B

Middle School (6th-8th)
PS2-MS-1, PS2-MS-2

Engineering & Technology Standards (ETS1)
K-5, MS