

Water Works

Water Works' hydraulic learning stations demonstrate the roles played by water as a force of nature and source of energy. Make it rain, observe flood plains, control a river's flow and create and sail boats. Use the power of water to set machines in motion and use pipes to move water from one area to another.

Water Works is an area where visitors can learn about the water cycle, why objects float and how water is used to do work.

Every substance has a particular **density**, or how much mass is present in a certain volume. The density of water can be rounded to one thousand Kg/m^3 . Any substance with a **larger density than water will sink**. A substance that has a **lower density than water will float**. For example, ice has a lower density than water, so it floats when placed in water.

Take the case of a raft in water. Its weight pulls it down into the water. However, the water pushes back, supporting the raft with a force called **upthrust**, or the **Buoyant Force**. The amount of upthrust depends on how much water is pushed aside when the raft enters the water. The upthrust increases as more of the raft settles in the water. The raft will **float when the upthrust equals the weight of the raft**.

Objects can also float in a gas, such as a balloon filled with Helium. If the weight of the balloon and the air it contains is less than the upthrust, it will rise.

There is a lock and dam downstream and a dam upstream. Dams are usually not placed in rivers to control flooding. Often they are there to keep enough water for boats to pass. Before the dams were placed on the Ohio River, large boats could not travel up and down river except during periods of heavy rain.

Water is often used to help people accomplish work. Think of the Hoover Dam, which uses the water to generate electricity. Water is often used as transportation. Barges move up and down the Ohio River daily, and are able to move much more material per load than trains and trucks.

ACTIVITIES

INDIVIDUAL:

- Flood or save the town
- Bridge Building
- Boat Building and Testing
- Operate a dam and lock system
- Build systems to transport water

TEAMWORK:

- Work systems to move water to reach various goals.

TOWN

FLOOD CONTROL: In this section of the exhibit, you can flood or save the town.

- Place a dam across the stream to raise the water level
 - Slide the white plastic board into position.
- Open the dam to let water out and save the town.

DRAINAGE:

- Observe the water falls and point out how the water runs from the land into the stream.
 - More water will flow from the land to the stream if there is inadequate vegetation to soak up the water.
- "How can we save the town?"
- "How can we flood the town?"

CONSTRUCTION

BRIDGE BUILDING:

- Complete a half finished bridge
- When you see the bridge completed, please dismantle it for the next visitor.

BOAT BUILDING: (What floats)

- Design and build a boat using different shapes
- Experiment with different designs
- Sail your boat downstream. A good place to start is above the dam near the town.
- If the design is not successful, ask why and create a new design.
- Keep designing and testing until you build a successful boat.

LOCK AND DAM

TRANSPORTATION ON WATER: (How boats travel up and down river)

- When traveling downstream on a boat, the small dam can be opened so the water level downstream rises.
- When the water levels are equal inside the lock, close the small dam and open the larger dam.
- The water level drops to the level downstream, and the boat can continue to sail on.
- "How can the boat go downstream without going over the waterfall?"
- "How can the boat go upstream since it cannot sail up the waterfall?"

WATER MECHANICS

ROPES, PULLEYS, FUNNEL AND TURBINE – RING A BELL: (Using water to do work)

- On one side of the water table fill the bucket with water.
- Then a system of ropes and pulleys is used to raise the bucket. It is the responsibility of someone on the other side of the water table to dump the water using the rope. It may take a few tries to get the timing down.

PUMP

- Find the handle with the large black knob.
- Move the handle forward and back.
- When successful, the water will travel up through the tube and spin a small turbine, ringing a bell.

CONVEYOR BELT AND GEARS- SPIN A PINWHEEL: (Using water to do work)

- A person on one side of the water table turns a wheel to transport water up a conveyor belt.
- It is the responsibility of a visitor on the other side of the water table to decide if the water will fill a bucket, turn a turbine or fall back into the table. This task is accomplished by turning a wheel.
- Notice how the gears work on the silver catch basin.
- What will happen when the bucket gets full?
- What will happen when the water hits the pinwheel?

WATER TURBINE – ELECTRICITY GENERATION: (Using water to do work)

- Find a handle connected to a water spout. When this handle is turned, water will spray from the spout and turn a turbine.
- This in turn will turn the balls connected to the top of the turbine. People often use water to turn a turbine and generate electricity.

LOWER POOL

PINWHEELS AND WATER MOVEMENT: (Using water to do work)

- Use various items to pick up water and pour into little pinwheel machines
- Build different structures to transport the water from one place to another.
 - Use plastic pipe that can be connected to valves on the water table.
 - Using the valves to shut off water flow in one tube will increase the water pressure in another tube.
- How can you spin the pinwheel?
- How can I make this water flow from this tube and spin the pinwheel?

SAFETY TIPS:

WALK - The floor is often wet in this exhibit; it is important to walk at all times.

MEETING SPOT - Since it is often difficult to stay directly with your group, provide a meeting spot for students and do visual checks periodically. Find a staff member to help you locate lost students!

USE OF APRONS

- There are several “splash zones” where children may get very wet.
- Aprons thrown on the floor can cause tripping hazards, so please hang your apron up!

FIRST AIDE - If you need first aid during your visit, please see a staff member. Staff can always be found at the entrance of the museum.

RULES OF THE EXHIBIT

NO RUNNING!

- Please **walk** while in WATER WORKS. The floors can get wet and it can get busy and kids will be kids, but there should be no running so that no one gets hurt. If you see someone running, ask if they could please walk. If you feel as though you need assistance, please call a staff person.

LEAVE THE EXHIBIT AS YOU FOUND IT

- When you see the bridge completed, please dismantle it for the next visitor.

STATE CONTENT STANDARDS (Ohio)

EARLY LEARNING AND DEVELOPMENT

- Social and Emotional Development
 - Peer Interactions and Relationships – Cooperative Play
 - Peer Interactions and Relationships – Socially Competent Behavior
- Physical Well Being and Motor Development
 - Small Muscle: Touch, Grasp, Reach and Manipulate
 - Sensory Motor
- Approaches Toward Learning
 - Initiative and Curiosity – Explore and Experiment
 - Initiative and Curiosity – Self Direction & Questioning
 - Planning, Action and Reflection
 - Persistence
 - Innovation and Invention
- Cognition and General Knowledge
 - Reasoning and Problem-Solving
 - Number Sense and Counting
 - Spatial Relationships
 - Inquiry
 - Cause and Effect
 - Explorations of the Natural World
 - Explorations of Energy
- Language and Literacy
 - Receptive Language and Comprehension
 - Expressive Language

LANGUAGE ARTS

See National Common Core

MATH

See National Common Core

SCIENCE

K-ESS-1 Weather changes are long-term and short-term.

K-ESS-2 The moon, sun and stars are visible at different times of the day or night.

K-LS-1 Living things are different from nonliving things.

K-PS-1 Objects and materials can be sorted and described by their properties.

1-ESS-2 The physical properties of water change.

1-PS-2 Objects can be moved in a variety of ways, such as straight, zigzag, circular and back and forth

2-ESS-2 Some kinds of individuals that once lived on Earth have completely disappeared, although they were something like others that are alive today.

2-PS-1 Forces change the motion of an object.

2-LS-1 Living things cause changes on Earth.

3-ESS-1 Earth's nonliving resources have specific properties.

3-ESS-2 Earth's resources can be used for energy.

4-ESS-2 The surface of Earth changes due to weathering.

SOCIAL STUDIES

NONE

NATIONAL CONTENT STANDARDS

LANGUAGE ARTS – Common Core

RL-K-1 With prompting and support, ask and answer questions about key details in a text

RL-K-4 Ask and answer questions about unknown words in a text.

RL-1-1 Ask and answer questions about key details in a text.

RL-2-1 Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text

RL-2-7 Use information gained from the illustrations and words in a print or digital text to demonstrate understanding of its characters, setting, or plot

RI-K-1 With prompting and support, ask and answer questions about key details in a text

RI-K-4 With prompting and support, ask and answer questions about unknown words in a text.

RI-1-1 Ask and answer questions about key details in a text.

RI-1-4 Ask and answer questions to help determine or clarify the meaning of words and phrases in a text.

RI-1-7 Use the illustrations and details in a text to describe its key ideas.

RI-2-1 Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.

SL-K-1 Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.

a. Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).

b. Continue a conversation through multiple exchanges

SL-K-2 Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood.

SL-K-3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood.

SL-1-1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.

a. Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion).

- b.** Build on others' talk in conversations by responding to the comments of others through multiple exchanges.
- c.** Ask questions to clear up any confusion about the topics and texts under discussion.

SL-1-2 Ask and answer questions about key details in a text read aloud or information presented orally or through other media.

SL-1-3 Ask and answer questions about what a speaker says in order to gather additional information or clarify something that is not understood.

SL-2-1 Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

- a.** Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).
- b.** Build on others' talk in conversations by linking their comments to the remarks of others.
- c.** Ask for clarification and further explanation as needed about the topics and texts under discussion.

SL-2-2 Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.

SL-2-3 Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.

SL-3-1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.

- b.** Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).
- c.** Ask questions to check understanding of information presented, stay on topic, and link their comments to the remarks of others.

SL-3-2 Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

SL-3-3 Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.

SL-4-1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

- b.** Follow agreed-upon rules for discussions and carry out assigned roles.

c. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.

SL-5-1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

b. Follow agreed-upon rules for discussions and carry out assigned roles.

c. Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.

SL-6-1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

b. Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.

SL-6-2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.

MATH – Common Core

K-MD-1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.

K-MD-2 Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference. For example, directly compare the heights of two children and describe one child as taller/shorter.

K-G-1 Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to.

K-G-2 Correctly name shapes regardless of their orientations or overall size.

K-G-3 Identify shapes as two-dimensional (lying in a plane, “flat”) or three dimensional (“solid”).

K-G-4 Analyze and compare two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts (e.g., number of sides and vertices/“corners”) and other attributes (e.g., having sides of equal length).

K-G-5 Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes.

K-G-6 Compose simple shapes to form larger shapes. For example, “Can you join these two triangles with full sides touching to make a rectangle?”

3-MD-2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.

SCIENCE – Next Generation

K-PS2-1 Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

K-PS2-2 Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

1-ESS1-2 Make observations at different times of year to relate the amount of daylight to the time of year.

2-ESS1-1 Use information from several sources to provide evidence that Earth events can occur quickly or slowly.

2-ESS2-1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

2-ESS2-2 Develop a model to represent the shapes and kinds of land and bodies of water in an area.

3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

3-PS2-3 Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

3-ESS3-1 Make a claim about the merit of a design solution that reduces the impacts of a weather related hazard.

4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

SOCIAL STUDIES – National Standards

NONE