Water Wits

aquatic safety, science, and stewardship
education program

GRADES 3-5

OREGON STATE MARINE BOARD

Dear Educators,

June 30th, 2015

With thousands of people enjoying activities on Oregon's waterways each year and rising demand for clean water resources, there is a need to educate people early about responsible waterway use. Humans and wildlife both need resilient waterways for health, safety, and survival. That's why we have developed this new K-12 educational curriculum, *Water Wits*!

This program aims to encourage awareness and responsible use of aquatic and marine resources. It goes beyond traditional boating and water safety education to include stewardship messages and scientific principles. It is designed to be interdisciplinary, academically rigorous, interactive, and student-led. We hope that by taking an integrated approach to thinking about water, this curriculum will spark a renewed interest in responsible waterway enjoyment for both educators and students.

Water Wits addresses 3 pillars of aquatic literacy:

Safety: what are the best practices for smart decision-making in, on, and around the water?

Stewardship: how can we reduce our impacts and manage water resources for people and wildlife?

Science: how do physics, engineering, ecology, and the social sciences explain and inform both of these?

The curriculum includes 12 complete lesson plans, divided into grade units (Kindergarten-2nd Grade, 3rd-5th Grade, 6th-8th Grade, and 9th-12th Grade). All lessons are aligned to state and national education standards, including Next Generation Science and Common Core, across multiple subjects. Each unit contains 3-4 lesson plans with suggestions for how to adapt the activity to best suit your students. Lesson plans include a list of aligned standards, background information, detailed instructions, and additional resources including printable worksheets and hand-outs. Each lesson is designed to be completed in one class period, but many offer rich opportunities for extension and suggestions for additional activities are also included.

The *Water Wits* program includes concepts from all subjects: Science, Math, Social Studies, Language Arts, and Physical Education. It also fosters 21st-century skills including collaboration, critical thinking, problem solving, global awareness, and civic and environmental literacy. We encourage you to work with other educators at your school or in the community to create a cross-cutting implementation plan. Doing so will provide you with exciting professional development opportunities and enable you to reach students with different learning styles and interests!

While much of the *Water Wits* curriculum is designed to be academic in nature, the interactive activities and low-cost materials make the lessons adaptable for almost any setting. Determine the age range of your audience and set up the hands-on portions of appropriate lessons at public events, workshops, classroom visits, or your camp site.

For more information and additional support, or if you are interested in adapting this curriculum for your own organization or agency, please contact MariAnn McKenzie, Boating Safety Education Coordinator at mariann.mckenzie@oregon.gov / 503-378-5158.

Thank you for choosing the *Water Wits* program. We hope that you and your students enjoy it!

Randy Henry, Boating Safety Program Manager

Sara Shaw Roberts, Curriculum Writer

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3rd – 5th grade

GRADES K-2 OR 3-5

Time: 30 mins-1 hr.

What Floats?

Aligned Standards

2014 ORSS (NGSS)

- 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- 5-PS1-3. Make observations and measurements to identify materials based on their properties

COMMON CORE: MATH

- K.G. Identify and describe shapes.
- K.G. Analyze, compare, create, and compose shapes.
- 1/2.G. Reason with shapes and their attributes.
- 1/2.MD. Represent and interpret data.
- 3.OA. Represent and solve problems involving multiplication and division
- 3.OA. Multiply and divide within 100
- 5.OA. Write and interpret numerical expressions

COMMON CORE: READING

- Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade-appropriate reading and content.

HEALTH BENCHMARKS , K-5

- Identify ways to reduce risk of injuries in or around water.
- Set a goal for safety in and around water.
- Identify safe behaviors in and around water.

Activity at a glance

Students experiment with buoyancy by placing common objects in water and assessing why some objects float while others sink. This is then related to the importance of wearing life jackets for personal buoyancy.

Materials

- Tub or container (clear is best to allow better observations)
- Water
- Orange(s)
- Common everyday objects such as: bath toys, buttons, beans, coins, sponges, etc. (NOTE: you may request that students bring in items from home to test)
- Copies of Student Sheets (pg. 3-4)
- Scale and graduated beakers (optional—see pg. 4)

This lesson can be used with both K-2nd and 3rd-5th grades. For younger students, simply make observations together. Older students may record these observations on Student Sheet 1. More advanced students may calculate density on Student Sheet 2.

Objectives

Students will:

- Investigate how the physical properties of objects affect the objects' buoyancy
- Explore the concept of density and how this determines buoyancy
- Understand the necessity of wearing personal floatation devices (i.e. life jackets) when in, on, or around water

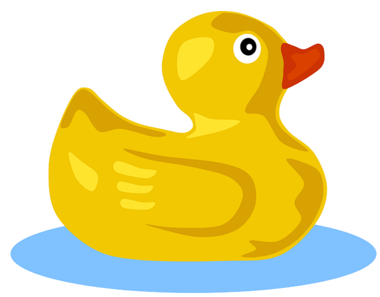

Image credit: Creative Commons

Background Information

Some objects float while others sink. This is not always due to differences in weight, but also due to the object's **density**, which is calculated by dividing the object's **mass** by its **volume**. An object's shape and size also influence whether it can float or not.

The ability of an object to float on a fluid is called **buoyancy.** Technically, buoyance is the upward force exerted by the fluid that opposes the object's weight. An object's buoyancy can sometimes be difficult to predict. Sometimes, changing the property of an object will change its buoyancy.

Why do some objects float while others sink?

A striking example of this phenomenon can be demonstrated with an orange. Drop an orange in the water and it will float, but remove the peel from that same orange and it will sink. Why is this? It would seem as if removing the peel would decrease the orange's mass and therefore make it even more buoyant. However, the physical properties of the peel actually make it more buoyant than the orange itself. The rind is very **porous**, meaning it is filled with tiny pockets that trap air. This makes the orange less dense overall than the water, causing it to float.

This same principle applies to all of us when swimming or boating in our local waterways. Without life jackets, it is much more difficult for people to float. The foam in the life jacket is porous and traps air, just like an orange peel, buoying us on the water. These same properties make life jackets life-saving in cold water, because it helps our bodies to stay warmer longer.

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Procedures

1. Introduce this activity by asking students to name some things that float in the water.
2. Looking at the objects you have gathered for the activity, ask students if they think any of these will float? If so, why (or why not)?
3. Conduct the experiment! One at a time, place each object in the tub of water so the entire class can see. Get students to participate by allowing them to volunteer to drop objects in the water. *ALTERNATIVELY, if you have enough containers and objects, break students into smaller groups and have them work together.* Allow each object to sit in the water a few moments, then ask students what they are observing. Does the object sink, float, bob up and down, or something else?
4. For each object, engage students in a brief discussion about WHY the object reacts the way it does. Does it sink because it is heavy? Does it float because it is small? What is the object made of? Note factors such as size, shape, texture, etc. *Older students may record their observations on Student Sheet 1.*
5. Tell students that the last special object they are going to test is an orange. Do they think it will sink or float? Drop it in the water and watch it float. Then, remove the peel (or have a second orange with the rind already removed to save time). Drop it in the water again and watch it sink. (*NOTE: this may take a couple of minutes. Older students may do this themselves in small groups.*) Why do you think this happened?

The average density of an orange peel is about .41 g/cm^3.

6. After brainstorming answers with your students, reveal the real reason why oranges float only with the peel on: the rind has pockets of space in it which trap air. The air makes the orange float. Without the air-filled rind, the orange is too heavy (dense) and sinks. Tell students that the air pockets inside the peel are like tiny soap bubbles – and what is inside a bubble that makes it float in a bathtub? AIR!
7. *More advanced students may calculate each object's density and compare this to water density to show that an object's density determines buoyancy—see Student Sheet 2.*
8. Wrap up: Ask students if they have been swimming lately. Without wearing life jackets or other floatation, did they feel like they could float in the water? Chances are students will say no, they had to keep swimming to stay afloat. This is because they, like a peeled orange, are heavier than the water. But what can they wear to make themselves float? Hint: It is often also orange and full of air!

Children under 13 years of age *must* wear a life jacket when on board a moving vessel and *should* wear one when in, on, or around water!

The answer is: LIFE JACKETS! Like an orange peel, a life jacket can wrap you in a floating bubble that can save your life. In rough waters, or if you are too tired to swim yourself, a life jacket will keep you from sinking. Other floatation devices, such as swim floats, pool noodles, and boogie boards are also great things to have when in, on, or around the water.

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Buoyancy Experiment Student Sheet 1

OBJECT	OBSERVATIONS (size, shape, material, etc.)	MY PREDICTION	RESULTS
EXAMPLE: *Rubber ducky*	*Small, round, made of rubber*	*It will float because it feels light*	*It floats!*
1.			
2.			
3.			
4.			
5.			
6.			

The orange floats when the peel is on because: ______________________________

____

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Buoyancy Experiment Student Sheet 2

DENSITY is how much "stuff" is packed into the space within an object. The more tightly packed together the "stuff", or **molecules** are, the denser the object. Think of a dice versus a marshmallow: both are about the same size, but the dice is more dense because the marshmallow is mostly air inside. We can find out an object's density if we know the object's **mass** and **volume** by solving this equation:

mass / volume = density

Density is the reason an object floats or sinks. If an object is more dense than water, it will sink. If it less dense than water, it will float.

Now that you've observed your objects' buoyancy, you are going to calculate each object's density. Weigh each object on a scale and record its mass in **grams** below. Then determine its volume by placing it in a graduated beaker with water. Record how many **millimeters** the water in the cylinder rose when the object was placed inside: that is the volume. Finally, divide each object's mass by its volume to calculate its density.

OBJECT	**MASS (g)**	**VOLUME (ml)**	**DENSITY (g/cm^3)**
EXAMPLE: *Rubber ducky*	*65*	*150*	*65/150 = .43*
1.			
2.			
3.			
4.			
5.			
6.			

The density of tap water at room temperature is about 1 g/cm^3. Did the objects which have a density less than 1 g/cm^3 float? Did objects heavier than this sink?

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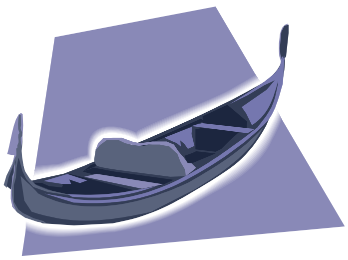
Discussion Questions

- What did the floating objects have in common?
- What did the sinking objects have in common?
- Did any of the results surprise you? Why?
- Are people more or less dense than water? Can everyone float easily? What can we wear to make sure we are *always* buoyant in the water?
- Why can huge, heavy boats float? (Think about the shape of the bottom of the boat…)



A boat's bottom, or hull, is usually curved. This helps the boat to stay stable and upright even in waves. The shape also creates a pocket of air in the bottom of the boat, which keeps it floating even though it is heavy.

Additional Resources

Importance of life jackets for kids: http://www.uscgboating.org/safety/life_jacket_wear_wearing_your_life_jacket.aspx

NOVA Online Buoyancy Basics: http://www.pbs.org/wgbh/nova/lasalle/buoybasics.html

Book: Things that float and things that don't by David A. Adler, illustrated by Anna Raff.

Calculating density for kids video: https://www.youtube.com/watch?v=SimFy9wOMXY

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GRADES 3-5

Time: 45 mins-1 hr.

Seesaw Ship

Aligned Standards

2014 SCIENCE (NGSS)

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

COMMON CORE: MATH

- 3.OA. Represent and solve problems involving multiplication and division
- 3.OA. Multiply and divide within 100
- 3.MD. Solve problems involving measurement and estimation of intervals
- 4.OA. Generate and analyze patterns
- 5.OA. Analyze patterns and relationships
- 5.OA. Write and interpret numerical expressions

COMMON CORE: LANGUAGE

- 4.6. Acquire and use accurately grade-appropriate general academic and domain-specific words

HEALTH BENCHMARKS

- Identify safe behaviors in and around water.
- Demonstrate communication skills encouraging water safety behavior.
- Encourage family and friends to practice water safety behavior.

Activity at a glance

Students use classroom materials to represent a boat, moving waves, gear, and passengers, and perform a series of experiments to understand the physics of balance and center of gravity.

Materials

For each group of 4-6 students:

- 1 sturdy (not flexible) ruler: plastic or wooden
- 1 Pencil with flat sides (not rounded)
- 10-20 Pennies
- Seesaw or materials to make a simple seesaw (optional—see Extension Activities)

Objectives

Students will:

- Investigate the effects of balanced and unbalanced forces
- Understand the physics of balance and center of gravity
- Use simple math to calculate and predict the amount of force necessary to achieve balance
- Apply knowledge to describe safe boating behavior

Image credit: Creative Commons

Physics determine how and why boats stay balanced—or not.

Background Information

As land animals, we are not used to having to constantly adjust ourselves to stand upright, but this is exactly what you must do when onboard a boat. If the people and gear on board are not arranged evenly, the boat will tilt towards one direction, or **list**, in the water. This makes it much more likely to **capsize** (overturn) in large waves or windy conditions. One person suddenly switching sides on a boat may be enough to cause it to flip, which could quickly become a dangerous situation in cold or rough waters.

Balanced and **unbalanced forces** impact the motion of an object such as a boat in different ways. When the forces (or mass) acting on all parts of the boat are equal, it is said to be balanced, or at **equilibrium.** The amount of force from gravity pulling downward is equal to the force of the boat's deck pushing all the gear upward. The boat will feel stable even when moving over waves. However, if the forces acting upon the boat are unbalanced—meaning the boat deck is not pushing upward equally across its entire surface—it will list. The friction caused by shifting gear increases this unbalanced effect. Given enough weight of gear and/or people and enough imbalance on one side of the boat, it can capsize completely.

In such situations, there is very little or no time to put on a life jacket before going into the water. Once in the water, with the shock of the cold and waves in your face, it is nearly impossible to fasten the buckles of a life jacket. This is why it is so important to always prepare by wearing a **PFD** at all times. **Remember—no accidents are planned!**

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Procedures

1. Ask students if they have ever been on a boat. What did it feel like? Was it stable? Did they feel like they were going to fall in? If so, there's a reason for that—it's called *forces.* Forces can be something like your friend pushing you, but there are also invisible forces acting on your body every day. Can students name one of these? How about GRAVITY! Gravity pulls you down towards the Earth. Without it, we would all float away!

2. Tell students that they are going to do an experiment to see if they can balance the force of gravity with the force of objects arranged on a ruler. The ruler will represent a boat, and it will rest on a pencil that represents a moving ocean. Their first task is to set their ruler on their pencil so that it is centered and balanced. Split students into their small groups and wait until they have done this before moving on.

3. Now they must put their "gear" on their "boat" so that it doesn't tip to one side or the other. Allow students to experiment with the best process for this. Does it work better to place one penny at a time on each side of the ruler, or to place them simultaneously? Where on the ruler do the objects best balance? Encourage group discussion and cooperative problem-solving. The goal is to have the most pennies on their ruler while still keeping it balanced—in other words, neither side of the ruler should touch the table. Friendly competition between the groups will make it more fun!

4. Next, students will explore the physics of balance with some simple calculations. Remove all pennies and make sure the ruler is balanced on the pencil as before. First instruct students to place 4 pennies on one side of the ruler. Then place 4 on the other side so that the ruler balances. Are the pennies at about the same location on both sides of the ruler? To make it balance, they should be.

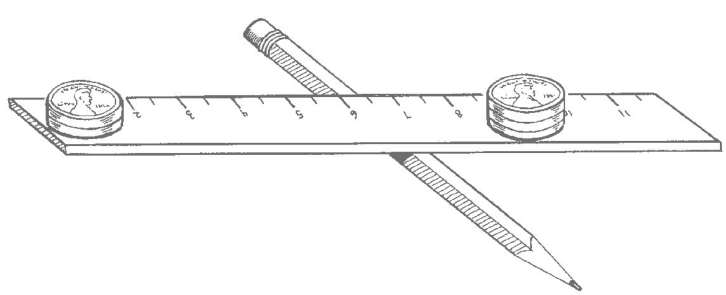
5. We are going to see how we can make our "boat" balanced even when there are unequal numbers of pennies on each side of the ruler. Place 6 pennies exactly 2 inches from the pencil on either side. Tell students they must find a way to make the boat balanced with only 3 pennies on the other side. After some trial and error, they should discover that this is possible!

6. When each group is successful, tell them to measure the distance from the pencil to the pile of 3 pennies. It should be about 4 inches. *Why is this?* The farther away from the **fulcrum**, or balance point (in this case the pencil), the more their gravity works to balance the ruler. We can see this using simple math:

   6 (pennies) x 2 (inches) = 12

   3 (pennies) x 4 (inches) = 12

7. Knowing this, what other combinations of pennies and distances can students come up with to make their ruler balanced? Record successful calculations on the board.



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Extension Activities

1. Create a large-scale seesaw at school! Find an open area and create a simple seesaw using a sturdy plank of wood and a round log as the fulcrum. Have students experiment with how many of them should sit on each side to create balance. Try moving the fulcrum away from the center and see how that changes where and how many students should sit on each side to create balance.
   NOTE: Monitor this activity carefully and watch for safety issues!
2. Ask students to stand squarely on their two feet. It's pretty easy to balance when standing like this. Then have students stand on one foot and see how long they can balance. Finally, have students stand on their tippy-toes on only one foot—this makes it very hard to balance! Why is this? It's because the smaller the point of support, the more difficult it is to keep their center of gravity steady. Ask students to report ways that make it easier to balance, such as raising their arms at their sides. Just like the ruler and the seesaw, their arms act as levers which generate balanced forces, helping to prevent tipping over.

Additional Resources

The Physics Classroom—Balanced and Unbalanced Forces: http://www.physicsclassroom.com/class/newtlaws/Lesson-1/Balanced-and-Unbalanced-Forces

Center of Mass, Balance, Torque, and Acrobats: http://www.pbs.org/opb/circus/classroom/circus-physics/center-mass/

Online Physics Balance Game: http://www.physicsgames.net/game/Balance.html

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GRADES 3-5
Time: 15 mins for prep, 45 mins. for activity

Chilly Fingers

Aligned Standards

2014 ORSS (NGSS)

- 3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.
- Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

HEALTH BENCHMARKS

- Describe the correct use of safety equipment during physical activity
- Identify safe behaviors in and around water.
- Encourage family and friends to practice water safety behavior.

COMMON CORE: ELA

- Describe characters in a story and explain how their actions contribute to the sequence of events.
- Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade-appropriate reading and content.

Activity at a glance

Students experience the impacts of cold water immersion, discuss actions they can take to lessen these impacts, and learn about how marine mammals stay warm and buoyant in the ocean.

Objectives

Students will:

- Experience the impacts of cold water immersion in a safe environment
- Investigate what to do if they fall into cold water, and steps to take to prevent cold water injuries
- Relate the human invention of life jackets to marine mammal adaptations (i.e. blubber)

Materials

- Bucket of ice water
- Ziploc bags
- Crisco or other vegetable shortening
- Duct or other strong tape
- Life jacket for demonstration (if available)
- Images of marine mammals (optional)

Image credit: Creative Commons

Marine mammals such as this Minke whale use blubber to survive cold waters and stay afloat.

Background Information

Have you ever jumped into water that was so cold, you actually gasped? This **involuntary reaction** is only the first your body undergoes when immersed in very cold water. Drowning often begins in these very first moments, when the victim gasps water into his or her lungs and goes under. **Hyperventilation** can also occur, causing the victim to become unconscious and sink. After only a few minutes, the body begins to conserve its heat for the vital organs so the victim finds it very difficult to move his or her limbs to swim. **Hypothermia** is actually the final step in **cold water immersion**—many times, the victim is not in the water long enough to undergo hypothermia because they have already drowned or been rescued. "Cold water" does not mean only icy waters—especially in children, these reactions can occur in water 77 ° or less.

Drowning, especially due to cold water, is a serious concern for adults and children alike. It is the second-leading cause of death in children age 15 and under. Most of these deaths could have been prevented with adult supervision—because drowning most often occurs swiftly and silently—and the use of life jackets. *In 90% of drownings, the victims were not wearing life jackets*.

Not only do life jackets keep your head above water and prevent immediate water inhalation, they also insulate your body. It takes much longer to reach the hypothermia stage. They also make the victim much more visible. All of these factors add up to a simple fact: children and adults wearing life jackets are much more likely to be rescued and survive.

Marine mammals which inhabit cold waters have adapted over millennia to have their own "life jackets": blubber. **Blubber** is a thick layer of fat beneath the animal's skin, which both insulates and protects. In large whales, blubber can be up to 12 inches thick! Also like life jackets, blubber provides buoyancy, making it easier for marine mammals to surface for air.

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Procedures

1. Make one or more Blubber Gloves (see box).
2. Fill one or more tubs with ice water.
3. Introduce the activity: Ask students what it feels like when they jump into cold water. What happens to their body? Encourage physiological descriptions such as shivering, gasping, skin becoming numb, etc. For extra fun students can even act out their reactions.
4. Tell students they are going to test their cold water survival skills using only their hands. Each student will take turns sticking their hand into the ice bucket and seeing how long they can stand it before pulling their hand out.

NOTE: It is very important NOT to introduce this activity as a challenge or competition. Otherwise, students may keep hands in the water longer than is safe and become injured. **If a student has pre-existing health conditions, such as circulatory or heart problems, they should not participate.**

5. Discuss students' reactions to the cold water. How did it feel? What would it feel like if their entire body was in that ice bucket? Would they be able to survive for long?
6. Next, remind students that many animals actually live in water that cold their whole lives. Ask students for some examples (whales, seals, dolphins…) - these are *marine mammals* and though they breath air like us (we are also mammals), they have special *adaptations* which allow them to live in water humans could never survive.
7. Ask if students can name some of these adaptations. Lead them to the answer "blubber" and briefly describe using the Background Information.
8. Tell students they are now going to experience the same icy cold water the way a whale would, with blubber. Have each student take a turn wearing the Blubber Glove and putting it into the water. They should barely be able to feel the cold this time (if they can, there might be a leak in the glove!)

MAKE A "BLUBBER GLOVE"!

- Fill about half of a gallon size Ziploc bag with Crisco or other vegetable shortening. Do not seal the bag.
- Place another open, gallon size Ziploc bag inside the first bag. Press down until it is surrounded by the Crisco but don't let any Crisco get into the inside bag. Do not seal this bag either.
- Fold the tops of both open bags down together on both sides, two or three times. Use the duct tape to secure the folded edges of the bags.
- The "blubber glove" should now be sealed with the Crisco trapped between the two bags.

9. Gather again as a group and ask how the water felt while wearing the Blubber Glove. Compare and contrast this experience with how it felt on their bare hands.
10. Of course, humans do not have blubber. But what is something that we can wear that acts like blubber, helping us float and protecting us from the cold? If nobody lands on "life jackets", lead students to this conclusion.
11. Wrap up the activity with a discussion of WHY life jackets are so important, based on the evidence they have gathered during this activity. Remind them how numb and stuff their hands were after being in the ice water—would they be able to put on and buckle up a life jacket once already in the cold water? This is why it is especially important to wear a life jacket at all times when on a boat or playing near water, just in case!

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Extension Activities

- Ask students to bring in any life jackets they may have from home, and have them practice putting these on. Point out that some of these may not fit properly: they should be snug and not too big, and when pulled by the shoulder straps, shouldn't be able to be pulled past the ear lobes.
- If you have access to a large area outside, hold a Life Jacket Relay Race! Students form two teams and must *properly* put on a life jacket (fully buckled up and snug) before running to the other side.
- Print out copies of *Boating Safety 101* and have students sign the pledge. Encourage students to take these home and have their families do the same.
- Have students investigate other marine mammals which use blubber for protection and warmth.

Image credit: Creative Commons

In the 1800s, people used natural materials for buoyancy, such as this jacket made from cork!

Additional Resources

Facts about cold water immersion: www.oregon.gov/OSMB/pages/safety/coldwaterimmersion.aspx

Life jacket loaner program information: www.boatoregon.com/OSMB/BoatEd/index.shtml

Marine mammal adaptations: http://www.scientificamerican.com/article/marine-mammals-cold-avoid-freezing-death/

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GRADES 3-5

Time: 1-2 hrs.

Plenty of Fish in the Sea?

Aligned Standards

2014 SCIENCE (NGSS)

- 3-LS4-4. Make a claim about the merit of a solution to a problem caused when environmental changes and the types of plants and animals that live there may change.
- 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and the environment.

OREGON SOCIAL SCIENCE

- Identify conflicts involving use of land, natural resources, economy, and competition for scarce resources.
- Identify and analyze Oregon's natural resources and describe how people in Oregon and other parts of the world use them.

COMMON CORE: MATH

- 3.OA. Represent and solve problems involving multiplication and division
- 3.OA. Multiply and divide within 100
- 3.NF. Develop understanding of fractions as numbers
- 4.OA. Generate and analyze patterns
- 5.OA. Analyze patterns and relationships
- 5.OA. Write and interpret numerical expressions
- 3/4/5MD. Represent and interpret data.

Activity at a glance

Students learn about fishing catch limits through an activity demonstrating the effects of overfishing, and calculate their own fishing regulations to maintain sustainable populations.

Objectives

Students will:

- Learn about local fish species and catch limits
- Calculate new regulations to best conserve the fish resources at their "lake"
- Discuss how people might react to these catch limits and ways students can explain why they are important
- Be reminded of important boating rules that must be followed when fishing

Materials

- Short wooden dowels
- String or twine
- Duct tape
- Magnetic tape
- Paperclips
- Fish coloring pages (pg. 4)
- Calculators
- Copies of student sheets
- Stopwatch/timer

Image credit: Creative Commons

Background Information

For everyone to be able to fish long into the future, we must be aware of and follow regulations.

Oregon's waterways offer a bounty of fish which people may harvest commercially or recreationally. Salmon, trout, catfish and bass inhabit rivers and lakes throughout the state. Off the coast, marine species such as rockfish, tuna, mackerel and halibut range from shallow to deeper waters. These provide people with money and food.

To maintain healthy populations of these species, scientists set fish **catch limits.** These restrictions are based on research studies determining how many fish of any particular species can be caught while still maintaining a **sustainable** population. This means a group of individuals that are abundant and healthy enough to ensure the existence of that species into the future. Both marine and freshwater species have limits on how many can be taken home by **anglers** (people who fish). Beyond that number, fish must be released. If too many fish are removed from the ecosystem and there are not enough left, it is called **overfishing.**

All anglers over the age of 14 must obtain a fishing license from the Oregon Department of Fish and Wildlife and follow catch limits, or they can be fined.

In Oregon, two thirds of boaters use their boats primarily for fishing. This means that not only must they obey catch restrictions, they must also help protect fish and other water users by using waterways responsibly, by never throwing trash into the water, and watching for oil leaks from their boats. They must also remember that although they are fishing, they still need to be aware of boating safety and regulations.

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Procedures

DAY ONE

1. Introduce the activity briefly and show students the “local fish species” sheet. Have students color and cut out their fish. Attach a paper clip to each fish. (see pg. 3)
2. Students make their fishing rods with a small piece of magnetic tape on the end as “bait”. They should design a rod that they think will catch the most fish (see pg. 3).
3. While students are working, the teacher may begin setting up the lake or ponds (see Note box) in the classroom and “stocking” them with the prepared paper fish.

DAY TWO

1. Engage students by asking whether any of them have gone fishing before. Did they catch anything? If so, did they release it or take it home and eat it? Were there plenty of fish? Did they follow any limits on how many they caught?
2. Explain that **one minute will represent one day**. Allow kids to catch whatever they want, however much they want for **up to 7 minutes (one “week”**). Time how long it takes for all the fish to be caught.

> **NOTE: If the class is small, all students may fish out of one large “lake” or “sea”. For larger classes, divide students into groups of 4-6 and have each group fish out of their own smaller “pond”.**

3. Calculate the rate of fish caught per minute (i.e. if 30 fish were caught in 5 minutes (“days”), then 6 fish per minute (“day”) were caught). Write this simple equation on the board.

$$\frac{\text{30 fish total}}{\text{5 days}} = \frac{\text{6 fish}}{\text{1 day}}$$

TEACHER’S NOTE

This works best as a two-day activity: students can color their fish and make their fishing rods on Day 1, and complete the activity on Day 2. However if you are limited to one class period, you may wish to make the fishing rods and fish yourself ahead of time.

4. What happened when everyone was allowed to fish however much they wanted? Did they catch every fish? The number of fish decreased. Introduce the concept of catch limits and why scientists use these to help maintain a good fish population.
5. Have students estimate a better rate for capture (i.e., if 6 fish per minute (“day”) were caught without regulations, then maybe we should only allow 4 fish per “day”). Write this new equation on the board and calculate how many fish that would be per week.

$$\frac{\text{4 fish}}{\text{1 day}} \times \text{7 days} = \frac{\text{28 fish}}{\text{week}}$$

6. Try the exercise again, enforcing the students’ agreed-upon catch limit. Keep track of fish caught each minute on the board, and when the limit is reached for that minute, yell STOP! Until the next “day” (minute) begins, students may keep fishing but must release anything they catch. *It may be useful for students to call out “Fish on!” when they catch a fish to make it easier for you to keep track.*
7. Evaluate the success of their catch limit. Were there enough fish left this time for the population could continue? If it was unsuccessful, come up with a new number and try the exercise again (if time allows).
8. Discuss the experience. How might catch limits impact anglers? Would they be happy about not being able to take every fish home? How might students convince an angler to follow the catch limits? Help students cite the ecological and economic reasons for maintaining a sustainable population.

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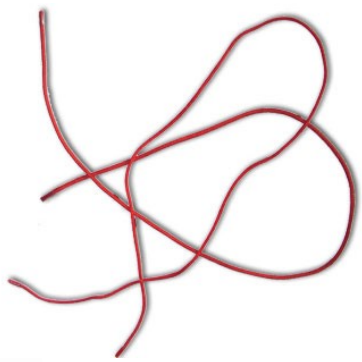
Assembling the fish and rods

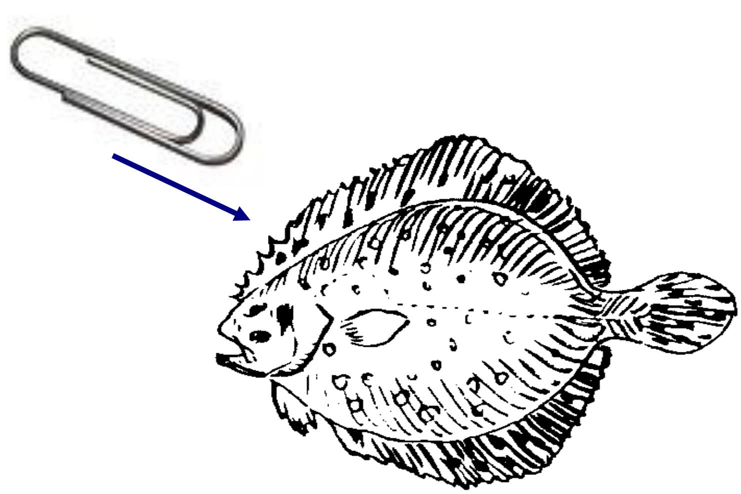


1. Get a short wooden dowel about 10-12 inches long. Alternatively, collect sticks outside to use as fishing rods.

2. Cut a piece of string about 20-24 inches long (long enough for the end to reach the floor when you're holding the rod at waist height). Tie it to the top of your fishing rod and use duct tape to secure it.

3. Cut two squares of magnetic tape, both the same size, about 1 square inch. Peel the backing off the sticky sides. Sandwich the end of the string between the sticky sides of the squares of magnetic tape (with both sticky sides facing each other). Press tightly together until it is secure.

To make the fish, just slide a paperclip onto each fish. If it seems the paperclip may slide off you can secure it with a piece of Scotch tape.



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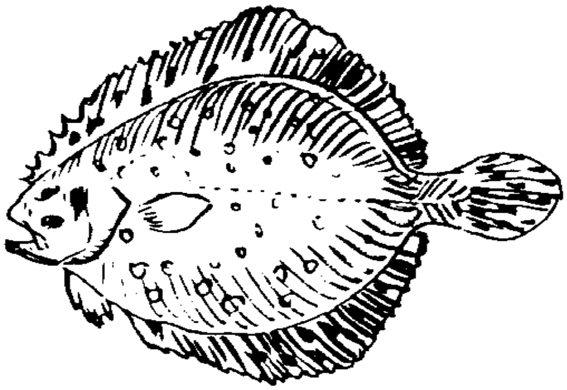
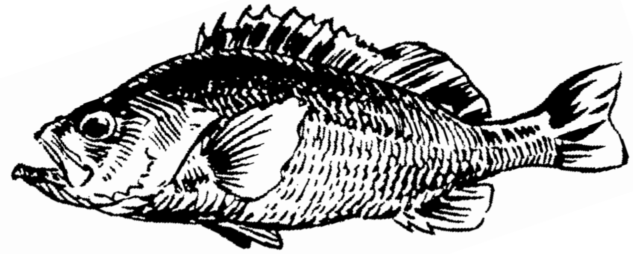
Oregon Fish Species

Color and cut out each fish.



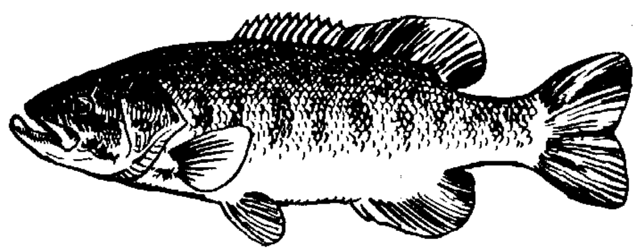
Halibut



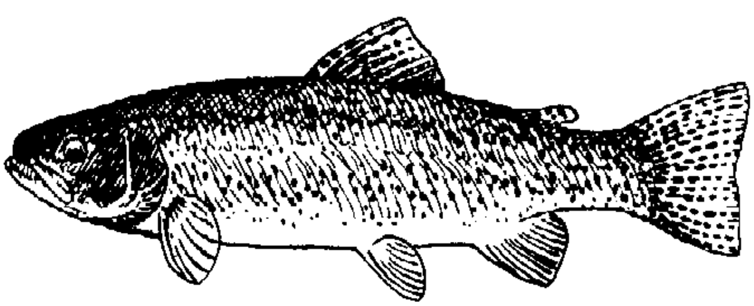
Rockfish

Mackerel

Salmon



Bass



Trout

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Extension activities

Boating and fishing: Remember, even if you only use a boat to go fishing, you are still a boater! Remind students of the safe practices and rules for boating which must be followed at all times while fishing, including wearing life jackets and knowing what to do if a person falls overboard (**reach** toward them with a pole or branch, **throw** something to them that floats, or **row** to them without using the motor. Only strong swimmers should go after the victim and only as a last resort!). It is especially easy to fall overboard when reaching to net a fish out of the water, so remember to always keep the boat balanced with the same amount of gear and people on all sides.

Habitat adaptations: Study the body shapes and adaptations of each fish species. Note that they are all different, and ask students why this may be? Fish, like all organisms, are adapted to the habitat where they live. Some fish are flat and camouflaged to match the sand which they sit on. Others are sleek, silvery and striped to blend in with the open ocean, where they swim quickly to catch prey. Some are brownish or greenish to match the rocks they hide in. Have students draw a picture of one or more marine or aquatic habitats, and paste the cut-out fish in their correct habitat on the drawing.

Additional Resources

Oregon fishing regulations and catch limits: http://www.dfw.state.or.us/resources/fishing/

The importance of fishing laws: http://takemefishing.org/fishing/fishopedia/fishing-and-conservation/the-importance-of-fishing-laws/

Science of annual catch limits: http://www.fpir.noaa.gov/SFD/SFD_regs_acls.html

Oregon common fish species: http://www.dfw.state.or.us/fish/species/

Fish adaptations and habitats: http://earthguide.ucsd.edu/fishes/environment/environment.html

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PO Box 14145
Salem, OR 97309

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For more information please contact MariAnn McKenzie, Boating Safety Education Coordinator:

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Boating Safety 101

- Make sure all gear and people are balanced
- Don't make sudden movements that could tip the boat over
- Stay seated at all times when boat is in motion
- If your boat does capsize, STAY WITH IT! Most boats will float even when upside-down. And a boat is much easier to spot by rescuers than a person!
- For safety, everyone on board should wear a life jacket at all times — adults AND kids. Children 12 & under must wear one when the boat is in motion— it's the law!

DID YOU KNOW?
Life jackets are available to borrow at many Oregon Waterways! For a list of sites, visit:
www.oregon.gov/osmb

Draw a picture of your family having a fun day on the water here!

I PLEDGE TO USE THESE SAFE PRACTICES WHEN ON A BOAT.

SIGNED: ____________ ____________ ____________ ____________

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Glossary of key terms and vocabulary

1-10-1 Principle—in cold water, you have *one minute* to get your breathing until control and calm yourself, *ten minutes* of meaningful movement, and *one hour* before you lose consciousness due to hypothermia.

Acceleration— in physics, is the rate of change of velocity of an object.

Action and Reaction—in every interaction, there is a pair of forces acting on interacting objects. Each reaction is in response to the initial action.

Aeolipile—also known as a "Hero's Engine", it is a simple bladeless steam turbine which spins when the central water container is heated. Torque is produced by steam jets exiting the turbine, much like a rocket engine.

Anglers—Men, women, or children who fish.

Aquatic—of or relating to water.

Balanced and unbalanced forces—If two individual forces are of equal magnitude and opposite direction, then the forces are said to be balanced. An object is said to be acted upon by an unbalanced force only when there is an individual force that is not being balanced by a force of equal magnitude and in the opposite direction.

Ballast—heavy material, such as gravel, iron, or water, placed low in a vessel to improve its stability.

Biofouling—the gradual accumulation of waterborne organisms on the surfaces of structures in water that contributes to corrosion of the structures and to a decrease in the efficiency of moving parts.

Blubber—The thick layer of fat between the skin and the muscle layers of whales and other marine mammals. It insulates the animal from heat loss and serves as a food reserve.

Boat—all watercraft used or capable of being used as a means of transportation on the water, including a seaplane on the water (not in flight) but NOT including boathouses, floating homes, air mattresses, beach and water toys, or single inner tubes.

Booms—a temporary floating barrier used to contain an oil spill and prevent it from reaching the shoreline. Booms help to concentrate oil in thicker surface layers so that skimmers, vacuums, or other collection methods can be used more effectively.

Buoyancy—the ability or tendency to float in water or air or some other fluid.

Capsize—to overturn in the water.

Catch limits—also known as bag limits; laws imposed on fishermen restricting the number of animals within a specific species or group of species they may kill and keep. Size limits and fishing seasons sometimes accompany catch limits.

Chemical dispersants— a common tool used after oil spills to break up oil slicks on the water surface into smaller particles and increase the oil's rate of degradation by wind or wave action.

Cold water immersion—When one's body completely enters cold water. The definition of cold water is

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variable. For practical purposes, significant risk of hypothermia usually begins in water colder than 77° F.

Density—the degree of compactness of a substance.

Deposition—the geological process in which sediments, soil and rocks are added to a landform or land mass. Wind, ice, and water, as well as sediment flowing via gravity, transport previously eroded sediment, which, at the loss of enough kinetic energy in the fluid, is deposited, building up layers of sediment.

Drought—a prolonged period of abnormally low rainfall; a shortage of water resulting from this.

Equilibrium—a state in which opposing forces or influences are balanced.

Erosion—A type of weathering in which surface soil and rock are worn away through the action of glaciers, water, or wind.

Force— In physics, something that causes a change in the motion of an object.

Friction—the resistance that one surface or object encounters when moving over another.

Habitat—the natural home or environment of an animal, plant, or other organism.

Hydrologic cycle—the storage and movement of water between the *biosphere* (the regions of Earth occupied by living organisms), *atmosphere* (the blanket of gases surrounding the Earth), *lithosphere* (the rigid outer part of the earth, consisting of the crust and upper mantle), and the *hydrosphere* (all the waters on the earth's surface, such as lakes and seas).

Hyperventilation—a condition characterized by abnormally prolonged and rapid breathing, resulting in decreased carbon dioxide levels and increased oxygen levels that produce faintness, tingling of the fingers and toes, and, if continued, alkalosis and loss of consciousness.

Hypothermia—a medical emergency that occurs when your body loses heat faster than it can produce heat, causing a dangerously low body temperature.

Incapacitation—occurs within 5 – 15 minutes in cold water. Vasoconstriction decreases blood flow to the extremities in an effort to preserve heat in the core, thereby protecting the vital organs but allowing the periphery to cool. Within this critical time frame you will lose meaningful movement in your hands and feet, and then your arms and legs.

Inertia—a tendency to do nothing or to remain unchanged.

Invasive species—an organism (plant, animal, fungus, or bacterium) that is not native and has negative effects on our economy, our environment, or our health.

Involuntary reaction—there are two types of involuntary reactions, *autonomic* and *reflex.* The autonomic nervous system controls the body's internal environment without conscious intervention and helps to regulate vital functions. A reflex is an involuntary response to a stimulus, such as withdrawing your hand from a hot surface before you become aware of the heat.

Irrigation— is the watering of land to make it ready for agriculture.

List—a nautical term for when a boat tilts towards one side.

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Marine mammals—a diverse group of species including whales, polar bears, dolphins, and otters that rely on the ocean for their existence. All of these species have the five characteristics of mammals: they are warm-blooded, have hair or fur, give birth to live young, nourish their young with mother's milk, and breathe air.

Mass—a measure of the number of atoms in an object. The basic unit of measurement for *mass* is the kilogram.

Mitigation—The elimination or reduction of the frequency, magnitude, or severity of exposure to risks; the minimization of the potential impact of a threat or warning.

Morphology—the shapes of river and stream channels and how they change over time.

Native species—an organism (plant, animal, fungus, or bacterium) that is naturally found in a region. These can be either endemic (found only within a particular region) or indigenous (found both within the region and elsewhere).

Natural resources—anything that people can use which comes from nature. People do not make natural resources, but gather them from the earth. Examples are air, water, wood, oil, wind energy, hydro-electric energy, iron, and coal.

Newton's First Law—every object will remain at rest or in uniform motion in a straight line unless compelled to change its state by the action of an external force.

Newton's Second Law—The acceleration of an object as produced by a force is directly proportional to the magnitude of the force, in the same direction as the force, and inversely proportional to the mass of the object.

Newton's Third Law—For every action, there is an equal and opposite reaction. The statement means that the size of the forces on the first object equals the size of the force on the second object.

Non-point source pollution—water and air pollution from many diffuse and sometimes unknown sources.

Oil skimmers—a machine that separates a liquid from particles floating on it or from another liquid, such as oil.

Organic materials—matter composed of organic compounds that has come from the remains of organisms such as plants and animals and their waste products in the environment.

Overfishing—a non-sustainable use of aquatic or marine resources in which the supply of fish and other animals is depleted or exhausted.

Plankton—small and microscopic organisms drifting or floating in the sea or fresh water, consisting chiefly of tiny plants and algae, small crustaceans, and the eggs and larval stages of larger animals.

PFD—Personal Flotation Device

Point source pollution— a single identifiable source of air, water, noise or light pollution.

Porous—having minute spaces or holes through which liquid or air may pass.

Reservoir—a large natural or artificial lake used as a source of water supply.

Resource manager—a person who develops conservation and rehabilitation plans for nature reserves, land, rivers, and other natural resources, so that people can use these resources in an ecologically sustainable way.

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Shock—lasts for only about a minute after entering the water and refers to the effect that cold water has on your breathing. Initially, there is an automatic gasp reflex in response to rapid skin cooling; this can lead to hyperventilation. If the head goes underwater, water may be breathed into the lungs during the gasp.

Slicks—a film or layer of oil floating on an expanse of water, especially one that has leaked or been discharged from a ship.

Stakeholders—people who can affect, be affected by, or have personal interest in an issue.

Strainer—a common river hazard consisting of sticks or branches. Water passes through these but solid objects like boats or people do not, similar to a kitchen strainer. Even boaters wearing life jackets can drown if they are washed into a strainer, because they can get trapped underwater against the branches by tons of water pressure.

Sustainable—capable of being maintained at a steady level without exhausting natural resources or causing severe ecological damage.

Town Hall Meeting—an informal public meeting at which community members discuss issues and concerns.

Vectors—a pathway by which non-native species are transported or carried to new environments. This can include currents, boats, humans, or other organisms.

Volume—the amount of space that a substance or object occupies, or that is enclosed within a container.

Water scarcity—the lack of sufficient available water resources to meet the demands of water usage within a region.

Woody debris—large wood that falls into a stream or river, including logs, branches, and root balls. This debris can cause dangerous hazards in rivers for boaters.

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