Lesson Plans

<table>
<tr><td>GRADE 2</td><td>Subject: Science</td><td colspan="2">Time: 1.5 hours</td><td>Topic: Wonderful Water: Learning About Conservation and the Water Cycle</td></tr>
<tr><td colspan="5">Big Ideas: Water is essential to all living things, and it cycles through the environment.</td></tr>
<tr><td colspan="5">Overview: Through a series of games and discussions, students will explore the questions: Why is water important for all living things? How can you conserve water in your home and school? How does water cycle through the environment?</td></tr>
<tr><td>Curricular Competencies</td><td colspan="4">Demonstrate curiosity and a sense of wonder about the world
Make and record observations
Express and reflect on personal experiences of place</td></tr>
<tr><td>Content</td><td colspan="4">Water conservation
The water cycle
Local First People’s knowledge of water: water cycles, conservation, connection to other systems</td></tr>
<tr><td>Materials/ Resources</td><td colspan="4">Activity 1
8-10 buckets (~10L)
4 large sponges
Coloured items (bandanas, stickers, face paint, etc.) in red, yellow, and blue
Activity 2
2 buckets per team (each labelled with a waterline, and one bucket filled to that waterline)
1 large sponge per team
Worksheets
Worksheet 3
Printed or projected diagram of the Water Cycle (see Teacher Resources)</td></tr>
<tr><td>Prior Knowledge</td><td colspan="4">Students should have a basic understanding of the concept of conservation as it relates to natural resources. An understanding of the basics of the water cycle will also be helpful.</td></tr>
<tr><td>Component</td><td colspan="3">Description and Details</td><td>Teacher Notes</td></tr>
<tr><td>Opening Circle</td><td colspan="3">Gather students around in a circle.

Qs:
Why is water important? (animals and humans drink it; plants need it to live, animals live in it, etc.)
Is water only important to humans?
What does ‘conservation’ mean? (to protect and preserve from destruction)
Why is it important to conserve and respect water? All organisms need water to live.)
Do you know any Elders in your family or community who have shared stories about the importance of water? (Allow students to share and/or share your own stories.)</td><td>Ask for students to volunteer their answers with a raised hand.

Students should be thinking about other organisms that rely on water, and the role humans can play in helping conserve water</td></tr>
<tr><td>Hook</td><td colspan="3">Water Cycles
Place an image of the water cycle in the middle of the circle.

Qs:
How does water cycle through the environment? (Evaporation, Condensation, Precipitation, Infiltration/Overflow)</td><td>There is an image in the Resources Section if needed.</td></tr>
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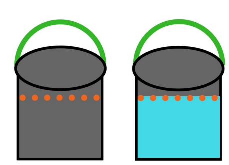
	• Does it always move the same way? (follows same cycle, but some different pathways) • Is there new water being created or is the same water being recycled? (same water is being recycled over and over)	Students could be asked to trace the flow of water through the cycle.
Activity 1	**Rain, Run, Recycle** Students are placed into groups. 80% of the class will be water, 10% of the class will be sun, and 10% of the class will be humans. Students in the water group will wear something blue (bandanas, face paint, stickers, hats, shirts, etc.); students in the sun group will wear something yellow; students in the human group will wear something red. Water students have a designated play area where they run around trying not to get tagged by humans or the sun. If tagged by the sun, the sun students yells 'EVAPORATION', and the water student becomes a cloud (they are stuck in place and must wave their arms to try and catch other water students running by). If they tag a water student running by they yell 'CONDENSATION' and join hands. After 5 seconds, both water students in the cloud yell out 'PRECIPITATION' and they are released back into the game. If there are too many clouds and not enough water students being recycled into the game, a teacher can call out 'RAINFALL', and any clouds are back in the game as water. If water students are tagged by humans, they are stuck in place with their hands pressed together above their head (mimicking the shape of a bottle). They must remain stuck in place as bottled water until one of the humans calls out DRINK UP! They are then cycled back into the game.	The objective is to understand the water cycle in simple detail, and to know that humans remove water from the cycle all the time. The human representatives in the game must be aware of how much water they are taking out of the game, and try to manage the resource sustainably so the cycle is not interrupted. You can play this for as little at 10 minutes, or as long as the students are engaged for.
Transition / Discussion	Collect all materials and gather students together in a circle to reflect on the game. **Qs:** • What happened to water that was taken by humans? • In the past, how did humans gather water from the environment to meet their water needs? • Is this different from how humans gather water today? • Is it possible for humans to take too much water from the environment?	Allow space for all students to share, and to listen to the ideas and insights of others.
Activity 2	**Where's the Water?** Students are placed into 4 teams. Each team has 2 buckets: 1 bucket filled with water and with a large sponge, and 1 empty bucket. Each bucket has an identical line marked on it at the level of the full bucket waterline. The teams line up behind their full bucket (the empty bucket is across the playing area from their full bucket). When the teacher calls 'Drink up!', the first member of the team grabs the sponge and runs to the empty bucket (this can be as far away as you want, the further, the more difficult). They squeeze the wet sponge to empty it into the bucket, and run back to hand off the sponge to the next team member. They wet the sponge again, and run back to the other bucket to empty the sponge. This continues until the team's first bucket is empty.	 The objective is to fill the empty bucket with as much water as possible.

	Collect all materials and gather students into a circle. **Qs:** ● What happens to the water that's spilled or sweated out into the air? (evaporation) ● What are other ways that humans lose water to the environment? (watering lawns, washing cars, steam from factories and buildings, breathing out, etc.)	The students will inevitably lose water as they race. This mimics our need to constantly replace water as we exert ourselves.
Transition	**Conservation Creation** Use the following questions to brainstorm ideas with the students. **Qs:** ● How can humans reduce the amount of water we lose to the environment when we are exerting ourselves (like in a running race)? ● How can we conserve water so that humans and the environment have enough water? Students are given Worksheet 1. Read through the worksheet together as a class, and answer any questions. Students will they take time to design something that would help humans conserve water.	Students could also design their creations on a computer, verbally or with modeling materials.
Closing Circle	**Conservation Showcase** Gather students into a comfortable circle. Go around the circle and give students a chance to explain their creation or idea to the class. Encourage students to ask questions or give constructive feedback about the designs being shared.	This could be a brief sharing or an extended activity based on class needs.
Extensions	Educators could extend this lesson in a number of ways. ● Extended the activity so students are allowed to work on their drafts for a couple of days before showing them off to the class. ● Students could model their ideas in 3D on on the computer. ● Students could be allowed to use strategies to minimize water loss in the 'Where's the Water?' game and then test their ideas. This can be connected to the ways in which runners minimize water loss during races.	

GRADE 5	**Subject:** Science	**Time**: 1.5 hours	**Topic:** Levers in Action: Using Simple Machines to do Work

Big Ideas: Machines are devices that transfer force and energy.	
Overview: Through a series of activities and discussions, students will explore levers in the form of seesaws to move heavy loads.	
Curricular Competencies	• Make predictions about the findings of their inquiry • With support, plan appropriate investigations to answer their questions or solve problems they have identified • Use equipment and materials safely, identifying potential risks
Content	• Machines (constructed, found in nature)
Materials/ Resources	**Opening** • Model of image of a seesaw, model or image of a wheelbarrow, pop can with tab, tongs, tweezers, nutcracker, canoe paddle or oar, other lever examples **Activity 1** • 1 buckets of water per group • 1 wooden plank per group • 1 long log or multiple smaller logs per group **Activity 2** • 1 stick per student (approximately 1.5" in (3.75 cm) diameter and 1 foot (30 cm) long) OR 1 ball per student • 1 bucket per team (for sticks/balls) • 1 or many targets to aim for (cardboard boxes, empty cans, a hanging sheet hanging with a bullseye, etc.) **Worksheets** • Worksheet 2
Prior Knowledge	Students should have a basic understanding of the concept simple machines (specifically levers, their components [fulcrum, effort, load] and their function).

Component	**Description and Details**	**Teacher Notes**
Opening Circle **Hook**	**Opening Circle** Gather students around in a circle, and hand out the following items to be passed around: a model seesaw, a model wheelbarrow, a pair of scissors, a nutcracker, pop can, tweezers, tongs, etc. **Q:** • What do all of these objects have in common? (All of these objects are examples of the use of a lever to exert force and complete a task) • What purpose do these objects serve? (allow humans to do work more efficiently by reducing the amount of force needed to do work) • Do they provide any services for humans? (humans can do more more, more quickly; humans with different ability levels can take part in meaningful work, etc.)	Ask for students to volunteer their answers with a raised hand.

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<td>Activity 1</td>
<td>Make it Move
Assign students into groups and hand out copies of Worksheet 3. Explain that groups will soon be given the materials required to make their own seesaw. They will also be given a bucket of water to lift off the ground using the seesaw. Go through Worksheet 3 as a class and answer any questions groups have before they begin.

Using Worksheet 3, students will first use drawings to design the lever system they think will allow them to move the bucket of water off the ground most efficiently.

They will then test their design in real life using the materials provided. They will record their observations and make changes to their model based on what they find in their experiment.

Qs:
How did you modify your system to make it work even better? (Allow students to share their ideas and results.)
How are human bodies like levers? (the musculoskeletal system e.g. biceps)
How well do you think your own body’s levers work?</td>
<td>Bonus: Encourage students to act respectfully towards the water in the buckets and to try not to spill even one drop. Consider rewarding teams who are particularly careful with their water.

If there are not enough buckets or water for this activity, consider rocks or heavy books, etc.</td>
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<td>Activity 2</td>
<td>Human Lever Relay
Students will be placed into teams for this relay race. Teams will line up at the Starting Line. Across from them will be the Throwing Line. Students must move towards the Throwing Line as quickly as they can. After every step they take, they must raise themselves up onto their tiptoes (using the lever action of their weight (load) bearing down on their toes (pivot or fulcrum) and using the calves (effort) to hold the position. There progression will be: take a step, raise onto tiptoes, take a step, raise onto tiptoes, take a step, etc.

Once they make it to the Throwing Line, there will be a bucket of sticks or balls and a target for them to aim for. Students must plant their feet at the Throwing Line. Using the lever action of their bicep, they will throw the stick and try to hit the target. Teams the hit the target get an extra run added to their score. If a student moves her feet while throwing, she is disqualified for that round, and must return back to the Starting Line.

Students who have thrown their stick return to the Starting Line in the same step, tiptoe, step, tiptoe fashion to send their next teammate through the relay.

Gather the students into a circle.

Qs:
How can you use the levers in your body to complete tasks more easily?
How can humans maintain their body’s levers? (building muscle, stretching, hydration, etc.)
Do you think this affects a body’s race time?</td>
<td>The Starting Line can be placed further away from Lever Line to increase the level of difficulty.

Safety: Ensure students are acting safely and responsibly with the throwing sticks.

After the reflection questions, you could collect the sticks, and give students another chance to run the relay.</td>
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<tr><td>Closing Circle</td><td>Transition to your final location for the lesson and gather students into a circle once more.

Qs:
Does using a lever make tasks easier or more difficult?
Does anyone have an Elder in their family or community who uses simple machines like levers to do work more easily?
Does anyone have any creative ideas about how to use levers to make work easier for themselves or their community?</td><td>Encourage students to share their insights and ideas here.</td></tr>
<tr><td>Extensions</td><td colspan="2">Educators could extend this lesson in a number of ways.
Explore ancestral hunting technologies such as the bow and arrow, Deadfall Trap and atlatl (throwing spears) as uses of levers by Indigenous people around the world
Allow students creative thinking time to come with ideas about using levers in their community for more efficiency
Investigate the ways in which humans can maintain healthy joints for endurance racing
Explore opportunities to use levers (and other simple machines) to improve the lives of people with physical disabilities (Grit Freedom Chair, Creating Ability paddling products, etc.)
Experimenting with paddles and oars as levers while canoeing, kayaking, rowing on a lake or river
Investigating prosthetic limbs and the levers involved to mimic natural movement. Reflecting on and designing prosthetics for humans or animals to understand levers.</td></tr>
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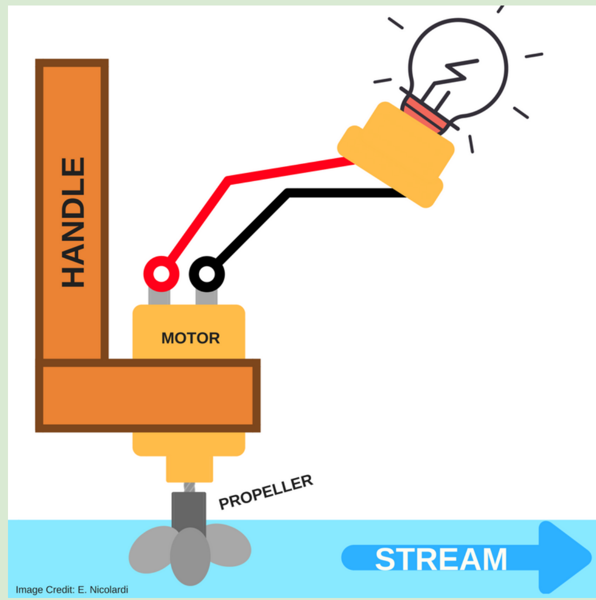
<tr><td>GRADE 11</td><td>Subject: Physics</td><td>Time: 1.5 hours</td><td colspan="2">Topic: Innovation for Conservation: Exploring Water-powered Generators</td></tr>
<tr><td colspan="5">Big Ideas: Energy is found in different forms, is conserved, and has the ability to do work.</td></tr>
<tr><td colspan="5">Overview: Students will build electricity-generating water turbines in order to learn about potential and kinetic energy. They will use their experiences and observations to generate ideas about real-world applications of this renewable technology applications in their local environment.</td></tr>
<tr><td>Curricular Competencies</td><td colspan="4">Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative)
Contribute to finding solutions to problems at a local and/or global level through inquiry</td></tr>
<tr><td>Content</td><td colspan="4">Potential and kinetic energy, the relationship between variables</td></tr>
<tr><td>Materials/ Resources</td><td colspan="4">Experiment Space
access to sinks with running water OR 3 buckets (2 large and 2 small) per group
paper towels/mop for clean up
Water-powered Generator
(multiply materials by number of groups)
simple electric motor (3 to 6v)
small propeller OR small aluminum plate and scissors (to make propellers with)
multimeter with crocodile clips set to read volts
pieces of wood and strong tape to make a simple wooden handle to hold the propeller in the stream of water from the buckets/sink/river
miniature bulb holder and light bulb
scissors
permanent marker/pen
Worksheets
Worksheet 3

</td></tr>
<tr><td>Prior Knowledge</td><td colspan="4">Students should have a basic understanding of the concept of energy (potential, kinetic, chemical, thermal, etc.). A basic understanding of hydroelectricity, water-powered generators and electrical circuits will also be helpful.</td></tr>
<tr><td>Teacher Resources & Pre-research</td><td colspan="4">Water, Energy & Hydroelectricity (www.lenntech.com/water-energy-faq.htm)
Research any local hydroelectric projects in your area. This research could be done with students.</td></tr>
<tr><td>Component</td><td colspan="3">Description and Details</td><td>Teacher Notes</td></tr>
<tr><td>Opening Circle</td><td colspan="3">Opening Circle
Gather the students into a comfortable circle. Review the concepts of potential and kinetic energy with the students through discussion and/or written definitions on the board. Have a discussion with the class using the following questions:

Qs:</td><td>Ask for student volunteers to share ideas and answers.</td></tr>
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	• What kind/s of energy does water contain? (potential and kinetic) • In what ways do humans use the energy of water to do work? (hydroelectric, current to move boats and cargo down river, etc.) • Are their local applications of technology that uses the energy of water to do work? • How does the use of water by humans affect the rest of the ecosystem? (flooding, ice irregularities, blocked fish migrations, etc.)	
Hook	Watch one or both of the following videoes as a class: • This video goes through the benefits and drawbacks of hydroelectricity in more detail https://www.youtube.com/watch?v=W0axSL4tQYA (0:05 sec - 3:10 min) • This video explains how energy is generated in more detail https://www.youtube.com/watch?v=ABv631t1OKI	
Activity 1	Tell students that they will be designing model water-powered generators today to transfer potential energy into kinetic energy into electric & thermal energy. Ask the students to make a prediction about: 1. How many volts does a single motor produce? (A single hobby motor produces a current that is 3-6v strong) 2. How many volts electricity does it take to run a small load, such as a miniature light bulb? (Regular flashlight bulbs are designed to work with approximately 3v.) 3. Will the lightbulb be brightly lit, dimly lit, intermittently lit, or not lit at all? 4. Does the type of light bulb (LED, incandescent, etc.) affect your predictions? Hand out Worksheet 3, and go over it ask a class. Allow students to ask questions. **Making Models** Using Worksheet 3, students will work in teams to build their model water-powered generators.	Consider allowing students to use batteries to test Question 2. This will give them an idea of the voltage they're aiming for. See the instructions and materials listed in the Resource section. It may be helpful to build a demo model in advance. This Activity could be extended over multiple classes as needed.
Activity 2	**Water Works** Using either the flow of water from a tap, hand-poured water from a bucket, or the flow of a natural stream, students will submerge their propellers in a stream of running water. **Round 1.** The motor is attached to the multimeter to assess the voltage generated. Note this reading in Worksheet 3 (Section 6). Based on the reading, students make predictions about whether the light bulb will turn on. **Round 2.** The motor is attached to the light bulb holder and students observe whether there is enough power being generated to keep the bulb lit and how bright the bulb is shining.	Spinning the propeller by hand is normally enough to produce 0.3 to 0.6 volts. This can clearly be seen on the multimeter.
Transition & Closing	**Qs:** • Which generators produced the most power?	

	• What variables affected that outcome? • What could be done to affect those variables and create a different outcome? **Closing Circle** Ask students to go around and share some of their innovative ideas from Section 9 of Worksheet 3.	Encourage students to share their insights and ideas with the group.
Extensions	Educators could extend this lesson in a number of ways. • Students could have additional class time to refine their propeller models, and experiment with more or less blades or different lengths and shapes. You could also modify the flow rate of the water. • Research current news events related to hydroelectric power generation in their local area. What are the current successes and challenges? Based on local challenges, engage students in an 'Innovation Challenge' to foster their sense of problem-solving, critical thinking and possibly entrepreneurship. • Take the model generators out of the classroom to a local river and test them in the flow of the river. • Explore other sources of renewable energy generation and storage (solar, wind, tidal, biomass, etc.). Compare and contrast each source of energy. Which is most useful to the local area? • Research how to attach the same light bulb holder to a treadmill and redo the experiment with human power instead of water power. • Explore how motors produce electricity. Experiment with building motors with students.	

Worksheets

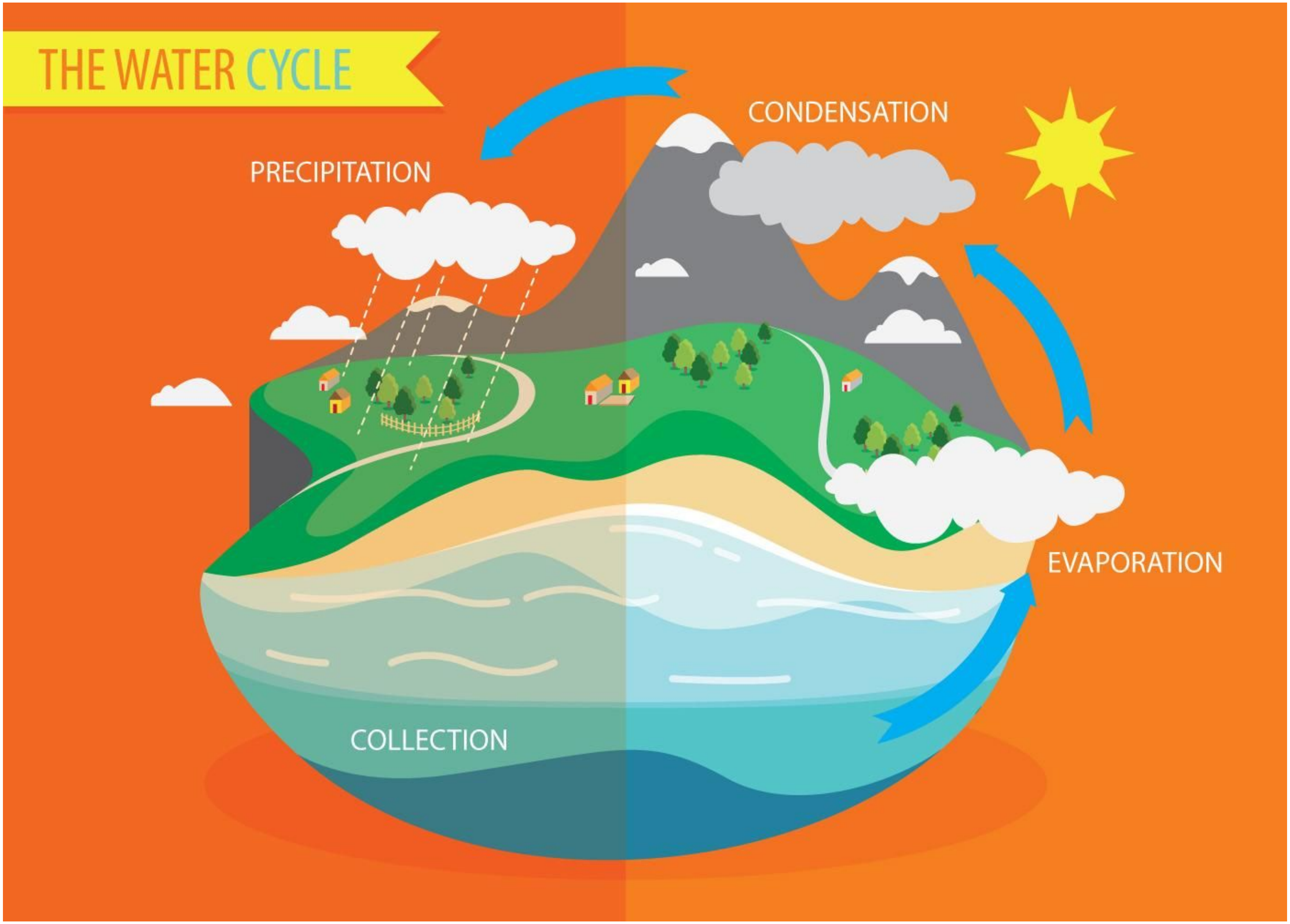
Worksheet 1
See attached .PDF

Worksheet 2
See attached .PDF

Worksheet 3
See attached .PDF

Teacher Resources

Grade 2 Water Cycle Diagram (Generated by Vecteezy)


THE WATER CYCLE
PRECIPITATION
CONDENSATION
EVAPORATION
COLLECTION

Grade 11 Water-powered Generator Instructions

How to Build Your Water-powered Generator (Adapted from Sciencing.com and Technologystudent.com)

How to Build a Pie Plate Propeller (Adapted from Scientist in Residence Program)

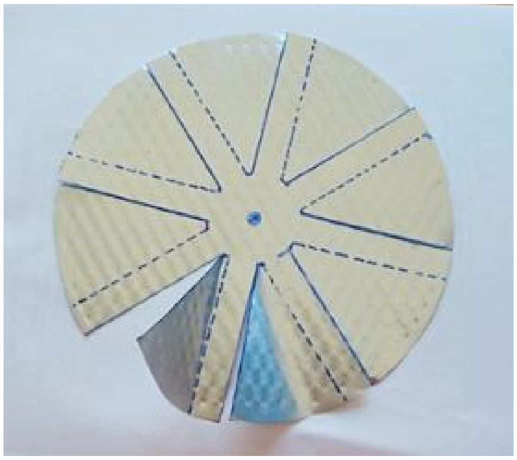


Image credit: Scientist in Residence Program

1. Use scissors to trim off the raised edge of the aluminum pie plate.
2. Punch a hole through the middle of the pie plate with a pen or scissors.
3. To make a six-bladed propeller, use a pen or permanent marker and a ruler to copy the design shown here. Adapt the design as needed to make a propeller with a different number of blades.
4. Do not draw lines right into the centre of the circle. Leave about about 2 centimeters (cm) from the middle of the circle.
5. Cut along the solid lines, and bend on the dotted lines to create your propeller.

How to Build a Cork Propeller (Adapted from Sciencing.com)

1. Take a cork cylinder and attach it to the rotating arm of a 3-6v hobby motor (available at hobby shops or online).
2. Take a number of plastic spoons (depending on how many blades you want on your turbine) and break the ends off.
3. Attach the blades to the cork cylinder by either hot-gluing them on, or pushing them into the cork.
4. There is also the option to purchase a set of hobby boat propellers for this purpose.

How to Build the Generator

5. Depending on the size of your motor, use scrap pieces of wood to create a handle to hold your motor.
6. Attach the motor to one end of the wooden handle. Make sure the propeller is hanging below the bottom edge of the handle.
7. Either connect alligator clip leads to the motor so that a multimeter can measure the voltage OR connect a miniature light bulb holder and bulb to the motor to see if enough power is being generated to keep the bulb lit.
8. Lower the propeller into a flow of water (hand-poured, from a tap, in a stream, etc.). Keep the body of the motor above the water line.
9. Observe the multimeter to see the voltage output, or check the light bulb to see if it stays lit.

Options for Materials

1. Light bulb holder (without bulb)
2. 3v hobby motor
3. Model boat propeller (this could also be a pie plate propeller or cork propeller)

1. 

2. 

3.