OUR
CLIMATE
QUEST

SCIENCE NORTH SCIENCE NORD

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Canada

EDUCATION GUIDE

Lesson Plans and Worksheets

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INSPIRE CLIMATE ACTION WITHOUT LEAVING THE CLASSROOM!

Our Climate Quest: Small Steps to Big Change is online!

Empower students to take climate action by visiting the online experience for Our Climate Quest at **climate.sciencenorth.ca**.

Our Climate Quest online directs youth to fun games and challenges that help them take an active role in climate action. There are also resources for educators and parents who want to help youth learn about climate change.

Benefits for students

- Explore the science of climate change in a fun and engaging way.
- Gain insight through Indigenous perspectives.
- Discover climate actions that can be taken today.
- Make a climate action pledge.
- Share climate action stories.

Benefits for educators

- Support classroom learning objectives.
- Access inspiring videos from change makers.
- Foster environmental initiatives among students.
- Empower students to lead their own learning about climate change.

WATER AND THE ENVIRONMENT

ZONE How do we know?

Activity Description

Students will learn about heat transfer using two experiments involving water.
In particular, they will explore convection and conduction.

Materials

Ice, water, beakers, Styrofoam, thermometers, large containers or buckets, a kettle, a trough, balloons, a hot plate

Safety Concerns

Frostbite risks with ice, burn risks with hot water

Background

Radiation, conduction and convection all contribute in a cycle to the earth's climate. The sun heats the surface of the earth using radiation heat transfer. The rock and ground heated by the radiation transfer warm the air in immediate proximity using conduction transfer. The pocket of warmer air created by the conduction transfer then rises due to convection, heating the atmosphere as a whole.

Definitions

Radiation: heat transfer via heat waves emitted by a hotter body towards a colder body. The sun emits electromagnetic waves which can be absorbed, reflected, or transmitted by the earth.

Conduction: Heat transfer between objects in direct physical contact. Particles move faster at higher temperatures. Fast-moving particles in a hotter object collide with and speed up the slower-moving particles in a cooler object, causing that cooler object to increase in temperature.

Convection: Heat transfer by movement of fluids. Molecules from a hotter fluid take up less room, and therefore have a lower density. Fluids of a lower density rise above fluids of a higher density; therefore, hotter fluids rise, while cooler fluids fall.

Gizizan: The Anishinaabemowin word for "heat", or "heat it up", sometimes spelled ghizizan. Gizh means hot, and -iz means to act on it, so the word contains the meaning of heat acting on something. What language do Indigenous People in your region speak? What is their word for heat?

WATER AND THE ENVIRONMENT

Procedure

Set up two stations and split students into two groups.

1. At the first station, have a beaker, warm water, ice cubes, and a Styrofoam tray.
2. At the second station, set up two containers with a trough between them. Have a kettle, water, ice cubes, and blue and red food colouring at the table.

Station One:

1. Fill the beaker with warm water.
2. Place an ice cube in the beaker and on the Styrofoam tray simultaneously.
3. Measure and record the temperature of the water (both in the beaker, and the meltwater from the ice cube) at 15 seconds, 30 seconds, 1 minute, and 2 minutes. Use Worksheet A Part 1 to record the results.

Station Two:

1. Place two containers on a sturdy surface with a trough between them.
2. Boil water.
3. Add boiling water to the leftmost container.
4. Add ice water to the rightmost container.
5. Fill the trough halfway with lukewarm water.
6. Add a drop of blue food colouring to the cold water container.
7. Add a drop of red food colouring to the hot water container.
8. Pour the hot water and cold water into their respective ends of the trough.
9. Record the results using Worksheet A Part 2.

Extensions

You can optionally add a third station to model how the earth heats the atmosphere.

1. Fill a beaker halfway with water.
2. Heat the beaker on a hot plate.
3. Feel the air near the beaker.

The earth warms the atmosphere from below. As the hot plate heats the water (conduction), the hotter water and eventually steam rises, heating the air (convection).

Adaptations

If you don't have a hot plate for the extension, you can instead fill a bowl halfway with boiling water and cover it with a plate. Feel how the plate gets warmer even though it's not touching the hot water.

At station two, you can use hot tap water instead of boiling water if necessary, though the bigger the difference in temperature, the more visible the result of the experiment is. Any colours of food colouring can be used, red and blue are just the traditional indicators of hot and cold.

OUR CLIMATE QUEST

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HEAT SINKS

ZONE How do we know?

Activity Description

Students will learn about how water absorbs and contains heat. Students will apply that learning to the climate change context by watching a demonstration and completing an experiment using water and ice.

Materials

Balloons, water, a candle or lighter, timers, ice cubes, hot plates

Safety Concerns

Open flame requires supervision, frostbite risks with ice

Background

A heat sink is a substance or device which absorbs and/or dissipates unwanted heat without getting substantially hotter itself. Water is a common and easily-accessed heat sink in the natural world because it has a very high heat capacity – it needs to reach a very hot temperature before it changes states from liquid to gas. As a result, it can hold an extraordinary amount of heat before that heat is released back into the atmosphere via a change in state.

This effect is observable in coastal communities, where the water has a mediating effect on the climate. Those communities don't get as hot or as cold as landlocked communities, because the water traps heat when it is warm, and holds onto it when it gets cold. The First Peoples of BC observe and monitor seasonal changes and climate along the coast, collecting reliable information about seasonal patterns, ocean currents, and tides. Recently, those seasonal indicators have become less predictable and reliable.

Thermal mass is the ability of a material to absorb, store, and release heat. It is a term used mainly in construction – especially in buildings meant to use less energy. A building with high thermal mass is more stable in temperature, and less energy is needed to heat or cool it. Water, by volume, has a heat capacity more than double that of concrete and three times that of bricks. It readily absorbs and releases heat into the environment. Therefore, large water pipes are being used in some buildings as a method of decreasing the energy needed to heat the building. Changing the flow direction of the water changes if it is absorbing or releasing heat.

HEAT SINKS

Procedure

Demonstration:

1. Blow up a balloon and tie it closed.
2. Blow up a second balloon, using water so that roughly both the air balloon and the water balloon are the same size (about the size of a small orange is fine). Let some air out, and add water until both balloons are about the same size.
3. Light a candle and place it on a sturdy surface.
4. Start a timer and using tongs hold the balloon filled with air over the flame. Be sure not to touch the balloon directly to the flame.
5. When the balloon pops, stop the timer and record the time with the class.
6. Repeat the experiment with the water balloon. It shouldn't pop unless held for a very, very long time.

Explanation:

The material of the balloon is weakened as the heat isn't being absorbed by the air as well as it is the water, until it pops. Water, however, has a higher heat capacity. As a result, it was able to store that heat without turning to gas. The water heated slowly, preventing the air from heating up and expanding.

Experiment:

1. Split the class into small groups.
2. Give each group two beakers, a hot plate, ice, water, two thermometers, and Worksheet B.
3. The group will fill one beaker with ice water and one with room temperature water.
4. Both beakers will be placed on a hot plate.
5. Students will measure and record the temperature of both beakers every 30 seconds on Worksheet B.
6. Students will graph their results on a double line graph on Worksheet B.
7. Students will answer questions about their observations on Worksheet B.

Extensions

Is there a difference between salt water and fresh water? Between the ocean or a lake or a puddle? For students who want to investigate further, repeat the experiment with the following changes:

1. Put room temperature water into two beakers, and add salt to one of them. Mark which beaker has salt, and repeat the experiment. Which heats faster?
2. Put 10mL of water in one beaker, 25mL in another, and 50mL in a third. Which heats fastest and slowest?

Adaptations

If you can't, or don't want to, use candles in the classroom, use a lighter instead. Any open flame will produce the desired result.

If there is no hot plate available, do the activity without it, and measure the temperature every minute instead of every 30 seconds.

If there are no beakers available, any container will do as long as it is not used on a hot plate – plastic containers might melt.

CARBON SINKS

ZONE How do we connect to nature?

Activity Description

Students will learn about how different environments store carbon, in particular the less-discussed peatlands.

Materials

Bread, vinegar, airtight containers

Safety Concerns

Do not eat the experiment

Background

Interconnectedness is a key part of the belief system of many Indigenous Peoples on Turtle Island. This is the idea that there are many spheres which make up the universe, all connected, all impacting each other. The Carbon Cycle includes all four of earth's spheres: the atmosphere, biosphere, hydrosphere, and the lithosphere or geosphere. We as human beings aren't separate from the spheres, either; we are part of the biosphere, part of the systems working on Earth.

Carbon is an important element in many greenhouse gases. Carbon is also the key element in organic compounds – the molecules that make up living things. Materials like coal, oil, and gas were once living things, the carbon in them stored and compressed into something new. When we burn those materials for energy, that carbon is released into the atmosphere, and climate change continues to escalate.

There is a natural carbon cycle. Carbon is stored in living things, and released when they die. Most of the world's carbon is stored deep underground, dissolved in the ocean, and in long-living things like trees. It is released in small amounts, and re-sequestered again. However, the cycle is disturbed when larger amounts of carbon are released – deforestation and the burning of fossil fuels release carbon which should have been stored in much greater amounts than the carbon cycle is equipped to manage.

CARBON SINKS

Background Cont.

It's important to find ways to capture carbon, and to protect the natural sinks which still exist. The ocean captures about 25% of the world's carbon dioxide emissions, mainly with phytoplankton, microscopic algae and bacteria, and kelp forests, which consume carbon dioxide. Colder water dissolves carbon more easily, so in higher latitudes there is also some dissolved carbon in the water, which then sinks to the bottom of the ocean. Forests are another well-known carbon sink. Planting trees is a well-known, well-loved climate action.

Changing ocean conditions and deforestation mean that those carbon sinks are also releasing carbon in large amounts. There is another natural carbon sink, though – peatlands. Peatlands make up the largest terrestrial carbon sink, storing more carbon than all other vegetation types combined. They cover 3% of global land, and 12% of Canada's total land area. In Canada, that's 1.1 million square kilometers, and a full 25% of the world's peatland. They store carbon by interrupting the process of decomposition – which means that the carbon stored in all those living things can't be released into the atmosphere.

Peatlands take a long time to form (about 10 years for a single centimeter in depth), and they are vulnerable to drainage. The conditions need to be very specific – they need to be anaerobic (which means little to no oxygen), water-logged, and acidic. The water-logging itself is what creates the anaerobic condition. All of that stored carbon from the plants which cannot decompose normally is stored and compressed. Peatlands are the earliest stages of the formation of coal, and potentially even diamonds, but the process takes millions of years. Degraded peat land releases all of that stored carbon instead, which is why it is so vital that peatlands are protected.

CARBON SINKS

Procedure

Nuisance or necessity? Peatlands are considered a nuisance land, as it is unsuitable for farming or building on. However, they are vital carbon sinks and home to many highly specialized living things.

Ecotourism is on the rise, and since Canada is home to so much of the world's peatlands, this is a potential avenue by which peatlands could come to be seen as valuable, and thereby, become protected. Have students create a piece of signage for a potential protected peatland, describing what makes it unique and important, and explaining how peatlands form and how they store carbon.

Extensions

Simulate the conditions for creating a peatland. In a container, add soil, enough water to make the whole thing water-logged, a bit of vinegar, and some leaves. Seal the container. You won't see a peatland forming. This activity can help demonstrate the conditions needed for a peatland to form, and it can drive home the time scale involved.

Adaptations

Each part of this activity can stand on its own if needed. Part 1 can be completed with other foods than bread.

CODING CLIMATE

ZONE How do we connect to nature?

Activity Description

Students will use scratch to code a climate change mitigation scenario, first seeing how parts of the ecosystem are connected, and then finding solutions to changes in that ecosystem.

Materials

Scratch, computers

Safety Concerns

None

Background

All living things have specific conditions that must be met in order for them to survive and thrive. Climate change is changing where those conditions can be met. Climate change projections suggest that the distribution of tree species will shift to new locations. The rate of climate change is faster than the rate at which trees can migrate, however. Assisted migration is one option being considered, while trees which remain in unsuitable climates will be less productive and more vulnerable to disease and insects.

Insects are experiencing changing migrations. Their range is quickly changeable, and so species like the emerald ash borer are able to migrate north quickly with changing climates.
43 insect species rely primarily on ash trees. Those insects provide food to nesting birds such as woodpeckers. The leaves which fall are eaten by decomposers, and those are in turn eaten by amphibians, fish, and crayfish. Squirrels, mice, ducks, turkeys, and other birds eat the seeds and fruits of ash trees.

In the short term, more dead trees provides more roosting opportunities for the endangered Indiana bat, but in the long-term, there will be a sudden shortage. Fallen wood from the brittle trees can form habitats for fish and amphibians (spawning areas in particular), but the wood can also cause logjams.

CODING CLIMATE

Background Cont.

The loss of canopy also shifts the forested wetlands to an open habitat with shrubs and herbs.
The way that each of these conditions and species rely on each other is an example of Interconnectedness. Called many names by many Indigenous Peoples, Interconnectedness is the idea that all things, living and not, are related. Stewardship and sustainability are inherent in Interconnectedness; as humans, we are related to the earth and its resources, we have an impact. Therefore, we have a responsibility to care for the land, and make sure that those resources are maintained and not diminished.

Coping and adapting

Underplanting and replanting native trees maintains canopy and hydrology, as does assisted migration, making sure the new trees growing there are more adapted to the climate. Assisted migration of native parasitoid insects can control the spread of EAB via biocontrol. Public information campaigns limit the migration of EAB somewhat.

Procedure

Students will code a wetland forest made up mainly of black ash in scratch. The base for the simulation has been provided, and can be accessed and edited at this link: **https://scratch.mit.edu/projects/678166645**

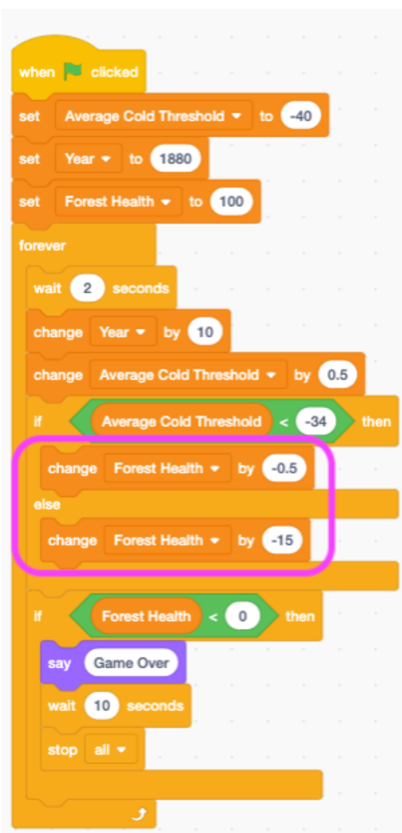
In the code provided, the emerald ash borers can't survive in the forest until the cold threshold goes above -34°C. The warmer the forest gets, the lower the overall forest health is. Once the emerald ash borers arrive, the forest health declines more rapidly, and they increase in number quickly. The endangered Indiana bat increases in population temporarily when forest health declines, as they benefit from the dead trees as a roosting place, but then the bats swiftly vanish completely when that health gets too low.

Have students run the simulation as it is, answering the questions in Worksheet D.

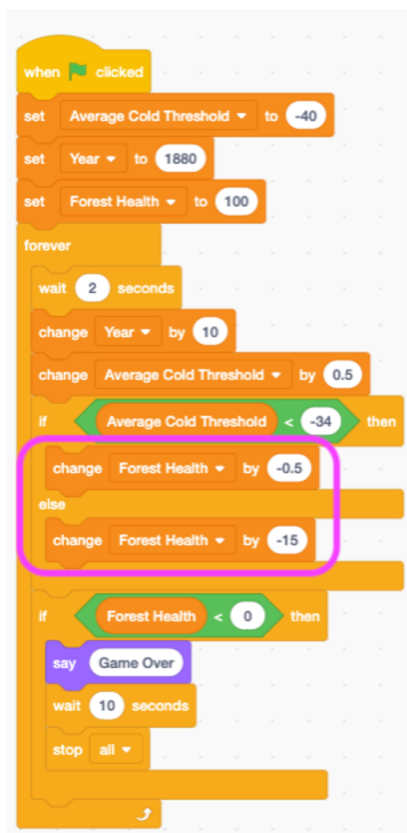
Discuss assisted migration as a mitigation strategy. Assisted migration means introducing species better suited to the changing climate. That makes forests hardier, and less sensitive to disruption.

Introduce assisted migration into the simulation by having students change the following code.

From:



To:

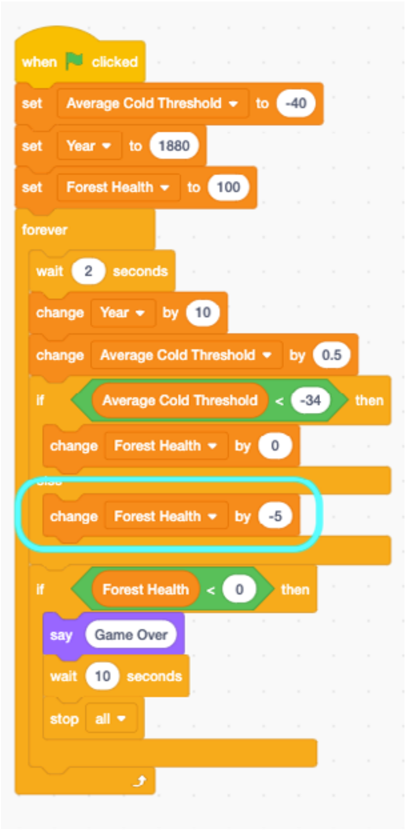


CODING CLIMATE

Procedure Cont.

Discuss public information campaigns. Have the students been told not to move firewood? Do they know that the reason is to prevent the spread of invasive insects, specifically the emerald ash borer?

To account for a public information campaign, delete two of the beetle sprites, and change the code to the following:



As a class, brainstorm other potential ways, futuristic or current, that the impacts of climate change on this forest could be mitigated. What can they do to help?

Extensions

Research climate adaptation and mitigation efforts in your area, and look for age-appropriate opportunities for youth to volunteer and get involved.

Adaptations

If the class is ready for more advanced coding, use the completed code as a teacher's guide and have them work through building the simulation themselves, providing them just the sprites and the background.

If the class doesn't have reliable access to the internet, use the background information and have students do research to create an action plan as a class to address emerald ash borer migration. Make a timeline, including underplanting, insect release, and a public information campaign. Design posters, or have the class script and film a PSA.

OUR CLIMATE QUEST

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SPROUTING SEEDS

ZONE How do we eat?

Activity Description

Students will learn about how they can grow new plants from kitchen scraps.

Materials

Plant pots, soil, cups, water, green onion stems, celery, sweet potato, garlic

Safety Concerns

None

Background

The relationship between food and carbon emissions is complicated. Some foods use more carbon to produce – for example, beef. The same kind of food grown by different people, or in different places, can use different methods of growing and harvesting which are more or less environmentally friendly. Food that is brought from very far away has a carbon footprint from that travel. The same food produced in a place it's not typically able to grow needs a larger carbon footprint to produce conditions in which it can grow at all.

There's no one guaranteed way to reduce your carbon footprint when it comes to food, but there are a few things you can keep in mind. Pick and choose what works best for you.

1. Grow it yourself. There are some foods that are easy to grow in your own garden, or even on your windowsill! You can even trade with your neighbours – if you grow tomatoes, and they grow zucchini, you'll both have more than you need of each. Share your produce.
2. Reduce your intake of food that is carbon intensive, such as red meat, dairy, and even things like chocolate, candy, and coffee. You don't have to eliminate these foods completely, but a small reduction can make a big difference.
3. Buy local. Local food isn't guaranteed to have a lower footprint, but if the food is seasonal and local, it's likely to help.
4. Foraging and hunting. Don't do this without appropriate expertise, of course, and follow all relevant laws. Consult with local Indigenous communities on best practices in your area, or buy from their hunters and gatherers.

SPROUTING SEEDS

Procedure

Green Onion:

1. Pour a thin layer of water into a cup (2-3cm deep).
2. Place the green onion stem inside, cut side up. Make sure it is standing (leaning against the wall of the cup), not floating, and not covered by the water.
3. Place the cup somewhere sunny.
4. Change the water daily or every other day (it will be fine over weekends)
5. New growth should be visible within a day or two.
6. OPTIONAL: the green onion can be replanted in soil at this point for better flavour, or it can continue to grow hydroponically.
7. After harvesting, the roots can be regrown multiple times.

Celery:

1. Fill a bowl with 2-3cm of water.
2. Place the entire base of the celery plant in the water, cut side up.
3. Place the bowl somewhere sunny.
4. When new growth appears, replant in soil.

Garlic:

1. Plant an unpeeled clove of garlic in soil.
2. Place in a sunny spot.
3. Water regularly, keeping the soil moist.
4. A stalk will begin to grow.
5. When the stalk turns yellow-brown at the base, harvest.

SPROUTING SEEDS

Procedure Cont.

Sweet Potato:

1. Cut a sweet potato in half.
2. Poke toothpicks in a circle around the middle of the potato.
3. Fill a shallow dish with water.
4. Rest the potato so that the toothpicks hold it up with the cut side in the water, not touching the bottom of the bowl.
5. Within a few days, roots will appear from the cut side, while a stem grows from the top.
6. When the stem sprout is 10-12cm tall, twist it off and set it in its own shallow bowl of water, root-side down.
7. When the roots of the sprout are 2-3cm long, replant in soil.

Extensions

Research your local farms and farmers markets, and put together a week-long meal plan using only ingredients grown and produced on those farms. If you live in a region where there aren't local farms, or where food insecurity is a problem, start a class discussion about how the school could set up a community garden, or how some foods can be grown easily at home. Discuss options for buying food farmed in that province, or supporting hunters and fishers from that province, or even from Canada as a whole.

Adaptations

Select the plants which are easiest to access/most interesting to your class. You can choose to grow some or one and not all of them.

The green onion and celery can both be grown entirely without soil.

MODEL HOMES

ZONE How do we live together?

Activity Description

Students will design and build a climate-friendly home, evaluating the best materials to use and the most effective structural elements.

Materials

Black paint, white paint, cotton, cardboard (flat and corrugated), craft foam, popsicle sticks, scissors, hot glue/tape/white glue, thermometer

Safety Concerns

Burn hazards with hot glue

Background

Heat Island Effect: urbanized areas experience higher temperatures than outlying areas because typical roadways and rooftops absorb and emit heat more than natural surfaces.

The heat island effect is detrimental to human health and to the environment. One of the ways it is being mitigated in cities is cool roofs. A cool roof is a roof made with a material with a high solar reflectance and a high thermal emittance. That means it reflects heat instead of absorbing it, and it releases heat rather than holding on to it. Most cool roofs are white in colour, since white reflects light. Heat is a byproduct of light, so light colours which reflect light also reflect heat, while dark colours which absorb a lot of light also absorb a lot of heat. While a cool roof doesn't change an individual household's energy costs, it does make a big impact on the heat island effect when they're used in entire neighbourhoods.

There are other ways to reduce the energy use of a single household, too. Any device that is plugged in is using power, even when it's turned off. This is called phantom power. You can make sure to unplug your devices to reduce energy use at home. You can also install solar panels as a source of renewable energy.

MODEL HOMES

Background Cont.

Your insulation makes a big difference too! If you have good insulation, you use less energy to cool and heat your home, as it should be better at maintaining its temperature. Some of the best insulators are fiber insulation like cellulose, fiberglass, or mineral wool. Fibrous or corrugated materials create air pockets which limit the spread of heat.

Pre-contact Indigenous Peoples in the Arctic had already invented home insulation. The Anishinaabe built wigwams with double walls enclosing an air pocket, with outer walls made from woven fibers. Northern Plains tribes used hide liners for their Tipis in the wintertime, stuffing grass between the layers, or snow in the wintertime. These practices are alive and well today, and

MODEL HOMES

Procedure

Discuss heat islands and cool roofs, insulation, and energy. Provide building materials and tools, and give the following challenge:

Build a sustainable home! Select insulation, colours, and materials that make your home easier to heat and cool with less energy.

When the homes have been completed, test them by shining a light on each one, and measuring the temperature inside over time, recording the temperature every 30 seconds.

Extensions

What's on your lawn? The grass most commonly used is a non-native monocrop that is hostile to invertebrate life. Research local grasses, flowers, leafy plants, and more, and design a biodiverse lawn for your home or neighbourhood. Draw the blueprint, and indicate why each plant is there.

Adaptations

Use the materials available to you. The key point is that there is something with pockets/segments, something fibrous, and some natural materials, as well as the black and white paint. If you don't have thermometers, test how long it takes for an ice cube to melt inside.

FLOATING CITIES

ZONE How do we live together?

Activity Description

If a coastal community becomes prone to flooding due to climate change, how can we adapt? Students will design and build a floating city.

Materials

Lego, large basin, water, leaf blower

Safety Concerns

Keep plugs and wires away from water

Background

Sea level has risen 21-24cm since 1880, and it set a new record high in 2020. The rate of sea level rise is increasing, and in many coastal areas, high-tide flooding is 3000-9000% more frequent than it was 50 years ago. Even if climate change follows a low-emission pathway, sea level will likely rise about 0.3m above levels from the year 2000 by the year 2100. A worst-case scenario of 2.5m in that same time frame cannot be ruled out.

25% of Canadians live in a coastal area, in relatively high density. Sea level rise causes flooding, shoreline erosion, and storm hazards in those areas. Globally, 8 of the world's 10 largest cities are near a coast.

What causes sea level rise?

The melting of glaciers and ice sheets are adding water to the ocean. They are melting faster and faster due to the albedo effect – the white of the snow and ice reflects heat, cooling the atmosphere. When those ice caps melt, there are fewer surfaces which reflect heat and light radiation, and so more of that heat is absorbed by the dark waters, causing the waters to warm. The warming of the water causes the remaining ice to melt even faster, creating more dark spots, and so the resulting positive feedback loop worsens the problem at faster and faster rates. The volume of water increases as it warms. Aquifers, lakes and reservoirs, rivers, and soil moisture are losing water to the oceans, largely due to groundwater pumping.

FLOATING CITIES

Background Cont.

How is sea level measured?

Tide gauge stations from around the world measure the daily high and low tide using manual and automatic sensors, and have collected over a century of data. From those, a global average can be calculated and adjusted for seasonal differences.

Since the 1990s, scientists have also been able to measure sea level using satellite altimeters which use radar to determine the height of the sea's surface by measuring the return speed and intensity of a radar pulse directed at the ocean.

Mass transfer is measured from glacier melt rates and elevation measurements calculated on field surveys, and satellite-based measurements of tiny shifts in Earth's gravity field, which changes slightly when mass shifts from land to ocean.

Thermal expansion is measured using buoys, satellites, and water samples collected by ships. Temperatures are measured by aquatic robots and oceanographic research ships.

We won't be able to plan our cities the same way we do now, if we want our coastal communities to continue to exist. Indigenous peoples of the Southeast Traditional Lands Area invented seawalls in 5000 BCE. Seawalls are structures built to protect the coastline from erosion caused by waves. These early seawalls were built up to about 3m tall of shells, with terraces built nearby as a place to build dwellings. Gardens were planted in the spaces between seawalls, and built cisterns into the walls to capture drinking water. Also built into early seawalls were fish corrals. Our use of sea walls continues in coastal communities to this day.

FLOATING CITIES

Procedure

1. Split the class into groups of 2-4
2. Fill a large basin or bucket with water.
3. Each group uses Worksheet E as a template to brainstorm four ideas for a floating city
4. As a group, they select one idea to expand upon.
5. For that idea, decide how people get around, what amenities are needed, how food is produced, and how the city is powered.
6. Draw a design plan for the city.
7. Build a prototype from Lego.
8. Test the prototype by placing it in the water to see if it floats.
9. Reiterate – make any changes to the model, improving on the prototype. Test again.
10. Build the final version.
11. Test the models by creating a storm. Use a leaf blower to create waves in the water and time how long each model city lasts.

Adaptations

To make the storm, use a blow dryer instead of a leaf blower for a gentler test.

Materials other than Lego can be used, as long as they will be able to float, and be water resistant long enough to complete the test.

OUR CLIMATE QUEST

REPAIR TOOLKIT

ZONE How do we shop?

Activity Description

Students will learn how to make their clothing last longer by making simple repairs.

Materials

Sewing needles, fabric (two varieties), socks with holes, thread, buttons, embroidery hoops, fabric, sewing pins, stuffing

Safety Concerns

Exercise caution with the sewing needles to avoid minor injuries

Background

Over 10 million tonnes of clothing are sent to the landfill every year. 2650L of water are used in the production of a single cotton t-shirt. An important action we can take on climate change is to repair our clothes instead of throwing them out and replacing them – and there are a lot of simple repair tricks that we can use to make our clothes last a lot longer. As Molina Parker, Oglala Sioux artist, has said, "Pre-colonization, natives used every scrap of material they had [...]. From one cut of fabric, I'd have a jumper, her a shirt, and the rest would go in a scrap pile for quilts and doll clothing" (Vogue, 2020).

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REPAIR TOOLKIT

Background Cont.

Darning: Darning replaces the fabric in a hole in a garment, and has no knots, so it's comfortable to step on, making it a great method for repairing socks.

Buttons: Lost buttons are a pain, but easily repaired. The method changes slightly depending on the number of button-holes, but being able to replace buttons can extend the life of a blouse or a pair of pants for a long time.

Whip Stitch: A whip stitch is used to sew together two separate pieces of material with flat edges. It is a visible stitch, and can be done with matching thread, or a contrasting one to emphasize visible mending. Use this to repair a seam.

Ladder Stitch: This is an invisible stitch that you can use to repair a seam or to close a hole. It is also known as a slip stitch, blind stitch, or invisible stitch. If you want to make a repair, but want the repair to be subtle, the ladder stitch is the way to go.

Patch-Making: When a piece of clothing really can't be repaired anymore, it can still help you extend the life of your other clothing! Turn old clothes into patches, and attach them to your clothes using a whip stitch. It's best to patch weak areas on your clothing before they rip! Use natural fabrics like cotton for armpits to extend how long they can be worn before they need to be washed.

Visible Mending: Visible mending is a growing movement towards not only repairing your clothes, but celebrating that repair by making it decorative and visible, usually through embroidery or patches.

REPAIR TOOLKIT

Procedure

1. Print off enough copies of the patterns provided in the appendix and distribute them to the students.
2. Cut out the pattern pieces from the paper.
3. Pin the paper pattern pieces to the fabric chosen for the bear. Pieces are labelled if they are body or accent; pin them to the fabric according to what fabric you want to be body or accent.
4. Cut out the fabric around the paper pattern.
5. Using scrap fabric, practice the whip and ladder stitches.

Whip Stitch:

a) Thread the needle, draw the thread halfway through, and tie the ends together in a knot.
b) Arrange two pieces fabric on top of each other and pin them in place.
c) Poke the needle through only the top layer of fabric, about 1/8" (0.3cm) from the edge. This hides the knot between the two layers of fabric.
d) Circle the needle around to the bottom layer and pierce through both layers, through the original hole. It should form a loop on the outside of the fabric. The stitch should be secure, but not so tight that the fabric bunches.
e) Circle the needle back to the bottom layer. Press it up through the first stitch at an angle, so that it goes in where the first stitch is and comes out about 1.5cm away from the first stitch, parallel to the first.
f) Circle the needle to the bottom layer, pierce through both layers at an angle, starting each new stitch at the bottom of the last stitch and coming up 1.5cm away. The stitches will not look angled; they will appear straight up and down, parallel to each other.
g) Repeat step 6 until you reach the end of your line.
h) On your final stitch, pierce the needle through the bottom layer and go straight up through both layers instead of at an angle.
i) Poke the needle through the bottom layer again, but not the top layer.
j) Pull the layers apart slightly to reveal the backside.
k) Wrap the needle through the last stitch, creating a loop. Thread the fabric around and pull tight to make a knot.
l) Cut the thread free.

REPAIR TOOLKIT

Procedure Cont.

Ladder Stitch:

a) Thread the needle and knot the ends together.
b) Insert the needle on the inside of the opening, and pull through until the knot is secure and hidden inside.
c) Pinch the fabric together.
d) All stitches will be made on the folded-in hem, not in the visible outside fabric.
e) Insert the needle through the right side of the fold, from the bottom to the top.
f) Put the needle through the left side of the fold, from the top to the bottom.
g) Repeat steps 5-6 until you reach the end.
h) Pull the thread taut and the fabric together. Pinch to avoid losing tension as you secure the stitch.
i) Knot the end of the thread by bringing the needle through the previous stitch. Make a loop, pull the needle through it, and pull it taut.
j) Repeat step 9 several times.
k) Cut the thread free.

6. Take the two body pieces and line them up, with the nice side of the fabric on the inside. Pin them in place.
7. Using the whip stitch, stitch all around the edge, leaving the space between the ears open.
8. Turn the bear inside out.
9. Add stuffing using the gap between the ears until the bear reaches the desired firmness.
10. Sew up the gap using a ladder stitch.
11. Add the patches for the stomach, ears, and paws using the whip stitch.
12. Sew buttons on for eyes.

a) Thread and knot the needle as in previous steps.
b) Position the button.
c) Push the needle through the fabric from under the button, through one buttonhole. Pull the thread all the way through.
d) Push the needle through the other hole and through the fabric from the top. Hold the button in place so it doesn't move.
e) Repeat several times.
f) On the last stitch, push the needle through the material but not the buttonhole.
g) Wrap the thread 6 times around the thread connecting the button to the fabric.
h) Knot the thread and cut it free.

REPAIR TOOLKIT

Procedure Cont.

13. OPTIONAL: **Embroider a nose and smile**

    a) Lay a piece of yarn on the face in the shape of the smile.
    b) Pin it in place using sewing pins.
    c) Make a small stitch and tie it off on each corner of the smile and at the dip to anchor it.
    d) Remove the pins.

Extensions

Students can bring in holey socks and practice darning.

1. Stretch the sock across an embroidery hoop with the hole in the centre and tighten.
2. Thread and knot the needle.
3. Stitch across the hole in one direction starting 1.5cm before the hole begins, and ending 1.5cm on the other end of the hole.
4. Do not tighten the stitches.
5. Repeat step 3, putting your long stitches close together and covering the entire hole.
6. When you have covered the hole in one direction, turn your needle perpendicular to the first set of stitches, and weave it over and under the stitches.
7. Repeat step 6. Do not tighten the stitches.
8. When the entire hole is covered in both directions, secure the thread by tying a knot through the last stitch, or by weaving it through a few more times.
9. Cut any excess thread free.

Adaptations

If students are ready for a more advanced project, a pattern for a frog will also be included.

ONE PERSON'S TRASH

ZONE How do we Shop?

Activity Description

Students will create seed starters from home waste.

Materials

Biodegradable egg cartons, soil, tray, scissors, containers, paint or markers, seeds (native grasses or wildflowers)

Safety Concerns

With younger students, exercise caution with scissors

Background

Plants need sunlight, water, and space to grow. A seed starter can help you make sure each seed has enough space without them choking each other out, and its own supply of nutrients from the soil. You can monitor how much sun and water they each get easily. Once they are bigger and hardier, they can be replanted in a bigger pot or outdoors.

Agriculture has been practiced on Turtle Island since 8000-7000 BC, by Indigenous cultures from the Northeast to Mesoamerica. Agriculture is the practice of cultivating the soil to produce crops. In the Eastern Woodlands, early crops included squash and sunflowers. Barley and Maygrass were early crops in the River Flood Plains. Agriculture requires knowledge of plants, growing cycles, and seed selection, as well as an understanding of how temperature, moisture, and soil impact plant growth.

ONE PERSON'S TRASH

Procedure

1. Have students bring in biodegradable egg cartons from home.
2. Each student or group of students should have a pair of scissors, an egg carton, soil, 24-36 seeds, and a waterproof tray.
3. Poke a small hole in the bottom of each basin of the carton using the scissors.
4. Fill each basin halfway with soil.
5. Add 2-3 seeds.
6. Cover seeds with a thin layer of soil.
7. Place the carton on a waterproof tray.
8. Water and provide sunlight based on the instructions on your seed packet.
9. 5-7 days after the plant has sprouted, cut the basins apart.
10. Plant each basin into another planter or the ground, 30sm apart. CAUTION: Only plant seedlings in the ground if your plants are native to the area.

Extensions

Students can bring in old containers (for example, yogurt tubs, ice cream tubs) that would otherwise be thrown out. Cut 3-5 drainage holes in the bottom of the pot, use the lid as a tray, and decorate the outside of the container. They can use their new pots for replanting their seed starters if they cannot be planted in the ground.

Adaptations

Non-biodegradable materials can be used, including plastic egg cartons, yogurt cups, or applesauce cups. Instead of planting the seedling in the basin, remove it from the basin to replant. The cups can be rinsed and recycled.

CLIMART

ZONE How do I feel?

Activity Description

Students will reflect on what climate change and climate action mean to them, making personal connections and expressing them through a collaborative art project.

Materials

Chalk, paper, crayons/markers/pencil crayons etc.

Safety Concerns

None

Background

Artivism is a long-standing tradition. It has always reflected the social struggles of the time. The word originated with the Chicano movement in LA in the late 1960s, but social and activist movements have always involved art, creativity, and innovation.

Artivism is about more than just spreading awareness, too. Creative thinking and reflection is key to thinking through problems and their potential solutions in new ways. Artistic works can inspire critical thinking and empathy- and empathy and emotional responses are critical to inspiring action.

Check out Onaman Collective's collection of climate art banners here:
http://onamancollective.com/murdoch-belcourt-banner-downloads/

The Onaman Collective are a community-based social arts and justice organization who believe that the arts are a powerful way towards creating positive social change. They have many projects on the go, from language camps and workshops on traditional crafts such as canoe building and showshoe making, to research with elders and youth.

ONE PERSON'S TRASH

Procedure

1. Give students quiet time to reflect on climate change and climate action – what it means to them, and how it makes them feel. If they have completed other activities from this guide, they can reflect on what they have learned and how it made them feel.
2. Each student will write words and draw pictures to make a collage which represents their reflection.
3. As a class, discuss what they have added to their collage.
4. Brainstorm what they have in common in their reflections.
5. Work together to select a few key elements to include in a climate action chalk mural.
6. Form groups. Each group will work together on an element of the chalk mural on the blacktop.

Extensions

Students can write an artist's statement, detailing the process of designing the mural, describing what each element means to them, and explaining what they want people to take away from their artwork.

Adaptations

A whiteboard or blackboard in the classroom can be used if there are barriers to using the blacktop. Chart paper and markers can also work.

A CLASS AGREEMENT

ZONE How do I take action?

Activity Description

Students will work together as a class to create a climate action plan that suits them.

Materials

Varies; poster paper, markers, paint, popsicle sticks, jar, other depending on the actions chosen

Safety Concerns

Wear gloves and use pick-up sticks on yard cleanups or handling waste, walk/bike safely around cars and other pedestrians

Background

Climate action doesn't look the same for everyone. We all have things we are able to do, and things that are less feasible in our situation. A student who lives really far from the school might not have the option of walking or taking the bus; parents might not have the means to change how we eat. That's why a personalized plan of action is good – we can identify what we can do, and commit to doing it. These actions don't have to be all or nothing, either! Walking to school once or twice per week still makes a difference.

Actions can be ongoing activities or one-time events. We've made some suggestions here, but you don't need to include all, or even any, of them.

A CLASS AGREEMENT

Background Cont.

Ongoing

Reducing meat in lunches
This can mean implementing a meatless Monday, for example, or it can look like everyone agreeing to use one slice of ham in a sandwich instead of two.

Reducing plastic waste in lunches
This can look like using glass or reusable plastic containers instead of Ziploc bags. It can look like a Waste-Free Wednesday, where once per week there is nothing to throw out in lunches.

Track the classroom garbage, recycling, and compost
For example, you can make a tally of every item that is thrown out, recycled, or composted. Make a new list every day, week, or month.

Reduce printing
Use overhead slides instead of printing out instructions, for example.

Take the bus or walk/bike instead of getting a drive to/from school
Set goals – once or twice per week, per month.

Turn off unneeded lights
Have a daily Climate Champion whose job it is to turn on and off the lights when the class comes and goes.

Keep devices unplugged
Have a daily Climate Champion who makes sure unused devices are unplugged.

A CLASS AGREEMENT

Background Cont.

One-Time

Have a planting day
Plant trees or native flowers and grasses.

Have a letter-writing day
Practice literacy and civic engagement by finding out who your MP and MPP are and what their climate promises were. Write letters to them, asking how they are accomplishing those goals.

Host a clothing swap
Have students from your own class or as a whole school bring in clothes they don't want anymore or have outgrown. Students can browse what has been brought in and take home their favourites, instead of buying clothes new and throwing old clothes out.

Hold an e-waste drive
Have the entire school or just your class bring in cords, old phones, and other ewaste from home and bring it all to your local drop-off to keep those items out of the landfill.

Have a yard cleanup
Spend a day outside picking up litter.

Create climate art or write and perform a climate-themed play for the school
Any arts-based action can be effective for inspiring reflection

A CLASS AGREEMENT

Procedure

1. As a class, brainstorm potential climate actions. Draw from the list in the Background Information if suggestions are needed.
2. Categorize the brainstormed actions as ongoing or events.
3. Vote on 1-3 items from each category, making a list of 2-6 climate actions for the class.
4. As a class, write a detailed description of the chosen actions, including success criteria.
5. As a class, decide how to reward each action. For example, a student who walks to school or uses a reusable container could add a button to a jar, while the class hosting a big event could add 10 buttons to the jar. When the jar is full, there is a prize such as a pizza party or a pyjama day.
6. Write up the actions and descriptions on a piece of poster board or chart paper, as well as the prize.
7. The teacher will read it out. The class will vote yes or no on if they agree to follow it.

Extensions

Create and decorate the class poster with the climate agreement, and post it on the wall as a reminder.

Check out Climate Action Youth Ambassadors Canada (CAYAC) – a network of Indigenous and non-Indigenous youth who are discovering and sharing climate solutions here:

www.iisaakolam.ca/cayac

Adaptations

Use whatever kind of token or counting method works for you. Select the actions that work for you. Take care around accessibility concerns; some students may not be able to afford to use reusable containers, for example, or have clothes to spare to bring into a swap. Some students may live too far away to walk or bike to school. Discuss how and why different actions might be easier or harder for different people, emphasizing the value of personalized plans.

MY ACTION PLAN

ZONE How do I take action?

Activity Description

Students will put together a personal climate action plan, and track their progress.

Materials

Notebooks, stickers, decorations, markers/pencils/pens

Safety Concerns

None

Background

How we eat, shop, and live together all have a climate impact. There is no one path to climate action that works for everyone, but everyone is able to do something. We have provided some suggestions for each category.

How we eat

- Reduce red meat
- Eat more local food
- Use reusable containers
- Grow some fruit, vegetables, or herbs at home

How we shop

- Buy secondhand
- Repair the things I own
- Buy fewer things

How we live together

- Unplug my devices and turn off lights when not in use
- Volunteer with a climate group
- Join or start a climate club at school
- Walk/bike or take the bus instead of driving more often

MY ACTION PLAN

Procedure

1. Each student will set three climate action goals:
   a) One related to food
   b) One related to shopping
   c) One related to lifestyle

2. Each student will set subgoals for a day, a week, a month, and a year.
3. Each student will set metrics for success.
4. Each student will set up a journal to help track their progress, designed and decorated according to their own preference.

Extensions

At the end of each period (a day, a week, and a month), students can write or record a reflection on how they are doing with their goals, how it is impacting them, how they feel about it, etc.

Use the website **climate.sciencenorth.ca** to find ideas to inspire their journals and collect points and badges for completing climate actions. Learn about possible actions by watching videos by experts and youth activists. Have students record themselves doing an action and share it on the website, and watch the inspiring videos submitted by others!

Adaptations

The journal can be a photo or a video journal, wherein students document themselves taking climate action instead of writing it in the journal.

APPENDIX 1

Worksheets

WORKSHEET A

Water and the Environment

Part 1

Measure and record the temperature of the water (both in the beaker, and the meltwater from the ice cube) at the following intervals:

	0 Sec	15 Sec	30 Sec	60 Sec	120 Sec
Water Temp (beaker)					
Water Temp (Styrofoam)					

Which sample of water changes the most? ______________________
(Temp at 120 Seconds – Temp at 0 seconds)

At which interval is there the biggest difference for each sample: ____________________

Part 2

Draw what you see when the hot and cold water samples meet in the trough.

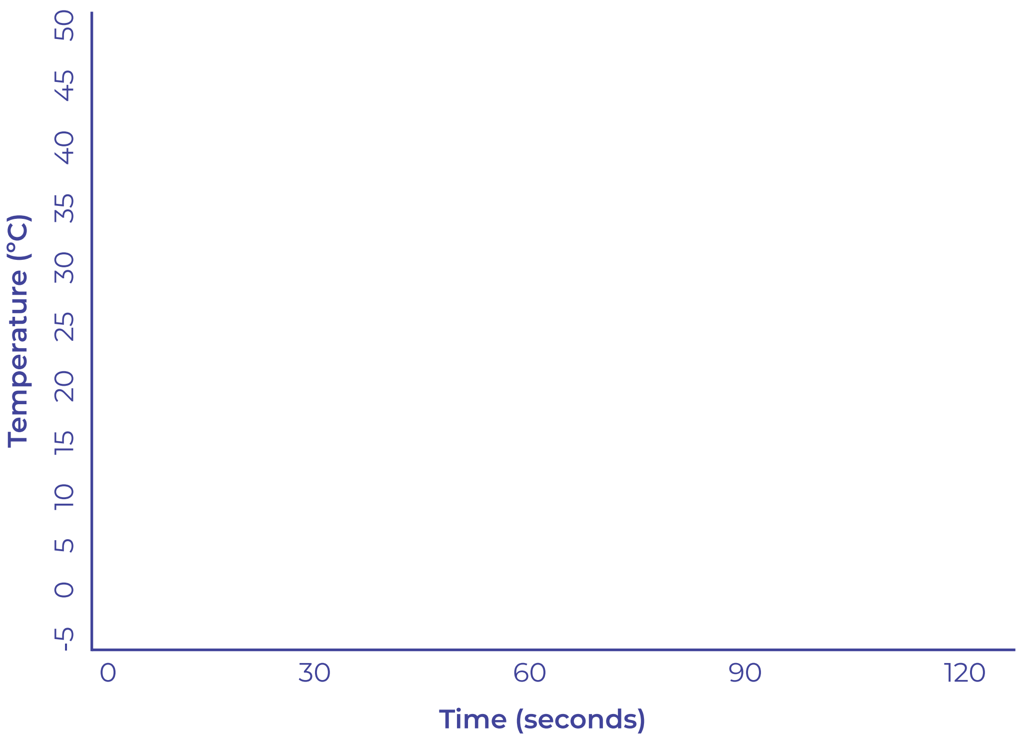
WORKSHEET B

Heat Sinks

Measure and record the temperature in both beakers every 30 seconds. Record the results:

	0 Sec	30 Sec	60 Sec	120 Sec
Temperature (ice water)				
Temperature (room temp water)				

Graph your results as a double line graph:



1. Which melted faster, the ice water or the room temperature water?

2. What happened when the last of the ice melted?

3. Which has a higher heat capacity, ice or water?

4. What does this mean for climate change?
   For example, what will happen in the arctic if the last of the ice melts?

OUR CLIMATE QUEST

SCIENCE NORTH SCIENCE NORD

WORKSHEET C

Carbon Sinks

Record the condition of the bread slices after a day:

After three days:

After a week:

OUR CLIMATE QUEST

SCIENCE NORTH SCIENCE NORD

WORKSHEET D

Coding Climate

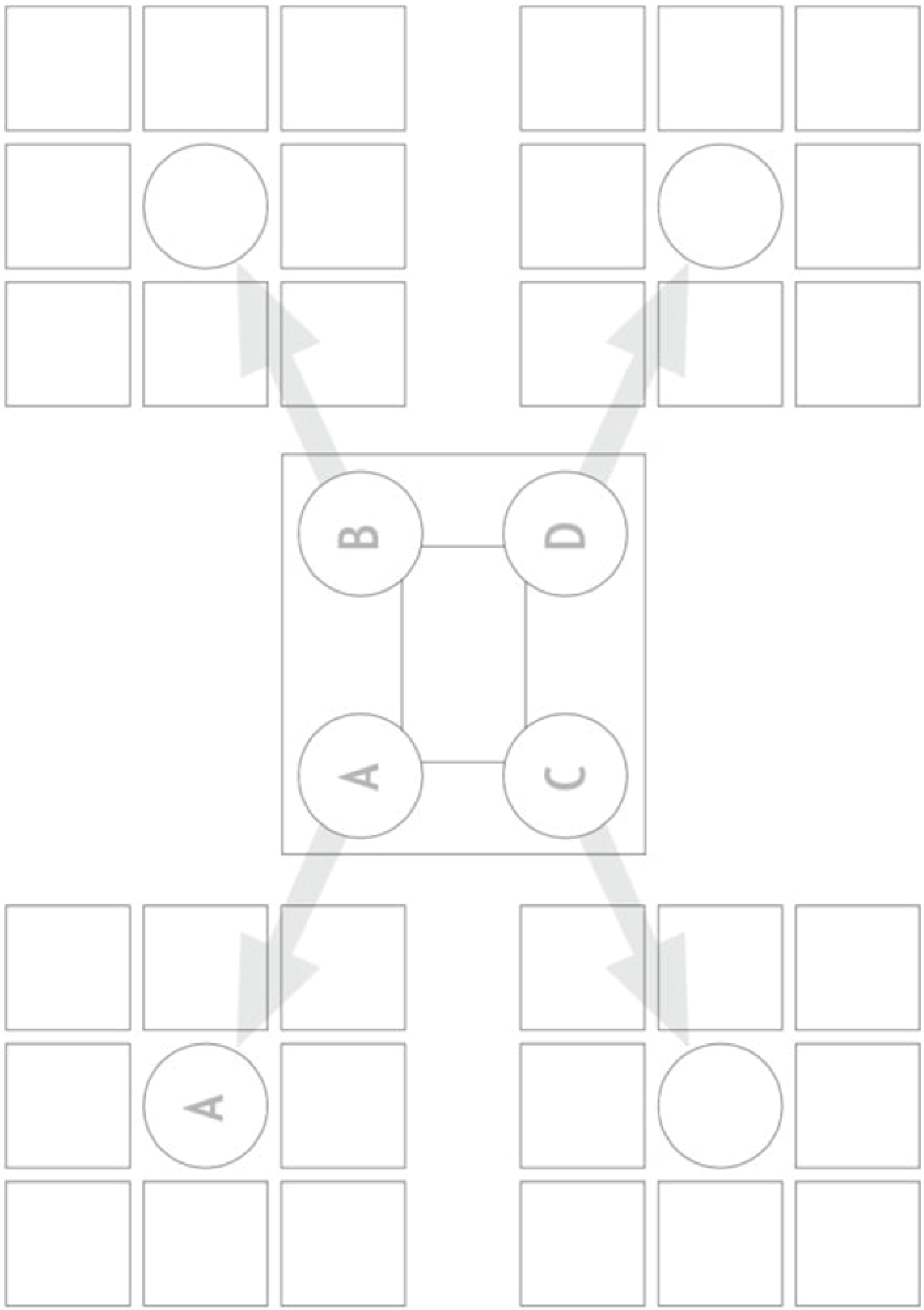
1. Emerald Ash Borers are an invasive insect which lay their eggs under the tree bark over the winter. They cannot survive if the temperature goes below a certain temperature. At what temperature do you start seeing the beetles surviving in the simulation?

2. As the emerald ash borers increase, and forest health decreases, more bats start to appear. As they are an endangered species that roost in dead trees, this would seem to be a good thing, but they suddenly all disappear. Why do you think that might be?

3. 43 insect species rely mostly on ash trees, and woodpeckers rely on those insects in turn. What do you think happens to the insects and the woodpeckers over time?

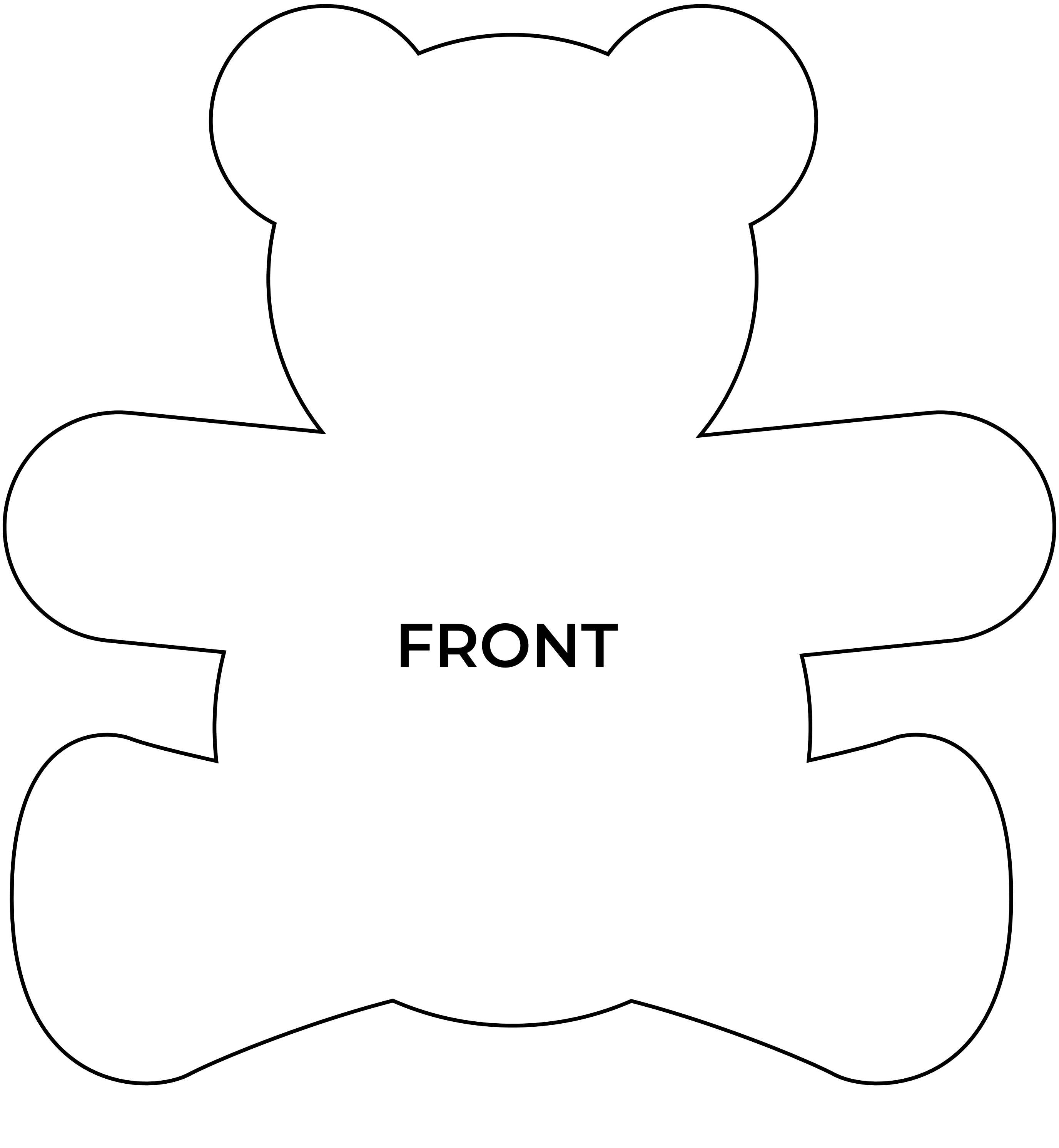
WORKSHEET E

Floating Cities



APPENDIX 2

Patterns (Repair Toolkit)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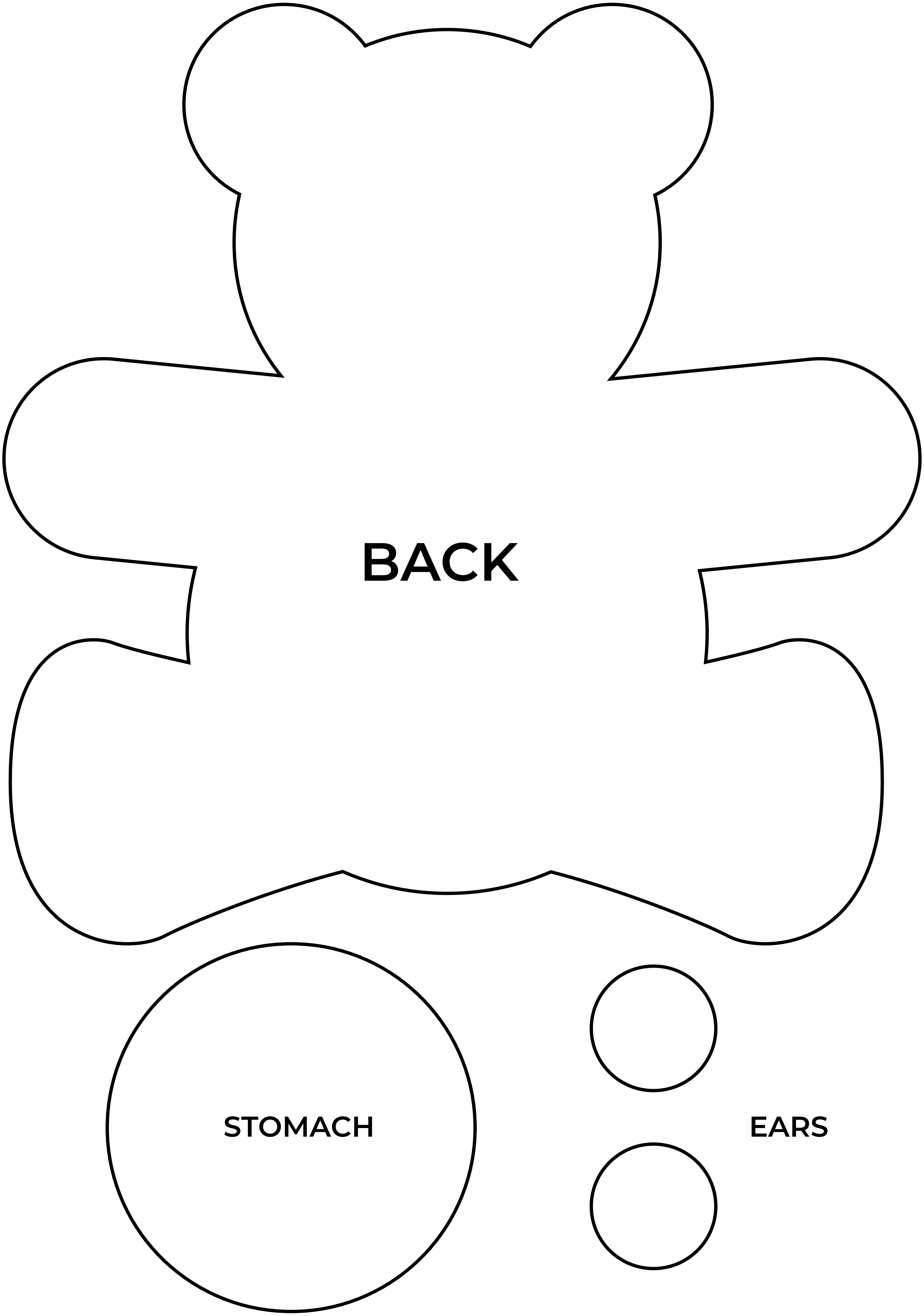
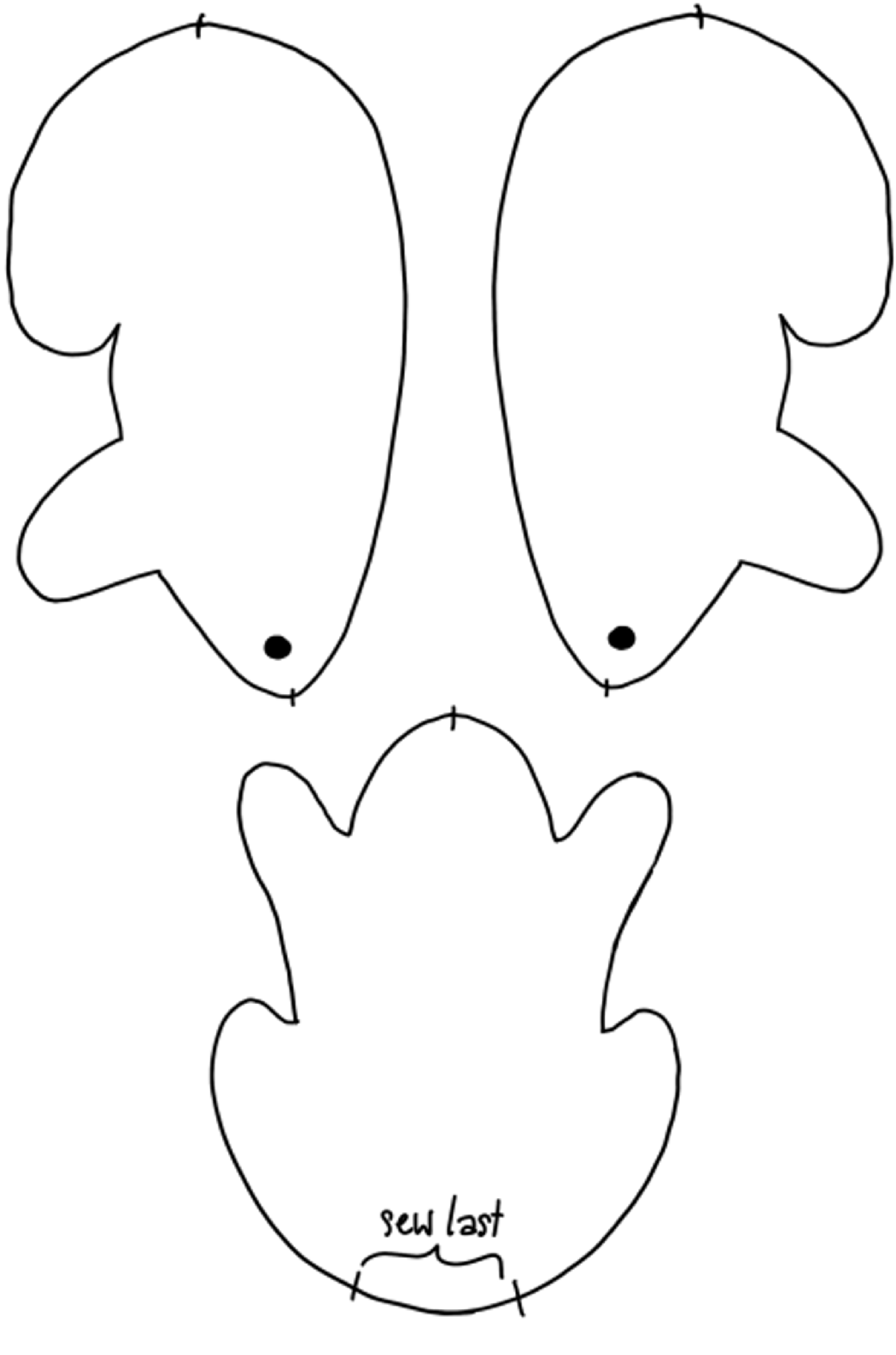

BACK
STOMACH
EARS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OUR

CLIMATE QUEST

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