Sample Climate Change Unit
Habit-of-Heart: Oneness

Sense It Step

[Before class, make a picture of the carbon cycle available or sketch it on the board for use during the introductory steps.]

Place your hands on your lower ribcage, so you can feel your own breathing. Listen to the sound of the air coming into your lungs and moving out. Watch as everyone in the class breaths together. What comes into your lungs? [Oxygen] What do you breathe out? [Carbon dioxide]

Look at a plant in the distance. Can you see it breathe? What is it taking in? What is it breathing out? Do you feel a sense of oneness with the plants, who take up what we give away and who receive the air we give them?

Whenever you think about the balance needed in life, bring yourself back to this moment, this awareness of the natural exchange of resources between living beings, and think about ways to protect or restore that process.

See It. Say It. Shape It. Synchronize It.

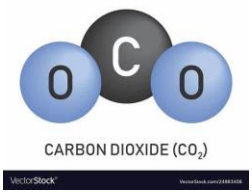
Write the word Oneness. Sketch the earth in the “O”. Clap out the two syllables. Sing or chant them in a way that becomes a morning chant throughout the unit.

Symbolize It.

This unit of oneness will show us what we can do to protect the balance of nature and to help humanity from the impacts of climate change. It will also help us understand the processes nature set in motion long ago to create balance.

First look at the formula for a carbon molecule. We find carbon many places in nature. We need it, in just the right amounts and places, to sustain life. What gesture can you imaging that suggests balance when you look at this image? (They may choose fists with thumbs up or some other symbol.) When you see one another exhibiting balance, feel free to use this sign to encourage each other. Now we need three people to come to the front of the room and represent a carbon molecule.

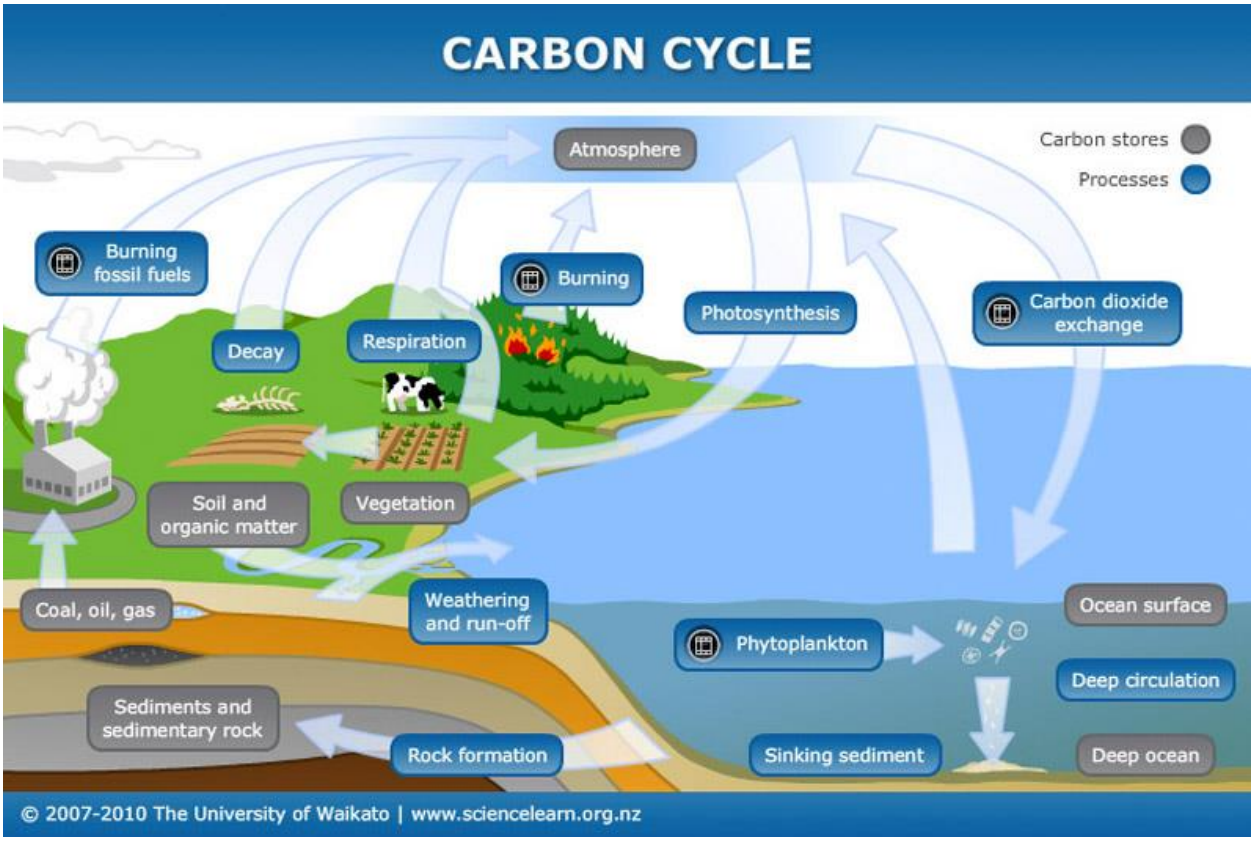
[These three lock arms.]



Storytell It

Before class, present the picture of the Carbon Cycle, either on paper or sketched on the board. This cycle demonstrates the way earth's complex systems work together when carbon emissions are in balance.

In class, ask students to list the elements of a story (e.g., a main character, drama, cause and effect, etc.) Ask them to listen for these dramatic elements as they listen to a story about oneness in nature—the story of the carbon cycle.



The Main Character in the Climate Change Story

Carbon and methane drive the rapid rise of climate change more than any other greenhouse gases. Carbon emissions have increased ever since people began to drive cars and buses and as factories began to operate using coal. Petroleum products, such as gasoline, oil, and even plastics all come from fossil fuels, named for the creatures whose bones liquified far beneath the earth to create these substances. If we leave the fossil fuels there where nature put them; in other words, if we "sequester" them

underground, we may be able to stop emitting carbon and slow down the effects of climate change. That would make life easier for our human species and for the family of all living beings. Understanding the carbon cycle, then, helps us realize where carbon comes from and how to keep it in balance.

Divide the class into ten read-aloud groups. As the “carbon molecule” travels through the carbon cycle, each group will stand and read its step with the teacher. After hearing the descriptions, the three molecular students will act out the motions of the journey.

[The group readings help students listen to one another for correct pronunciations. Standing sends adrenaline to the brain for increased engagement.]

Explain that the carbon molecule is helpful in sustaining life, but only in the right amounts. How will the class keep this molecule in balance?

What happens when there is an imbalance—when we have too much carbon in the air, for example?

Ask ten students to come forward to demonstrate the carbon cycle. Hold up an object representing a carbon molecule. Pass it along the chain of students, who will each hold it as they read their step.

Group Readings:

1. Earth’s atmosphere is full of carbon, mostly made of carbon dioxide with some methane and hydrofluorocarbons. The amount of carbon dioxide in the atmosphere is increasing.
2. When you eat bread or rice, you are eating carbohydrates. Plants eat carbon as carbohydrates. Land plants absorb one fourth of all the carbon in the air, so grasslands and forests are nice beds for carbon. We also call them carbon sinks.
3. Trees can store a lot of this CO2, so we like to plant them. When we cut or burn trees, we release carbon into the atmosphere. Decaying plants and ash return to enrich the soil.
4. Wildfires that burn trees in large numbers speed the rate of climate change.
5. The ocean helps to store carbon. At any time, there is about 60 times more carbon in the ocean than in the atmosphere. Much of the carbon *came from* the ocean in the first place.
6. Ocean fish like to eat zooplankton and phytoplankton--microscopic animals and plants. Some of these have tiny shells.
7. As the plants and animals die off and sink to the bottom of the ocean, their shells settle and may not return to the surface for centuries.
8. Some shells wash up as sediment and become trapped in rocks when the earth’s underground tectonic plates shift, forming gas and oil.

9. Meanwhile, plants and animals breathe in the carbon (or CO2) and breathe out the oxygen that humans need. They fertilize bigger plants, and these plants and trees use the sun's energy to make more carbon.
10. As plants decay and fall into the soil, the microbes and soil animals (such as worms, insects and fungi) break down the dead plant material, releasing more carbon dioxide into the air. All of this is called the carbon cycle.
11. Rain washes minerals from rocks. Some of them, such as calcium carbonate, add to the sediments at the bottom of the ocean, and the process starts all over again.

Follow-up

Using the picture, the students who read will later draw their portion of the carbon cycle, to create a larger mural or poster.

Discussion Points

This carbon molecule is helpful in sustaining life, but only in the right amounts.

What happens when there is an imbalance—when we have too much carbon in the air, for example?

How can the class keep this molecule in balance?

As we strive to do so, we will practice oneness, not only as members of a classroom family, but as protectors of earth's family of living beings.

Sing It

During music time, encourage students to think about how to promote balance within natural systems. Ask them to imagine how a hike or a ride on a mountain will bring a beautiful view of the land and sky. However, a railway ticket will not buy a return to the past once human decisions create imbalance in the environment.

Learning all we can about our options allows us to make good choices. Here are just a few examples of questions students could research:

- Where could a family to learn which cookstove prevents the release of too much carbon into the air?
- As a nation develops its energy plan, to bring electricity to more homes, how can leaders make more of the energy is renewable? What options exist?
- If you had a taxi company, what types of cars could you buy, to reduce the use of fossil fuels? Where would you get them? How would you operate them?

- If you wanted to choose regenerative ways to manage farmland, what priorities would you consider? What methods could you compare?

Study the words of the song, Cool Summer Day, on page 9 of the songbook Change Agents.

Listen to the song, identified as Track 1 on the Change Agents CD. (Go to the Audio section for Educators, at www.fullcirclelearning.org.)

Challenge the students to sing the high and low parts and prepare to teach others about the importance of their choices for creating balance.

Show It

This step offers another chance at role play, often involving the five steps of conflict resolution. In this case, we will look at three nuanced opportunities to generate oneness. Choose three different pairs of students to demonstrate the role plays, with the class acting as the conscience. This step may also be introduced after the academic content has been covered.

1. **Personal Challenge**
   Oneness is the goal of each of the conflicts to be resolved. The first demonstration asks that two learners represent the positions of brothers deciding how to spend their summer. One thinks they should plant new trees. The other things they should teach people how to use cookstoves that do not need kindling from existing trees. They both share resources and must work together. How will they practice oneness in their family to show they care about climate change?
2. **Community Challenge**
   Pests are plaguing the farms and the soil has been depleted. Researchers have come to the community about a chance to compare alley farming with slash and burn farming. (Introduce the information in the Agroforestry section.) Two farmers on the conflict bridge disagree about whether or not the community should participate in the study or not. They both care about the oneness of all and about feeding the families. They both have different ideas on what will work best to help farmers in a changing climate over the next tend years. Help them strive to reach oneness on the conflict bridge.
3. **National Challenge**
   In this imaginary challenge, weather disasters have affected certain regions. People have fled and migrated to other areas. They want food and help from those living in farm-rich areas. Two leaders must debate whether to allow for the immigration of new residents in a country without enough funding to help all the residents already asking for new roads, clinics and teachers. One partner wants to require that people bring in a new skill if they change

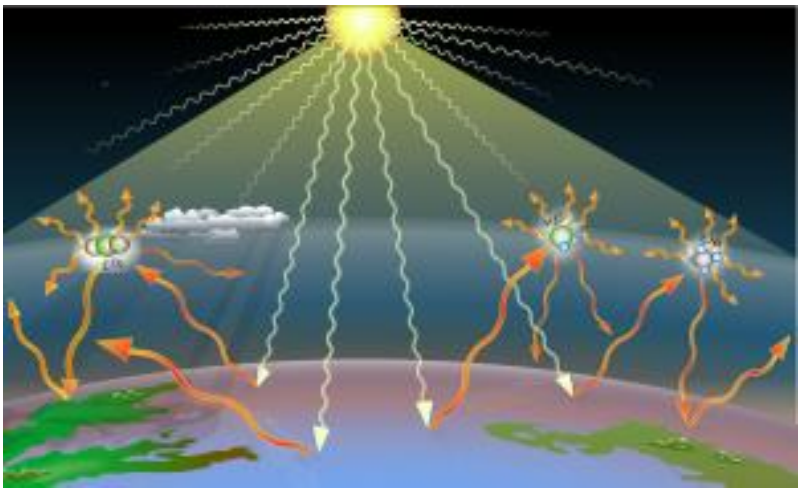
residency. The other wants to require that each newcomer pays a tax, even if they are coming to escape hunger, illness or disease. The migration has begun. How will these leaders think about oneness as it relates to their human family? The class can act as their conscious as they work it out on the conflict bridge.

Standardize It

(Activities that connect grade-level content requirements to the unit projects)

Science

Understanding Rising Temperatures



Earth's average temperature has risen at increasingly and will continue to do so between now and 2100, climate scientists tell us.

Even a rise of 1 to 5 degrees Celsius or 2 to 9 degrees Fahrenheit will change our weather patterns in dramatic ways. Draw the image to on the board to illustrate this effect.

What has caused the increase in temperatures? As gravity brings heat from the sun, heat also rises. (To show this principle, put an ice cube in a cup on the ground. Put another one on a higher surface, in the sun, covered by a glass. Ask students to check them both in ten minutes to see which one is melting.)

As the sun sends its UV rays to the earth, some rays bounce back, only to stop again at the top of earth's upper atmosphere. The earth's umbrella creates a "greenhouse effect," trapping the gases and preventing the earth from cooling. This effect raises temperatures, redirects winds, changes condensation and transpiration patterns, and interrupts weather cycles and systems. As a result:

1. We see pattern shifts all over the earth, in the form of more hot days, more severe storms, longer droughts and more deforestation.
2. Polar countries experience melting glaciers, leading to sea rise and shrinking islands around the world.
3. Animal habitats change, faster than some animals can adapt, and biodiversity suffers.

4. Equatorial become hotter and more humid, increasing the likelihood that bacteria, disease-carrying mosquitos, and garbage-eating rodents will thrive, impairing human health.
5. Floodwaters rise in swollen rivers as weather systems collide and clouds burst suddenly. If the water becomes contaminated, the people become ill.
6. We see shifting growing seasons, with unseasonal heat waves or cold snaps, and the crops may be pollinated on schedule. Fruit-bearing, nut-bearing trees also fall under the weight of snow where it never fell before. Farmers cannot dependably grow foods that once grew in a region.
7. As plants, animals and humans struggle to stay in their homelands and escape these challenges, we may see forced migration.

If you are able, view the following video, for a concise summary.

Greenhouse Effect and Global Warming | Environmental Science | LetsTute

Scientists are learning more each day about how we can educate the next generation to reduce the future impacts of climate change. Delve more deeply into the strategies that will shape our thinking in this changing world.

Who are the Culprits?

What causes the increase in temperatures? Seven greenhouse gases in the air, such as methane and especially carbon dioxide or CO2, trap the heat under the ozone layer.

A greenhouse gas (GHG) absorbs and emits radiant energy to cause the greenhouse effect. The primary greenhouse gases in Earth's atmosphere include water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3).

Without these gases, the temperature of Earth's surface would be much lower, as much as 18 degrees lower or 59 degrees lower in Fahrenheit. To test the potential effects of rising heat and greenhouse gases, conduct these two student experiments:

1. Heat or Greenhouse Gases?
    - Place a glass of cool water on the ground.
    - Place another glass of water on a table or chair, in the sun. Cover it with a larger clear glass, upside down.
    - In 15 minutes, check the water inside the two containers to see which is cooler. Develop a hypothesis. Did heat rise, or did the glass ceiling create a greenhouse effect?
    - Redo the experiment without the glass, using new water, to check your hypothesis.
2. Observe the Impact
    - Place a small potted plant in the shade outside the classroom. (It may be a small plant you have grown in a cup.)

- Observe the plant's leaves early the next morning. Are the undersides wet with dew? Is the soil moist from the dripping dew?
- Next, move the plant to the bright sunlight.
- Check the leaves again in the early afternoon. Are they dry? Is the soil moist or dry?
- Next, place the clear glass over the plant. Check it in one hour. Is the inside of the clear glass wet or dry? Is the plant drooping or fresh?
- What "climate impacts," if any, did your experiment create? Do you have a new hypothesis based on these weather conditions? Do you need to retry the experiment tomorrow?

Agronomy

Alley farming describes a method in which landowners plant hedgerows (border rows) of trees or taller plants with rows of crops in between. Nut trees or bean trees, for example, provide rich nitrogen and shade, preventing erosion. Livestock can feed in alleys as well, adding to the fertilizer in the alleys.

The more traditional slash and burn agriculture is the process of cutting down the vegetation on a particular plot of land and setting fire to the foliage just before the rainy season. New plants are grown in the enriched, ashy soil. A cleared area may be burned again in a decade, when the vegetation is thick again and pests have increased.

Slash and burn practices allow people to farm in regions otherwise difficult to cultivate. However, the practice brings several environmental challenges with it.

- Deforestation: With widespread use, lands do not have time to recover, and forests are lost forever.
- Erosion: Roots and underground water storage systems are lost when too many fields in a single area use slash and burn.
- Desertification: Overuse of the technique robs the soil of nutrients, and it becomes desert-like, leading to poor crop yields.
- Biodiversity Loss: Species that live in a burned area may not have other habitats and can become endangered or extinct as their living spaces diminish.

Too many fires can also release extra carbon into the atmosphere. However, in experiments comparing alley farming with slash and burn, some farmers returned to the traditional method because they could not afford the extra workers to prune their hedge rows. Practices that enrich the soil in both the short- and long-term require community commitment and record-keeping to track the results over a long time.

Social Science

How do Nations Define Sustainable Development Goals?

The “sustainable development” goals for the United Nations ask people to think about help us sustain (or continue) life—by ensuring that everyone has enough to eat, enough health care to feel comfortable, enough education to live a good life, and enough equality that women can share opportunities with men and that everyone has a chance for happiness.

Think about how climate change affects these goals. Today, some scientists talk about regenerating the earth. They believe we can reverse the impacts of climate change if we work together on fresh ideas and if everyone cares equally about everyone else.

Some of the efforts we make will succeed only if we learn to work peacefully with others to:

1. Learn the science of climate change.
2. Relearn practices that cause climate change.
3. Use regenerative farming techniques.
4. Teach prevention of diseases brought on by climate change.
5. Restore habitats.
6. Protect carbon sinks (forests, grasslands, and oceans).
7. Reduce fossil-fuels in energy plans and transportation systems.
8. Advocate for the vulnerable.
9. Make life choices that protect the human family and for all living beings.

Leadership Role Play

In the following example, the learners imagine that climate change has increased pest infestations in a certain part of the country. The crops have been affected, and there is not enough food to go around for everyone. War is about to break out, with people from one town stealing it to take to another.

1. You are kind and fair community leaders. In small groups of three or four, discuss the approach you will take to make sure everyone has enough to eat. You must also decide how to prevent a war.
2. Share your thoughts with the group across from you. Did you have the same thoughts? What ideas can you learn from one another?
3. Volunteer to role play your best ideas for the class. How did you first prevent war? How did you make sure everyone had food? Did you teach new skills in farming? In conflict resolution?

4. Create a Venn Diagram on the board to see how many groups used the same practices to help people learn not only science but social skills to adapt to climate change impacts.

Mathematical Reasoning

1. Greenhouse gas levels before the Industrial Revolution stood at 280 parts per million. Challenge students to guess what they were they after the Industrial Revolution. [380 parts per million] Draw a graph on the board to convey the ratios and infer their meaning. [Emissions increased by one third with industries using fossil fuels or pumping greenhouse gases into the air.]
2. Many people in a country such as Liberia remain without electricity, keeping the carbon emissions from electric power plants quite low. Hydroelectric, the main energy source, is renewable. Charcoal fires emit carbon, however, and, over time, will dimmish forests, so learning to use efficient cooking, heating, lighting and cooling methods is still important.
3. Draw a Venn diagram. Ask students to guess the impact of fossil-fuels as the country develops. For example, if 10% of people had electricity at home and 10% worked in buildings with electricity, and 2% of people fit into both categories, what percentage would enjoy the benefits of energy? [8%]
4. If 3% of future energy sources come from fossil fuels, and the rest come from renewables, how much will greenhouse gas levels increase? [For example, if they increase by one third when a new region becomes industrialized, based on our first statistic, then if you divide 30% by 3, perhaps 10% more greenhouse gases would enter the atmosphere.] Graph this on the board.
5. What can we conclude? [We can conclude that it is important to continue choosing nonrenewable energy sources, such as solar, hydroelectric, and wind.] Below: 1. Full-Circle Learning student Benetta studies solar panels at EnDev. 2. Liberia's hydroelectric plant at Mount Coffee.

Art: Depicting Signs of Oneness in Nature

Photo by Joey Kyber

Look for the patterns in nature that show how trees work in concert with one another or how they unfold, in due time, to reveal a unifying process with the soil and air. Hold your index fingers and thumbs to frame what you see. Draw a picture of oneness. Write about what you have drawn. For example:

An average tree, after 25 years, stores 400 pounds of carbon. For this reason, a forest is called a “carbon sink,” as it holds carbon and gives off oxygen for humans and mammals to breathe.

The tree also feeds the plants. Have you counted the tree rings in a stump? The patterns demonstrate how logically nature builds a tree, ring by ring, year by year. Made mostly of cellulose, the tree is about one third carbon, and when a tree burns, carbon dioxide is released into the atmosphere. The ash returns to the ground, creating carbon benefits for the next generation of plants. The carbon would also be released if the tree died naturally and sent its carbon and other nutrients to other trees through its roots. A network of underground fungi help maintain the health of the forest when a mother tree dies.

These processes remains as long as we protect nature’s balance. If too many trees are cut for human purposes, we create deforestation. If natural fires become overdue and turn result in rampant wildfire, dangerous levels of carbon dioxide and carbon monoxide linger in the smoky air even after we can see the smoke. Protecting oneness means evaluating whether our actions regenerate or degenerate earth’s systems.

Would you draw the underwater if you could? Beautiful patterns appear there as well. The picture below shows the artwork resulting from a “bloom of jellyfish.” It appears lovely at first, but does not always bring balance, when too many jellyfish gather in one place.

A jellyfish can weigh less than an ounce and be 2/10 of an inch in diameter, or it can be larger than a human. Older than the dinosaurs, these zooplankton have existed in our oceans, well, almost forever! Some are eaten as a delicacy, but others can sting with their poisons and bring more drowning deaths per year than sharks.

Today they tend to interfere with the food supplies of certain fish, and, in the age of climate change and its warmer ocean waters, the jellyfish try to cluster in cooler swells. Blooms such as this one have been known to clog and shut down offshore power plants. Where jellyfish are out of control, they too can release too much carbon into the water and atmosphere.

You see, on land or sea, we need balance to protect the beauty and oneness of life.

Photo by Enric Cruz López

Share It

Plants as Communities

Present the world underground as a community. The topsoil, about six inches high, contains carbon that rotates in and out of the air with the seasons. The plant roots release carbon-packed sugars into the soil, then eaten by microorganisms. An underground neighborhood of fungi, algae, ants, insects, worms and other creatures eats, reproduces, and metabolizes waste, recycling the carbon and other nutrients that plants need to grow and to produce the oxygen that humans breathe.

Regenerative land also prevents erosion and holds up to 30 percent more water, improving the productivity of farmland. Remember the texture of the soil in the experiment? You may have noticed that the fungi had created a substance called glomalin, rich in carbon, which remains in the soil for centuries.

If a tiller, a plow, or shovel crashes into the community of underground life, it disturbs this community. The more we leave it alone, the greater the chances the carbon will be stored underground in what we call a carbon sink, not above ground in the air we breathe and the air that disrupts the climate.

Some movements around the world also suggest giving the garden back to the animals that live above ground—allowing biodiversity to thrive. Rather than digging a garden, allowing the indigenous creatures to run through it restores the balance of nature through fertilization.

Gift of Information

Try an experiment on a local farm to share the information with the farmer.

1. Using a shallow pan of water, scoop a handful of soil from a regenerative patch of farmland. Swish it around. Have them observe the results.
2. Obtain a second fresh pan of water. Move to a patch of land that has not experienced the benefits of regenerative agriculture. This time, as a handful of dry dirt enters the water, it will most likely swirl into the water, creating either reluctant mud or streams of light brown on the water's surface.
3. In the first pan, the soil should have been less likely to mix, holding its moist "dark earth" microbial structure intact rather than eroding when faced with an onslaught of water.
4. Challenge students to create a hypothesis about soil's resiliency to flood, storms and drought with the benefits of regenerative agriculture. They may share their observations of what farming strategies were most effective, so both farmers can shift their practices in a regenerative direction.

Send It

Renewable Energy Gifts

1. Help students realize their own capacity to create renewable energy. Several designs exist for homemade solar ovens with recycled cardboard and foil.
2. They can first experiment with several vegetables or stews to discover the easiest item to cook during school hours, then present the ovens to elders in need, with food enough for a first meal or two and instructions on how to use the ovens.

3. Challenge students to draw their own solar designs or solar inventions to send to a wisdom exchange partner school, locally or abroad, with letters about foods that cook easily in the ovens.

Sustain it

This step helps learners comprehend the value of reaffirming their ongoing habit, in this case Oneness.

1. Take a walk outside and ask students to imagine and list the creatures that live above ground where they live and think of ways to give some of the land back to these animals. For example, they may want to observe the number of roads that interfere with the animals' habitat. Digging pits also disrupts the soil and unleashes carbon. Fewer roads and car trips and construction sites would reduce carbon emissions while also allowing the animals to live in their homes.
2. Back inside, have one group of students draw the area around the school as it looks today.
3. Ask another group to draw it as it once looked, with fewer roads and cars and interruptions in the animals' homes.
4. Post the pictures side by side. As a class, brainstorm ways to protect life and protect the air for living things.
5. Have each student draw the classmate on their left. They will post the pictures of the classroom family next to the family of species and discuss how to protect the air for humans and to promote the oneness of their human family.

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