Green Teacher

EDUCATION FOR PLANET EARTH

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Two-Eyed Seeing: Integrative Science

Vitamin C Trees: Traditional Medicine

Linking Astronomy and Legend

Integrative Science with Native Elders

Resanctifying Nature through Story

Earth Alive! Ecosystem Deities

Teaching Solstices and Equinoxes

PM40069238

Page 11

Page 25

Page 39

Green Teacher

Issue 86, Fall 2009

Features

Departments

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Education for Planet Earth

Editorial

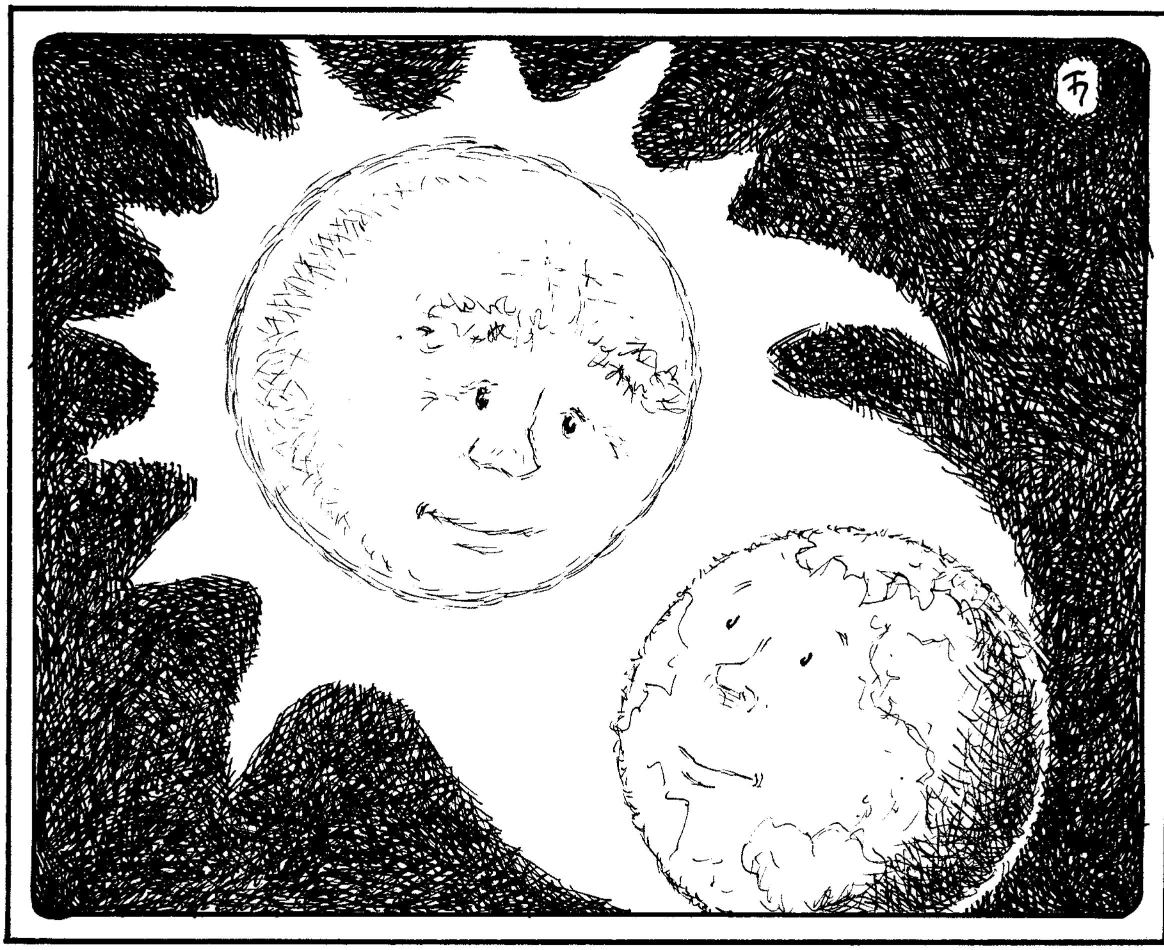
On an island in the middle of the St. Lawrence River, at the intersection of Ontario, Québec and New York, sits the Akwesasne Mohawk School. Twenty years ago, the school revamped the Grade 6–8 science curriculum so that their students could more confidently "walk in two worlds" when they left the island to go to public high schools across the river in Ontario. The program stressed the importance of local ecosystem knowledge, and graduating students were expected to recognize 50 local birds, identify the tracks of local mammals, understand the medicinal properties of plants, and be able to map the streams and rivers in their watershed. To facilitate such learning, Native elders accompanied students on numerous field trips during the school year. The new curriculum was so successful that teachers in non-Native schools nearby began asking if their classes could join the field trips. They recognized that the holistic, bioregional view of the environment imparted in Native science provided an essential counterpoint to the objective, analytical view imparted through Western science.

Having published the story of the Akwesasne curriculum project many years ago, we were excited to learn last year about the integrative approach to science education currently being taken by Annamarie Hatcher, Cheryl Bartlett and their colleagues in the Institute for Integrative Science and Health at Cape Breton University in Nova Scotia. Inspired by the concept of "Two-Eyed Seeing" developed by Mi'kmaq Elder Albert Marshall, their science program aims to help students learn "to see from one eye with the strengths of Indigenous ways of knowing, and from the other eye with the strengths of Western ways of knowing, and to use both of these eyes together." In this issue, we present some of the learning activities that they and others have designed for teaching science in this way, thus enabling students to take the best from both world views, Indigenous and Western.

Regardless of where one teaches, integrating the sciences and world views of local Indigenous peoples into the curriculum can be a fascinating inroad to a more bioregional education, one that enables young people to develop a strong sense of place, a respectful relationship with other species, and an awareness of their responsibilities as stewards of the land and resources they and future generations depend on. We hope you will find much in this issue to inspire your own teaching, and, as always, we welcome your comments.

— Tim Grant and Gail Littlejohn, Editors

Note about terminology in this issue:
Native Americans, First Nations, Aboriginal peoples, Indigenous peoples... depending on where you live, you may be more familiar with one of these terms than with the others, but they are synonymous. All refer to the original peoples of a particular region.
In editing this issue, we have chosen not to strive for consistency, but rather to let the individual authors use the terms of their choice.



Mother Earth, Grandfather Sun

A "two-eyed seeing" activity that integrates Western and Aboriginal world views in teaching about solstices and equinoxes

by **Cheryl M. Bartlett**

WESTERN SCIENCES tend to emphasize matter and energy and to encourage us to develop object-oriented minds, whereas consciousness is at the heart of the Indigenous sciences. Learning to ascribe consciousness to natural objects can change students' attitudes toward nature by fostering respect and reverence. This in turn may help to bring about the transformations in values and actions that are needed for more sustainable living.

"Two-Eyed Seeing" asks teachers and learners to acknowledge both Western and Aboriginal ways of knowing about nature. This exercise about solstices and equinoxes has students ascribing consciousness to an object which in the Western scientific view is inanimate — the sun. It is useful both in teaching the science concepts related to the seasons and in introducing students to Indigenous ways of "coming to know." While physical models for teaching this topic are plentiful, this exercise encourages learners to shift their consciousness to animate the sun — to "become" Grandfather Sun — and thereby enable him to see the Earth (Mother Earth). The exercise also provides an experiential foundation for discussion of the utility of models in the learning and doing of science, regardless of cultural perspective.

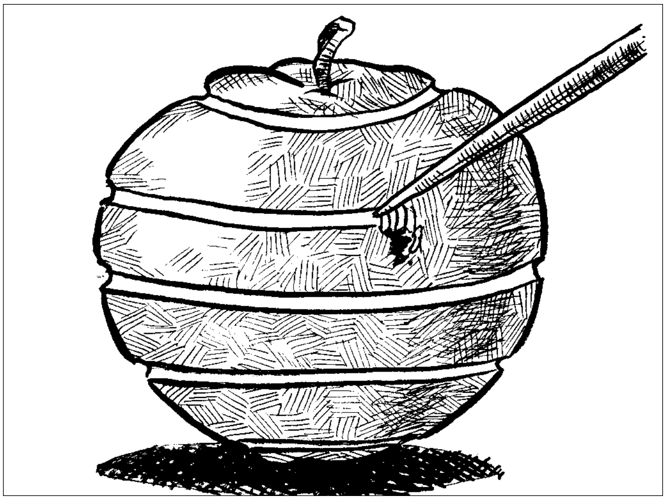
Introduction

In North America, Grandfather Sun and Mother Earth are common English-language renditions of Aboriginal peoples' names for the sun and Earth, respectively. In most Indigenous world views, both are animate. The exercise draws upon the visual sensibility of Grandfather Sun.

Time: 30 minutes

Grade levels: Grades 6–8

Materials: For each student, one apple (preferably round with a dark red peel such that scratching the peel will easily and readily produce distinctly visible white lines); one strong, thin skewer stick (at least 10 cm long); one thumbtack



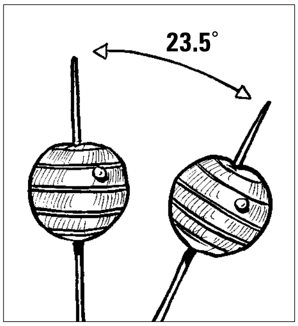
Marking latitudes on "Mother Earth."

Winter solstice in the northern hemisphere.

Procedure:

Mother Earth (the apple)

1. Provide each student with an apple, a skewer stick and a tack. Students will use the apple and stick to create a model of Mother Earth that has the geographical grid assigned to Earth in Western science.
2. Explain to students that the apple's stem and flower remnant (i.e., two oppositional points) mark the Arctic (or North) and Antarctic (or South) poles, respectively. Instruct them to create a latitudinal grid on the apple by deeply scratching the apple skin with the skewer stick as follows:
   - Mark the equator by scratching a line around the middle of the apple.
   - Mark the Tropic of Cancer by making a line around the apple about one-quarter of the distance from the equator to the North Pole (stem). Mark the Tropic of Capricorn by similarly moving about one-quarter of the distance from the equator to the South Pole. These two lines represent the tropics at 23.5° latitude north and 23.5° latitude south, respectively.
   - Mark the Arctic Circle by making a line about one-quarter of the distance from the North Pole (stem) to the equator. Mark the Antarctic Circle about one-quarter of the distance from the South Pole to the equator. These two lines represent the circles at 66.5° latitude north and 66.5° latitude south, respectively.
3. Push the skewer through the apple, from stem to flower, i.e. pole to pole, to represent the Earth's axis.
4. Ask students to determine the approximate latitude of their home location, and place the thumbtack in the apple at the spot approximating home.
5. Have students tip their apples 23.5° to represent Earth's tilt on its axis.

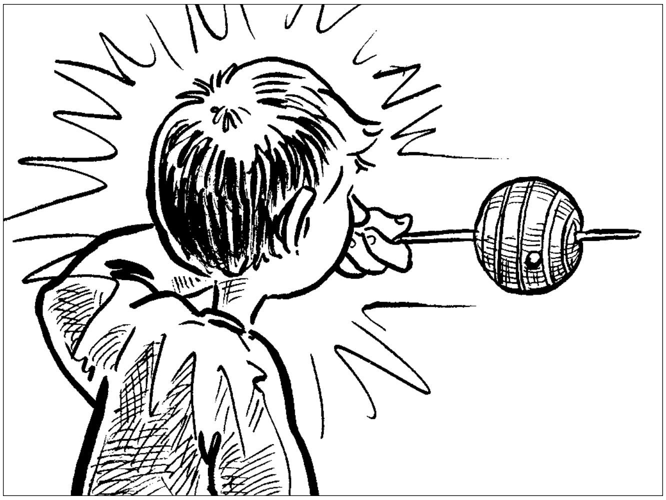


Grandfather Sun (the student)

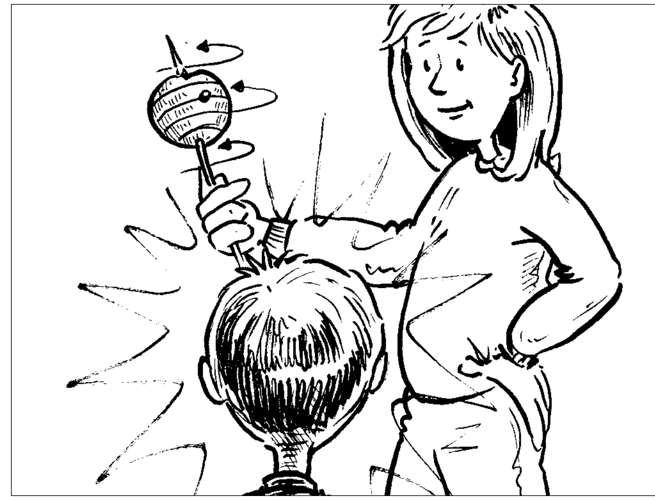
6. Next, Grandfather Sun is added to the model by designating the students' heads as the sun. The model now contains both the Earth and the sun, and can be used to demonstrate the seasons, with a particular focus on the solstices and equinoxes. Ask students to hold Mother Earth at arm's length at the level of their eyes, therefore enabling Grandfather Sun "to see" Mother Earth, i.e., mimic the sun's rays that fall upon Earth.

Solstices

7. Instruct the students to "become" Grandfather Sun and to tilt Mother Earth away from their heads (i.e., with the North Pole pointed away from Grandfather Sun) so that they can see up to, but only to, the near side of the Arctic Circle. In this position, Grandfather Sun should be able to see the South Pole of Mother Earth all the way across to the far side of the Antarctic Circle. (This may require a slight upward adjustment in the level at which the apple is held.)
8. Have students rotate the apple to mimic Mother Earth's rotation on her axis. As this happens, each student should come to realize that he or she (as Grandfather Sun) never sees higher on the apple than the line marking the Arctic Circle. This particular day is the winter solstice. At this time of the year, 24 hours of darkness would be experienced above the Arctic Circle (since Grandfather Sun never sees above that line), and concurrently there would be 24 hours of sunlight below the Antarctic Circle.
9. Have students reverse the position of the model so that Mother Earth remains on a tilt but the North Pole is pointed towards Grandfather Sun, i.e., the top of the apple is toward their heads. Instruct the students to, as Grandfather Sun, see the top of Mother Earth all the way across to the far side of the Arctic Circle (this may require slight adjustment in the tilt of the apple and/or slight adjustment in the level at which the apple is held). This position of the apple should enable Grandfather Sun to see the bottom of Mother Earth to the near side of the Antarctic Circle.



Spring and fall equinoxes.



Earth's orbit around the sun.

10. Again, have students rotate the apple to mimic Mother Earth's rotation on her axis. As this happens, students should come to realize that throughout the rotation they (as Grandfather Sun) can see across the whole of the top of the apple to the far side of the line marking the Arctic Circle. This particular day is the summer solstice. At this time of the year, 24 hours of sunlight would be experienced above the Arctic Circle (since Grandfather Sun always sees above that line) and 24 hours of darkness would be experienced below the Antarctic Circle.

Equinoxes

11. Shift the model 90 degrees, so that the North Pole (apple stem) points towards the left or right. As Grandfather Sun, the students should see the top of Mother Earth (i.e., the top of the apple) all the way to the North Pole but no further (this may require slight adjustment in the tilt of the apple and/or slight adjustment in the level at which the apple is held). This position should also enable Grandfather Sun to see the bottom of Mother Earth to, and only to, the South Pole.
12. Again, have students rotate their apples to mimic Mother Earth's rotation on her axis. As this happens, students should realize that throughout the rotation they (as Grandfather Sun) see as much of the top of the apple as they see of the bottom of the apple. These two particular days are spring and fall equinoxes. At these two times of the year, the sun is directly above the equator, and equal hours of sunlight and darkness are experienced.

In the demonstrations thus far, students have "become" the sun and created the sun–Earth relationship in front of their eyes. The strength of this heliocentric "in front of your face" depiction is that it readily enables students to understand that Grandfather Sun sees Mother Earth very differently on the winter versus summer solstices, and on solstices versus equinoxes, and that Grandfather Sun sees Mother Earth similarly on both spring and fall equinoxes. Explanations using the language of Western science can then be given. The weakness in this depiction is that it does not include Earth's orbit around the sun. This is addressed by adding the component described next.

An "around your head" orbit

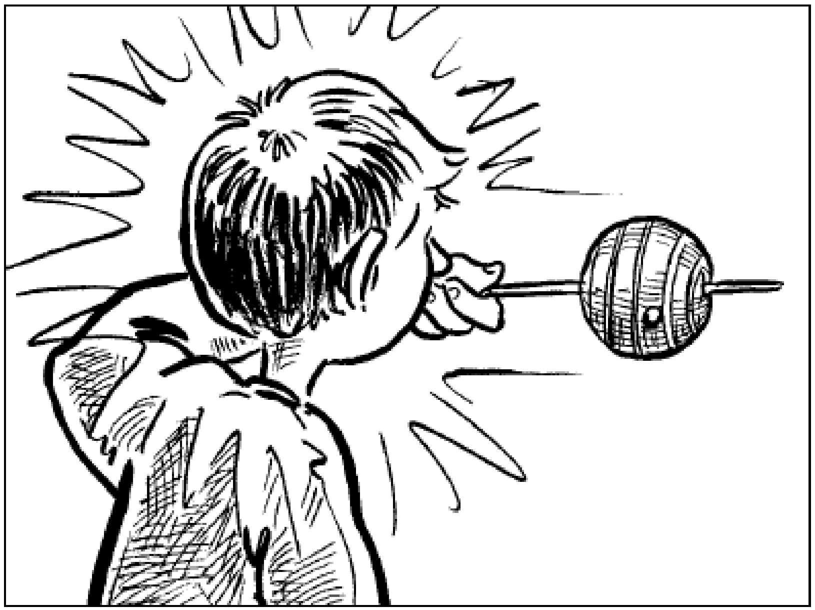
Once students have come to understand solstices and equinoxes, it is relatively simple to move them toward the more complex understanding of Earth's annual orbit around the sun. Students simply move the rotating apple 360° around their head while maintaining the required tilt (23.5°) of the Earth on its axis. This is easiest if the equinoxes are aligned with the ears. For example, if a student starts with the summer solstice directly in front of her, then movement along Earth's orbit takes the apple to the left ear for the fall equinox, behind the head for the winter solstice, to the right ear for the spring equinox, and back in front of the face to complete one full year. The difficulty in doing this resides with the student trying to retain Mother Earth (the apple) on her consistent, required tilt while also rotating her and also orbiting around Grandfather Sun (the student's own head). This gymnastic challenge is easily overcome by having two students work together, one being Grandfather Sun (but standing still) and one moving in a circle around the sun while rotating the apple on its axis. An additional request could be to have the student who is Grandfather Sun rotate to "see" Mother Earth (the apple) through all four seasons.

Questions for discussion

1. Sun rays

- What is the relationship between the sun's rays (or sunshine) and Grandfather Sun's "seeing" in this model? *(Grandfather's "seeing" represents the sun's rays.)*
- How are the sun's rays described in Western science? *(As waves of electromagnetic energy.)*
- In the summer, do the sun's rays feel warm or cold on your skin? *(Warm.)*
- Do you think Mother Earth can "feel" the sun's rays as you can? In what ways is the answer yes, and in what ways no? *("No" in that although sun rays do warm surfaces, Western science does not ascribe the sensory ability "to feel" to the Earth. "Yes," indirectly, in that life on Earth ultimately depends on sun rays and some life forms are capable of feeling.)*

Green Teacher; Fall 2009; Issue 86; Page 31



Spring and fall equinoxes.

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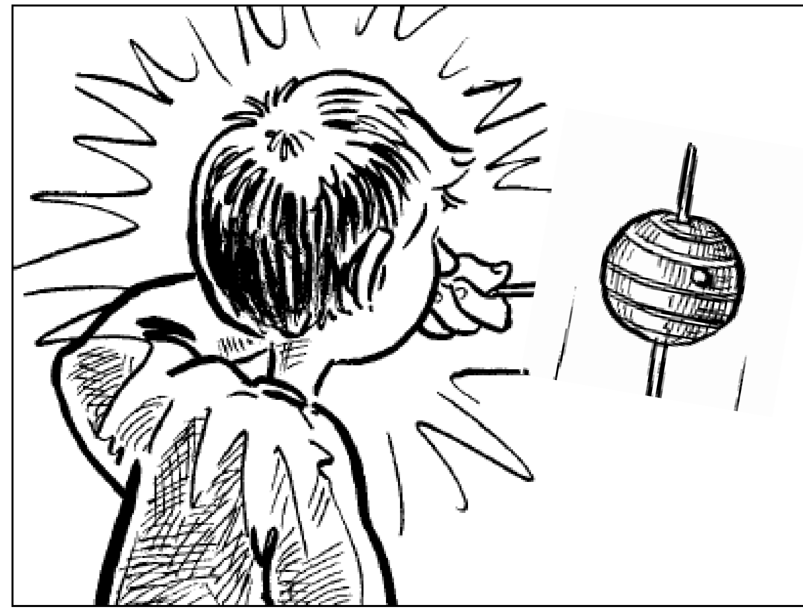

Spring and fall equinoxes.

correct

2. Daylight and darkness

- When Grandfather Sun sees Mother Earth's surface, does that part of Mother Earth experience this as light or darkness? *(Light, i.e., day time. Regions that are out of sight of Grandfather Sun experience darkness.)*
- In the United States and Canada, what day of the year has the shortest period of daylight? Is this a solstice or an equinox? Which one? *(winter solstice.)*

3. Hemispheres

- What part of the apple corresponds to the northern hemisphere of Mother Earth? *(The entire region north of the equator.)* What part corresponds to the southern hemisphere? *(The region south of the equator.)*
- In what hemisphere are United States, Canada, Australia? China? Argentina? Mexico?

4. Solstice

- When does Grandfather Sun see the greatest area of Mother Earth's northern hemisphere? *(At the summer solstice.)*
- In United States and Canada, what day of the year has the longest period of daylight? *(The summer solstice.)*

5. Equinox

- When does Grandfather Sun see an equal amount of area in both the northern and southern hemispheres? *(At the spring and fall equinoxes.)*
- At this time of the year, what is the relationship between the periods of light and dark in one whole day? *(They are equal.)*
- What does the "equi" in "equinox" mean? *(Equal.)*

6. Model manipulation

- How much would the Earth have to tilt on its axis in order for Grandfather Sun to be able to see all of the northern hemisphere all the time? *(This would require a 90° tilt with the North Pole pointed at the sun.)*
- What changes in the periods of light and dark in a day would this produce in the area where you live? *(In the northern hemisphere, daylight would occur all day, all year.)*
- Is there any planet in our solar system where this type of tilt does occur? *(Uranus has a tilt of 98°.)*

Cheryl M. Bartlett is the Canada Research Chair in Integrative Science and a Professor of Biology at Cape Breton University in Sydney, Nova Scotia.

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