Adapted to STEMAZing ECE Format by
DaNel Hogan
DaNel.Hogan@schools.pima.gov
Director of The STEMAZing Project

Time Flies:
Day, Night, Week, Month, Year

NOTE: Children should always be given ample time to experiment, notice, and wonder before they are provided an explanation.

Always engage children with our two favorite questions:

What do you notice?
What do you wonder?

Resist the urge to answer any questions children have while exploring. Instead, respond back with questions to children and let them make sense of the world. Sample questions you might use: What do you think? Do you notice any patterns? What could we change? Can we test something else? What can we try next? If children ask a testable question, which they could answer by doing an experiment, talk through with them how they might design a test to help answer their question. As much as possible and within reason, let them test their questions by trying the experiments they propose.

Learning Objectives
Children will…

- create a model of Earth rotating on its axis.
- use the model to demonstrate a day and a week by making the model Earth rotate.
- use the model to demonstrate a year by revolving around the Sun.
- recognize which half of the Earth is experiencing day and which half of the Earth is experiencing night.

Key Questions

What causes day and night on Earth?

What happens to Earth relative to the Sun as a year passes by?

Vocabulary (See **What the heck? Explanation of Science** at the end for definitions.)

Sun	Orbit	Rotation	Week	Model
Earth	Revolution	Day	Year	

Materials

sharpened pencil	3” Earth stress ball	LED flashlight or lamp with shade off

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Advanced Teacher Preparation

Sharpen a pencil and stick it into the middle of Antarctica at the bottom of the 3” Earth stress ball Styrofoam ball, as the image on the first page shows. **NOTE:** Multiple children or even all the children in your class can do this activity at the same time. Each child will need a 3” Earth stress ball with a sharpened pencil pushed into it.

Notice and Wonder Developmentally Appropriate Practice

1. In a dark room, set up the flashlight on one side of the room and clear space on the opposite side of the room.
2. Explain to the children that in this model, the flashlight is the Sun and, obviously the Earth on the end of their pencil represents Earth.
3. Demonstrate how Earth’s axis is tilted a little bit – 23.4° to be more precise. Encourage children to hold each other accountable – no straight axes!
    - NOTE: They should be rotating Earth to the right or counterclockwise as you look down on the top of it. Remember, the Sun rises in the East first and then sets in the west.
4. With Earth’s axis tilted, children should rotate Earth and make observations.
    - Ask them what they notice.
5. Ask children to show you where the Earth would be if we stopped it at sunrise or at sunset. (This also means they know where they are on the globe. You may want to add a push pin to their location to make this easier for younger children.
6. After they have had some time to make observations, you can explain and demonstrate that it takes one day (24 hours) for Earth to rotate on its axis.
    - Point out that half of Earth is lit up and experience daytime and the other half is dark and experiencing nighttime.
7. Once children understand what a day is, one complete rotation, have them demonstrate a week by calling out Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, and Saturday as they rotate Earth one rotation for each day they call out. You can also have them count to seven to represent a week as well.
8. Once children understand a week, ask them how many days are in the current month. For children who can count that high, have them demonstrate a month using their model.
9. A year is 365 days and it also corresponds to the amount of time it takes for Earth to make once complete revolution around the Sun. If you are using a flashlight you will have to point it at the children as they revolve around the Sun. If you are using a lamp without a shade, it should be releasing light in all directions like the sun does.
10. Have children walk around the sun while spinning the Earth as fast as they can to represent the days that are passing. When they get back to where they started, announce that a whole year – 365 days – has passed.

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Children should notice…

- when Earth rotates one complete rotation on its axis, a day has passed.
- when Earth has rotated 7 rotations, a week has passed.
- Earth rotates the same number of days there are in a month.
- one trip of Earth around its orbit, revolving around the Sun, is equal to a year. (Note: if we wanted to count that high, Earth would have rotated 365 times during that time.)
- half of Earth is always lit and experience day and the other half is always dark and experiencing night.

Extensions for Additional Learning

As always, ask the children throughout the experiment what they notice and what they wonder. If their wonder questions are testable, as much as possible and within reason, let them test their questions by trying new experiments.

See below for examples of what they might wonder and experiments they might do to test their wonderings. NOTE: Some of their questions may be answered in the What the Heck? Explanation at the end.

- I wonder how long days are on other planets?
- I wonder if the moon rotates?
- I wonder how long a year is on other planets?
- I wonder what would happen if Earth stopped rotating?
    - Let them try it or look it up on the internet!
        - Many of the questions they have will be things you can look up on the internet – a day on Venus is 5,832 hours while a day on Mars is 25 hours.
        - Let them experiment with different ways to make Earth orbit the Sun.

Differentiating Developmentally Appropriate Practice

For younger children, you can hold Earth at the correct positions and tilted the right way. Then rotate Earth on its axis and let the younger children make observations or count days. A similar accommodation can be made if you want to show them how the seasons work.

For older children, when you are teaching the seasons, they should be able to do everything on their own. Try to ask them questions to get them to notice the total darkness for some parts of the area around the North Pole and daylight always for areas around the North Pole in the summer. Older children can also think about what is happening with the Earth and its tilted axis part way between the solstices and equinoxes.

Older students can play with this PhET simulation. It is a digital model of the Sun, Earth, Moon system: http://bit.ly/PhETGravityAndOrbitsModel Lots to notice and wonder!

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#STEMAZingPictureBook Recommendations:

Sun! One in a Billion by Stacy McAnulty

Earth! My First 4.54 Billion Years by Stacy McAnulty

#STEMAZingVideo Recommendations:

Earth's Rotation & Revolution: Crash Course Kids 8.1

http://bit.ly/EarthRotationRevolutionCrashCourseKids

SAFETY CONCERNS

As always, pencils are sharp and could poke an eye out.

AZ Early Learning Standards

Science Standard - Strand 1: Inquiry & Application - Concept 1: Exploration, Observation & Hypotheses
The child observes, explore, and interacts with materials, others, and the environment.

Science Standard - Strand 1: Inquiry & Application - Concept 2: Investigation
The child researches their own predictions and the ideas of others through active exploration and experimentation.

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BONUS DEMONSTRATION – Seasons

Taken directly from: https://spaceplace.nasa.gov/seasons/en/

What cause the seasons? It's all about Earth's tilt!

Many people believe that Earth is closer to the sun in the summer and that is why it is hotter. And, likewise, they think Earth is farthest from the sun in the winter.

Although this idea makes sense, it is incorrect.

It is true that Earth's orbit is not a perfect circle. It is a bit lop-sided. During part of the year, Earth is closer to the sun than at other times. However, in the Northern Hemisphere, we are having winter when Earth is closest to the sun and summer when it is farthest away! Compared with how far away the sun is, this change in Earth's distance throughout the year does not make much difference to our weather.

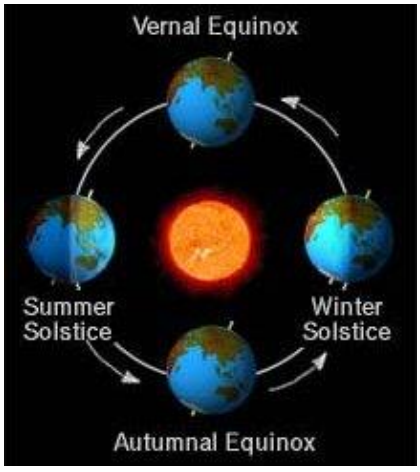
There is a different reason for Earth's seasons.

Earth's axis is an imaginary pole going right through the center of Earth from "top" to "bottom." Earth spins around this pole, making one complete turn each day. That is why we have day and night, and why every part of Earth's surface gets some of each.

Earth has seasons because its axis doesn't stand up straight.

Notice and Wonder Developmentally Appropriate Practice

Explain how the tilt of the Earth on its axis causes the seasons. Have children go to a spot along Earth's orbit around the Sun. At the first stop, tilt Earth's axis so it is pointing perpendicular to the sun by about 23.4° to represent the Vernal Equinox (photo to right). This means it is pointing neither toward or away from the Sun and it is spring. Both hemispheres of Earth are getting equal amounts of sunlight. The shadow edge should go straight through the north and south poles. Have children spin the Earth on its axis to practice keeping it tilted and having the shadow edge pass through the north and south poles.



Next, have children walk 90° along Earth's orbit. Now it is the Summer Solstice in the northern hemisphere so Earth's axis should be pointing toward the sun (photo to right). Have children spin the Earth on its axis tilted toward the sun and make observations. They should notice how some of the area around the North Pole never goes into the dark. They should also notice that the northern hemisphere is getting more direct sunlight than the southern hemisphere.

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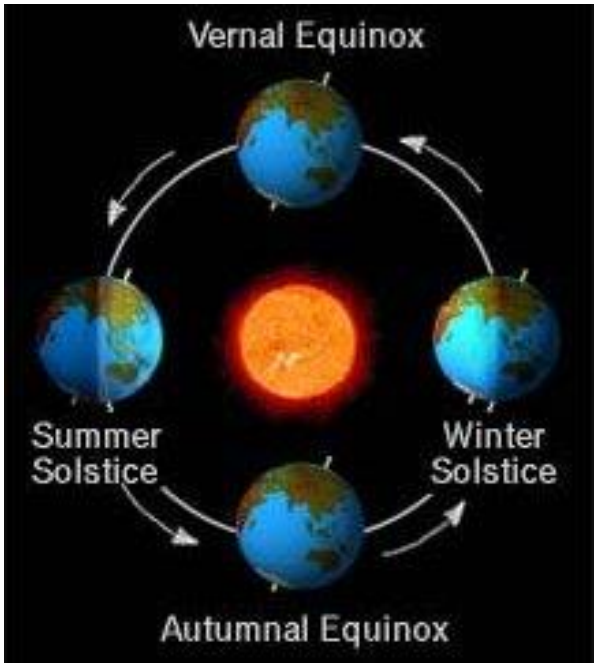
Have children walk another 90° along Earth's orbit. After summer comes fall, as show in the picture to the right representing the Autumnal Equinox. Just like spring, fall occurs when Earth's axis is pointed perpendicular to the sun. This means the shadow on Earth passes straight through the north and south poles. As children spin Earth on its tilted axis, they should notice that both the northern and southern hemispheres are getting equal amounts of light.

Have children walk another 90° along Earth's orbit. After fall comes winter, as shown in the picture on the bottom right. Now Earth's axis should be pointing away from the sun at an angle of 23.4° representing Winter Solstice. As children hold the axis tilted away from the sun and spin Earth on its tilted axis, they should notice that now there are some areas around the North Pole that never get any sunlight. They should also notice that the northern hemispheres is getting less light than the southern hemisphere, which would be experiencing summer.



Fun trivia: The scientific term for a tilted axis is obliquity.

#STEMAZingVideo Recommendation:

Seasons and the Sun: Crash Course Kids 11.1

http://bit.ly/SeasonsCrashCourseKids

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What the heck? Explanation of the Science (Vocabulary in bold.)
Earth is the planet we live on – the world. It is the third planet from the Sun. There are eight planets in our solar system. Mercury is closest to the Sun, followed by Venus, and then Earth. There are five planets with orbits further from the Sun. Those are (in order) Mars, Jupiter, Saturn, Uranus, and Neptune.

NOTE: Pluto was demoted from planet to dwarf planet in 2006 by the International Astronomical Union. A decision that is still controversial for some astronomers and lots of the general public who learned about nine planets when they were in school. A planet is now defined as a celestial body, which (a) is in orbit around the Sun, (b) is nearly round in shape due to its mass, and (c) has cleared other objects from around its orbit.

The **Sun** is the star at the center of our solar system. It is the closest star to Earth. The Sun is a yellow dwarf star. It gives off energy in the form of light, which includes infrared, visible light, ultraviolet light, and radio waves.

A NOTE ABOUT MODELS: The 3" Earth stress ball can be used to set our scale. If Earth really had a 3" diameter, the Sun would be more than 6.5 miles away. It would be hard to use a model completely to scale to explore phenomena. A flashlight or lamp more than 6.5 miles away wouldn't be viewable. The purpose of a **model** is not to be exactly the same as the actual system. Instead, it is to represent the system so we can better understand how and why things happen the way they do. So, it is fine that we didn't put the Sun over six miles away. We can still make observations about what happens on earth to cause day and night. We can also still model how the tilt of Earth's axis is the reason for the seasons.

What the heck? Explanation of Orbit and Rotation
(Adapted from: https://solarsystem.nasa.gov/planets/earth/in-depth/)

As Earth orbits the Sun, it completes one **rotation** every 23.9 hours. Rounding up to say one day is 24 hours is recommended for younger students. One rotation of Earth on its axis is a **day**. Based on the calendar we use, a **week** is defined as 7 days. That means Earth makes seven complete rotations on its axis in a week. It takes 365.25 days to complete one trip around the Sun. Rounding down to say one year is 365 days is fine for younger students. One **orbit** around the sun, also called a **revolution**, is defined as a **year**. The extra quarter of a day each year presents a challenge to our calendar system, which counts one year as 365 days. To keep our yearly calendars consistent with our orbit around the Sun, every four years we add one day. That day is called a leap day, and the year it is added to is called a leap year. (Fun fact: Leap years occur during years that are divisible by four!) Learn more about leap years and find a great animation of a day and a year here: https://spaceplace.nasa.gov/leap-year/en/

Earth's axis of rotation is tilted 23.4 degrees with respect to the plane of Earth's orbit around the Sun. This tilt causes our yearly cycle of seasons. During part of the year, the northern hemisphere is tilted toward the Sun and the southern hemisphere is tilted away. With the Sun higher in the sky, solar heating is greater in the north producing summer there. Less direct solar heating produces winter in the south. Six months later, the situation is reversed. When spring and fall begin, both hemispheres receive roughly equal amounts of heat from the Sun.