



Our Place in Space

Tracking Earth's Path around the Sun

AUTHOR: Jamie Repasky

GRADE LEVEL(S): 1-3

SUBJECT AREA(S): science, Earth, Sun, seasons, solar system, compass, compass rose, hemisphere, Earth's axis,

ACTIVITY LENGTH: 6 hours over 5 sessions in September, January, and May

DESCRIPTION: During sessions in October, January, and April we will discuss observations about the weather during that season (temperature, length of day, precipitation) and explore how this relates to the Earth's movement around the Sun. The lesson series will start with an introduction to compasses and predictions on how students' shadows will change over the day. Students will learn about how a hemisphere model works to demonstrate the sun's path across the sky and will record the sun's reflection on the dome at five times that day. By the end of the school year students will be able to predict where the path of the sun will be in the middle of the summer on their hemisphere model.

LEARNING GOAL(S): Students will be able describe how the Earth orbits the Sun and how the tilt of the planet creates the seasons by recording the 'Sun's path' in our sky in the fall, winter, and spring.

NEXT GENERATION SCIENCE STANDARDS:

- *1-ESS1-1:* Use observations of the sun, moon, and stars to describe patterns that can be predicted.
- *1-ESS1-2:* Make observations at different times of year to relate the amount of daylight to the time of year.
- *3-ESS2-1:* Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

COMMON CORE:

SCI.01.07 – Identify daily and seasonal weather changes

SCI.01.08 – Identify and trace the movement of objects in the sky

SCI.01.09 – Identify a cycle in our solar system

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STUDENT BACKGROUND: Prior knowledge of seasons

EDUCATOR BACKGROUND: Basic knowledge of how the tilt in the Earth's axis affects the season during the yearly orbit around the Sun.

MATERIALS LIST:

- (30) Compasses
- (90) Starbucks plastic lids
- Poster board for the hemisphere guide
- Sharpie markers
- Globe
- Light bulb or lamp
- Small object/toy and sticky tac to attach to the globe
- Whistle

BOOK SUGGESTION:

- What makes Day and Night by F. Branley

VOCABULARY:

- Compass
 - Compass Rose
 - North
 - South
 - East
 - West
 - Axis
 - Day
 - Night
 - Rotate
 - Revolve
-

Lesson Details:

DAY 1: Compass Training - September

TIME NEEDED: 1 hour (30 minutes in the classroom, 30 minutes outside)

MATERIALS:

- Compass rose handout
- Compasses
- Spacious field or room

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GUIDING QUESTIONS:

- How do we give some directions from point A to point B?
- How do we know which way is north?

ACTIVITY PLAN:

- Have the students glue the 'Compass Rose' drawing into their Outdoor Classroom booklet.
- Explain that there are four main directions on a map (they may have seen a compass rose in their Scholastic magazines). Ask them to name the direction that is on the opposite side of the rose from north.
- Have the student fill in E, S, and W on their rose.
- Introduce a mnemonic to help them keep the cardinal directions in the correct order such as:
 - Never Eat Soggy Waffles
 - Never Eat Sour Watermelon
 - Never Enter Stinky Washrooms
 - Never Ever Slap Walruses
- Explain that north and south are the key directions so when labeling the other four points of the rose, N or S should come first. Have the students fill in NE, SE, SW, and NW on their rose.
- Introduce how to use the compass. Explain that the compass needs to be on a flat surface as the magnetic is balancing in a liquid. The red side points to the north.
- Demonstrate how to turn the rotating housing to line up N with the red pointer.
- Use post-it notes to label the four directions in the classroom. Have the students write down directions on how to find the bathroom (walk north, turn, walk east, turn, walk south, etc.).
- Explain that when following compass directions you find north and line up the rotating housing. If the directions say to walk west, turn the rotating housing so that the red side of the magnet is pointing at the W. Now turn your body to line up the red pointer back to N. You will be facing west.
- Explain that besides being used for directions, treasure hunting, and exploring, compasses can also be used to identify which way the wind is blowing. Wind direction is always 'blowing from', i.e. a south wind is blowing from the south to the north.

Compass Activity

- Take the class outside with the compasses and compass rose handout. Have them identify landmarks around the school
- Ask them to work in teams of two with one person standing at the starting point while the other student follows the directions. If they finish, they can try the advanced directions or write their own directions in their booklet for their teammate.
- Select a starting point. Drop the start marker and using the compass follow these directions:
- **Course #1:**
 - Walk 5 paces to the north, stop
 - Walk 10 paces to the West, stop
 - Walk 20 paces to the south, stop
 - Walk 15 paces to the east, stop

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- Walk 15 paces to the north, stop
- Walk 5 paces to the west, stop.
- At this point, look down on the ground. You should be at the starting point!

- **Course #2: More Advanced (Using Bearings)**
 - Take a bearing of 90 degrees.
 - Walk 20 paces in that direction.
 - Take a bearing of 225 degrees.
 - Walk 28 paces in that direction.
 - Take a bearing of 315 degrees.
 - Walk 28 paces in that direction.
 - Take a bearing of 45 degrees.
 - Walk 28 paces in that direction.
 - Take a bearing of 180 degrees.
 - Walk 20 paces in that direction.

MORE RESOURCES:

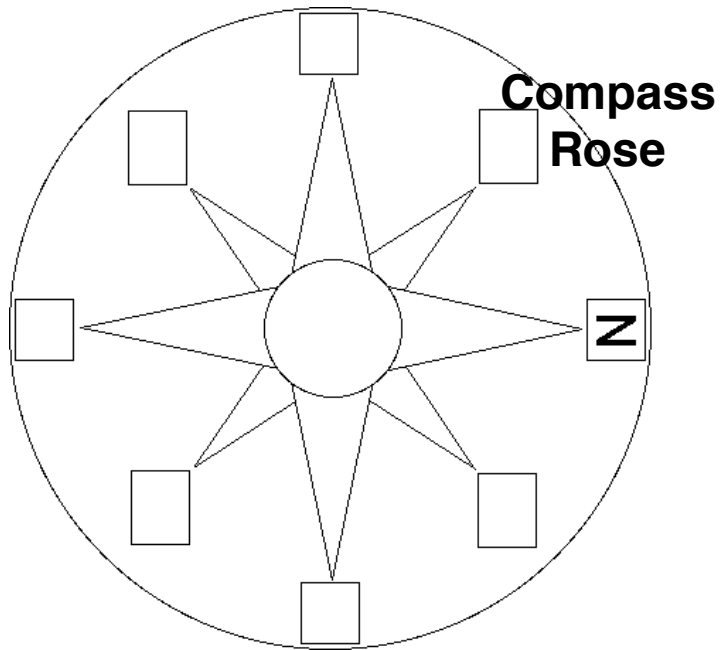
- Check out this link for more compass activities to scaffold your student's learning:
<http://dragon.sleepdeprived.ca/games/compass/compass.htm>

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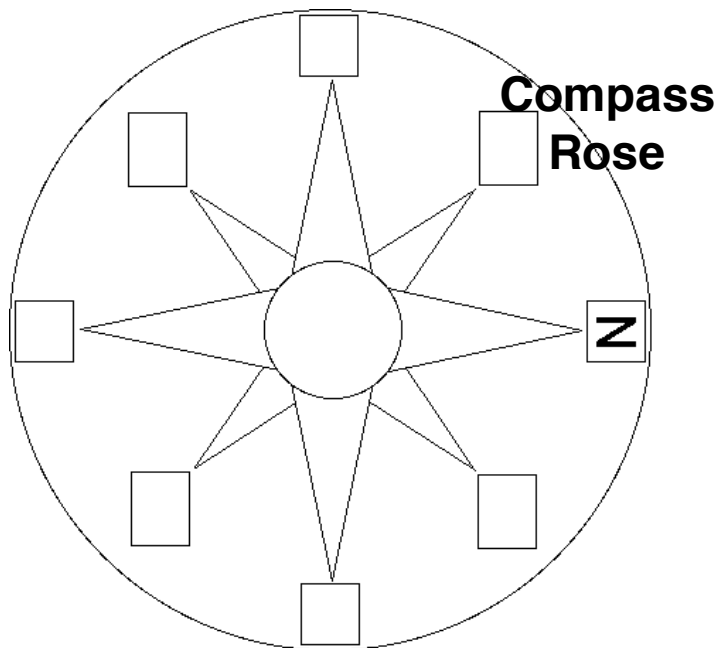
Cardinal Points - Version One

- Walk 5 paces to the north, stop
- Walk 10 paces to the west, stop
- Walk 20 paces to the south, stop
- Walk 15 paces to the east, stop
- Walk 15 paces to the north, stop
- Walk 5 paces to the west, stop.



Cardinal Points - Version One

- Walk 5 paces to the north, stop
- Walk 10 paces to the west, stop
- Walk 20 paces to the south, stop
- Walk 15 paces to the east, stop
- Walk 15 paces to the north, stop
- Walk 5 paces to the west, stop.



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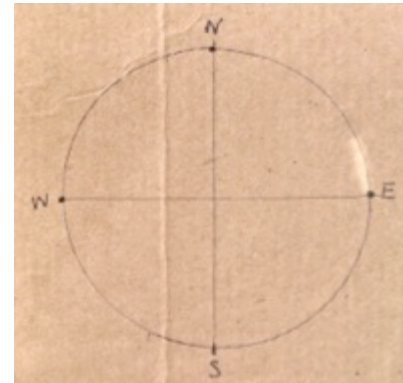
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DAY 2: THE EARTH AND THE SUN - SEPTEMBER

TIME NEEDED: 45 minutes outside right after school starts, 5 minutes each hour that day to record data. Best if it is a sunny day.

MATERIALS LIST:

- (30) Compasses
- (30) Starbucks plastic lids
- Poster board for the hemisphere guide
- Sharpie markers
- Globe
- Lightbulb or lamp
- Small object/toy and sticky tack to attach to the globe
- Whistle
- Worksheet - double sided



GUIDING QUESTIONS:

- What causes the difference between night and day?
- Why is it colder during the winter and warmer in the summer?

LESSON PREP:

- Cut the poster board into squares that are 1" larger than the plastic lids.
- Trace the lid on the board
- Using a ruler, make an + to mark North, East, South, and West
- Place the lid over the poster board and mark with a sharpie N, E, S, and W so that the students can align the lids during the activity.

ACTIVITY PLAN:

Night and Day Demo

- Have the students write down the two guiding questions on a piece of paper. Ask them to answer the question, explaining that it is ok to guess or to say they don't know. Allow them to add drawings to their explanations as well if they see fit.
- Using the globe and the lamp (the 'sun'), introduce the vocabulary words rotate and revolve.
- Attach the toy to the globe with sticky tack at your location. This object will represent the school. Place the "object side" of the globe facing the lamp. Ask if it is day or night there.
- Rotate the globe and ask again.

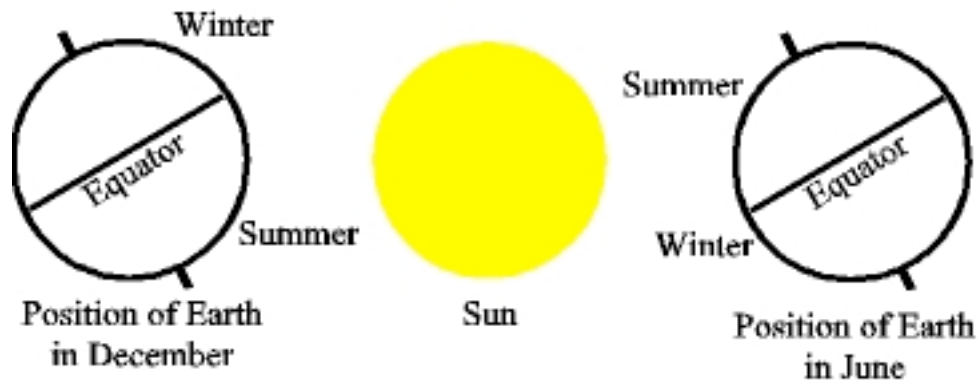
Go Outside: Demo 1 – Day and Night

- Take the class outside with the globe, plastic lids, sharpies, and poster board and place them in pairs. One person will be the sun and one will be the Earth.
- Have the 'Earth' start rotating. Blow the whistle and ask the 'Earths' to freeze. Ask the 'Suns' to call out if their 'Earth' is day or night. If the 'Earth's' face is away from the 'Sun', it is night and vice versa. After three tries, have the pairs change roles.

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- Now ask the 'Earths' to revolve around the 'Sun' (without rotating, they will be too dizzy). Blow the whistle and ask them to make one more revolution around the Sun while rotating too. Switch roles.



www.nauticus.org

- Have the class freeze, sit down, and close their eyes. Ask them the first guiding question again (What causes the difference between night and day?) and tell them to put their finger on their nose when they have an answer. When all noses are touched, ask them to remember their answer as they will be writing it down when the class goes back inside. Now their eyes can open.
- Have the student move to sit in a half circle around you.

Demo 2 – Seasons

- Using the globe, have the students observe the Earth's axis. Have one student stand as the sun and hold the globe so that the axis is vertical.
- Explain that the Earth's axis is not actually vertical to the Sun - it is tilted 23.5 degree from vertical (fun fact, Uranus is tilted on it's side so one side never sees the Sun!)
- Next, place 2 differently colored toy/objects on the globe with sticky tack, one on the Northern Hemisphere and one in the Southern Hemisphere. Hold the globe near the 'Sun' by holding the base of the globe. Ask the students which object is closer to the Sun.
- Revolve around the 'Sun' 180 degrees. Ask again which of the two objects is closer to the Sun. Ta da - the seasons!

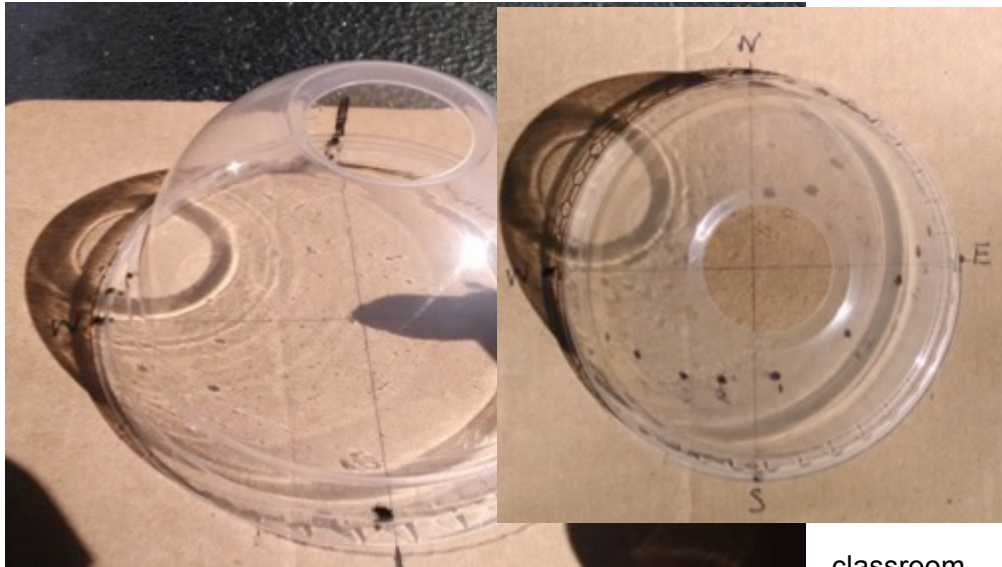
Teacher Note: this is one of the easiest times to build a misconception about the *distance* of the Earth to the Sun and the seasons. (Fun fact, the Earth is actually at its closest to the Sun during winter in the Northern Hemisphere!) For this reason, it may be useful to talk about which object is "facing" the sun. Repeating this activity at various distances from the Sun may also help reinforce to your students that two seasons always exist at one time (one *distance* from the Sun). It will be summer in the Northern Hemisphere when the toy is facing the sun.

Solar Domes

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- Explain to the students that over the school year, they will be recording data about the 'position' of the Sun in our sky.
- Have two students stand as the Earth and the Sun. Have the 'Earth' stand facing away from the 'Sun'. Slowly rotate the 'Earth' counter clockwise and demonstrate 'sunrise' (left shoulder), 'noon' ('Earth' facing the 'Sun'), and 'sunset' (right shoulder). This will help the students understand that the Sun is not moving, we (the Earth) are moving.
- Take out the poster board squares and lids. Demonstrate how they will use the compasses to match the North on their board with the Earth's North. They will place the lid on the board, and then use a sharpie to mark where the Sun's light casts a shadow (of the marker tip) at this moment. Have them write the time near the data point. Have one student hold their marker in the air and have a second student point to the ground where the shadow of the marker tip is located. Ask the student with the marker to move their hand with the mark so that the tip's shadow is right over the center of the cross (north, east, south, west) under the globe. Once the sharpie tip hits the globe (with the shadow of the tip still on the cross) make a small circle.
- Here is a Youtube demonstration that I created of the technique:
 - <http://youtu.be/-AHorJJ9Jms>
- Return to the



classroom

once the students or student teams have collected the first data point and labeled their name and data on the lid.

- Set a timer to remind the class to go out to collect more data every hour that day.
- At the end of the day, check the high and low temperature for your location that day and the time of sunrise and sunset. Have the students write these on their worksheet.
- Have the students write their answer to 'What causes the difference between night and day?' and collect the worksheets.

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DAY 3 - WINTER DATA COLLECTION - JANUARY

TIME NEEDED: 10 minutes in the classroom at the beginning of the day, 5 minutes each hour that day to record data. Best if it is a sunny day.

MATERIALS LIST:

- (30) Compasses
- (30) Starbucks plastic lids
- Poster board for the hemisphere guide
- Sharpie markers
- Worksheets from September

ACTIVITY PLAN:

- Ask the students to describe the weather over the last week as you hand out their worksheet from September, the original poster board squares, and new plastic lids to the students.
 - Review the vocabulary words rotate and revolve. Write on the board 'creates night and day' and 'creates the season'. Using the lamp and globe in a dark space, demonstrate how light rays are more spread out during the winter and concentrated in the summer. Additionally, ask students where they think the sun would be in the sky during each time of year.
 - Take the class outside. Review how they will use the compasses to match the North on their board with the Earth's North. They will place the lid on the board, and then use a sharpie to mark where the Sun's light casts a shadow (of the marker tip) at this moment. Have them write the time near the data point.
 - Return to the classroom once the students or student teams have collected the first data point and labeled their name and data on the lid.
 - Set a timer to remind the class to go out to collect more data every hour that day.
 - At the end of the day, check the high and low temperature for your location that day and the time of sunrise and sunset. Have the students write this data on their worksheet.
 - Collect the worksheets.
-

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DAY 4 - SPRING DATA COLLECTION - MAY

TIME NEEDED: 10 minutes in the classroom at the beginning of the day, 5 minutes each hour that day to record data. Best if it is a sunny day.

MATERIALS LIST:

- (30) Compasses
- (30) Starbucks plastic lids
- Poster board for the hemisphere guide
- Sharpie markers
- Globe
- Small object/toy and sticky tack to attach to the globe
- Worksheets from September

ACTIVITY PLAN:

- Ask the students to describe the weather over the last week as you hand out their worksheet from September, the original poster board squares, and new plastic lids to the students.
- Review the vocabulary words rotate and revolve. Place 2 differently colored toy/objects on the globe with sticky tack, one on the Northern hemisphere and one in the South. Ask a student to stand as the 'Sun'. Hold the globe near the 'Sun' by holding the base of the globe. Ask the students which object is closer to the Sun.
- Revolve around the 'Sun' 180 degrees. Ask again which of the two objects is closer to the Sun.
- Remove the object in the Southern Hemisphere. Start revolving around the 'Sun' and ask the students to stop you when you reach summer (in the Northern hemisphere), fall, winter, and spring.
- Have the class close their eyes. Ask them the second guiding question again (Why is it colder during the winter and warmer in the summer?) and tell them to put their finger on their nose when they have an answer. When all noses are touched, have them open their eyes and write their answer to on their worksheet
- Take the class outside. Review how they will use the compasses to match the North on their board with the Earth's North. They will place the lid on the board, and then use a sharpie to mark where the Sun's light casts a shadow (of the marker tip) at this moment. Have them write the time near the data point.
- Return to the classroom once the students or student teams have collected the first data point and labeled their name and data point on the lid.
- Set a timer to remind the class to go out to collect more data every hour that day.
- At the end of the day, check the high and low temperature for your location that day and the time of sunrise and sunset. Have the students write these data on their worksheet.
- Collect the worksheets.

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DAY 5 - DATA ANALYSIS - MAY

TIME NEEDED: 30 minutes

MATERIALS LIST:

- The 90 Starbucks plastic lids with the students' data from the three data sessions.
- Worksheets from September

ACTIVITY PLAN:

- Review the key vocabulary words ROTATE and REVOLVE.
- Hand out each student or student team's set of three labeled plastic lids (fall, winter, and spring).
- Ask the student to stack their lids on top of one another on their desk. It doesn't matter which order they stack them in.
- Direct the students to place their hand on their head when they have made two observations about their data. Once the class has all of their hands up, ask them share their observations with their neighbor.
- After a few minutes, allow the class to share their observations and/or questions with the class. Encourage the students to compare their weather/sunrise/sunset recordings with the solar path data.
- Ask the students where on the lids they predict the solar path would be during the summer.
- As a fun wrap up, have the class watch the music video for 'What Makes Day and Night' on YouTube:
 - https://youtu.be/ZoG1pF_r5zU
 - For more advanced students, here's a different version of the song:
<https://youtu.be/YONrbl6xLIM>

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The Earth and the Sun

Name: _____

- What causes the difference between night and day?

First guess:

Second guess:

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- Why is it colder during the winter and warmer in the summer?

First guess:

Second guess:

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Fall

Date: _____

Describe the weather this week:

Sunrise: _____

Sunset: _____

Temperature - High: _____ Low: _____

Winter

Date: _____

Describe the weather this week:

Sunrise: _____

Sunset: _____

Temperature - High: _____ Low: _____

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Spring

Date: _____

Describe the weather this week:

Sunrise: _____

Sunset: _____

Temperature - High: _____ Low: _____

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