

sunrise, sunset, seasons and shadows

by: jayne dean

instructional coach: chris gibler

description:

In the Sunrise, Sunset, Seasons and Shadows lessons, students will explore how the Earth's movement creates predictable patterns that ultimately affect the migration patterns of animals.

Students will investigate how shadows are created as the Earth rotates around the sun. Students will observe that the varying lengths of shadows are created at different times of day based on the sun's position in the sky using a lab and student journal to record their observations.

Models are used to help students discover the rotation of the Earth every twenty-four hours causes day and night, as well as, the revolution of the Earth every 365 days causes the differing seasons in the Northern and Southern Hemispheres. An informal take-home survey will allow students will discover differing misconceptions about what causes the four seasons.

Student will discover through a read aloud that the Earth's patterns are used by birds (and various other animals) when migrating. With this knowledge students will discover the times during the changing seasons that animals are preparing for their journey.

Weekly collection of weather data and other seasonal observations, such as sunrise and sunset times, and changes in the leaves, will be uploaded to the Journey North website using a Kestrel readings and Phenology data collection chart.

A quiz is used at the end of the Sunrise, Sunset, Seasons and Shadows lessons to assess students' knowledge of the lesson objectives and Missouri Grade Level Expectations.

grade level:

Fifth grade

essential question:

How do the predictable movements of the Earth affect the daily happenings of animals?

student learner objectives:

Day & Night

- Observe and identify there is a day/night cycle every 24 hours (*third grade – for review only*)
- Identify that the Earth rotates once every 24 hours (*fifth grade*)

Shadows

- Describe how the Sun's position in the sky changes the length and position of shadows (*third grade – for review only*)
- Relate changes in the length and position of a shadow to the time of day and apparent position of the Sun in the sky, as determined by Earth's rotation (*fifth grade*)

Seasons

- Relate the apparent motion of the Sun, Moon, and stars in the sky to the rotation of the Earth (*fifth grade*)

grade level expectation (gle):

6.2.C: The regular and predictable motions of the Earth and Moon relative to the Sun explain natural phenomena on Earth, such as day, month, year, shadows, moon phases, eclipses, tides, and seasons

featured scott foresman textbook:

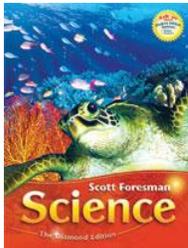


Image: pearsonhomeschool.com

Scott Foresman Science: Grade 5
Page 543 (Earth's Orbit)
Pages 544 -545 (Day and Night)
Pages 546 – 547 (The Pattern of Seasons)

featured picture book:

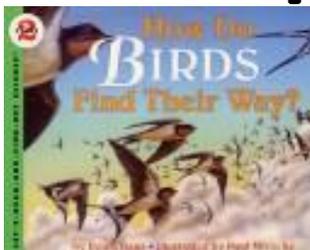


Image: mymcp.org

How Do Birds Find Their Way

By: Roma Gans

even more picture books:

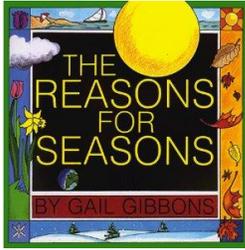


Image: mymcpl.org

The Reasons for Seasons
By: Gail Gibbons

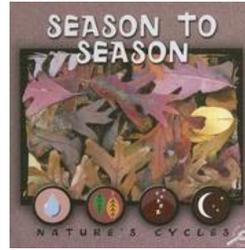


Image: mymcpl.org

Season to Season
By: Jason Cooper

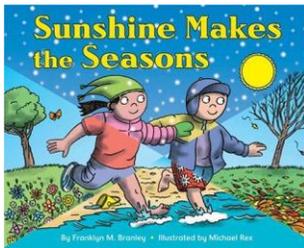


Image: mymcpl.org

Sunshine Makes the Seasons
By: Franklyn M. Branley

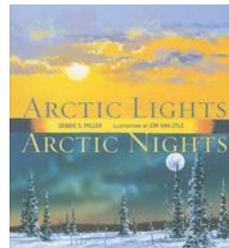


Image: mymcpl.org

Arctic Light Arctic Nights
By: Debbie S. Miller

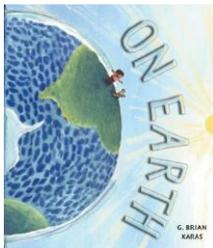


Image: mymcpl.org

On Earth
By: G. Brian Karas

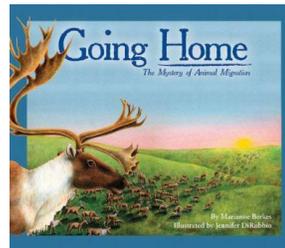


Image: mymcpl.org

Going Home
By: Marianne Berkes

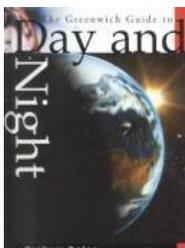


Image: mymcpl.org

The Greenwich Guide to Day and Night
By: Graham Dolan

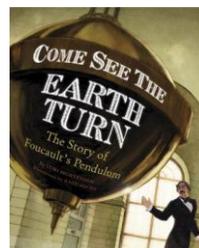


Image: mymcpl.org

Come See the Earth Turn
By: Lori Mortensen

time needed:

Prior to the first day of this lesson the students should begin to collect weekly weather and Phenology data using the Kestrel weather instrument and the Kestrel Readings and Phenology Data Collection Chart student page. The teacher may want to begin this the first week of the school year (it should begin no later than a start date of the fall equinox in September). The data will be used in the **Elaborate/Extend portion of the lesson.**

Day #1:

Engage with Shadow student page, More Shadow Pictures

Explore with Shadows Long Shadows Short Learning Lab and Shadows Long Shadows Short student journals

Day #2:

Explain with a model of day and night and the four seasons with flashlights, lamps and models of the Earth.

Day #3:

Elaborate/Extend with read aloud How Do Birds Find Their Way? and analyzing the weather and Phenology data collected

Day #4:

Evaluate with Sunrise, Sunset, Seasons & Shadows Quiz

academic vocabulary words and definitions:

revolution is one full orbit of the Earth around the sun

axis is the imaginary line that the Earth spins around as it rotates

rotation is one whole spin of an object on its axis

orbit is the path around one object in space around another object

summer solstice is the date that marks the first day of summer and has the most hours of daylight (*June 21 in the Northern hemisphere*)

winter solstice is the date that marks the first day of winter and has the most hours of darkness (*December 21 in the Northern hemisphere*)

autumn equinox is the date that marks the first day of autumn and has the same number of hours of daylight and darkness (*September 21*)

spring equinox is the date that marks the first day of spring and has the same number of hours of daylight and darkness (*March 21*)

materials:

Copies to make:

- ✓ Shadows student page (1 per student)
- ✓ Pictures of More Shadows (1 set of pictures per group)
- ✓ Shadows Long & Shadows Short student journal (1 per student)
- ✓ Shadows Long & Shadows Short Learning Lab student pages (1 set per science learning group)
- ✓ Seasons Survey student page (1 per student)
- ✓ It's In the Tilt student page (1 per student)
- ✓ *How Do Birds Find Their Way?* Anticipation Guide student page (1 for each student)
- ✓ Kestrel Readings and Phenology Data Collection Chart student page (1 chart for each month the students are taking Kestrel readings)
- ✓ Copies of the completed Kestrel Readings and Phenology Data Collection Chart (1 copy per science learning group)
- ✓ Sunrise, Sunset, Seasons & Shadows Quiz (1 per student)

Materials to gather:

- ✓ flashlight (1 per science learning group)
- ✓ small block of modeling clay (1 per science learning group)
- ✓ toothpick (1 per science learning group)
- ✓ large sheet of white paper (1 per science learning group)
- ✓ science themed rubber stamp (*teacher use only*)
- ✓ stapler
- ✓ pencil or pen
- ✓ 4 bamboo skewers or toothpicks
- ✓ 4 Styrofoam balls
- ✓ 4 plastic cups
- ✓ flashlight
- ✓ lamp with shade removed
- ✓ extension cord for lamp (if needed)
- ✓ *Arctic Light Arctic Nights* By: Debbie S. Miller (optional)
- ✓ *The Greenwich Guide to Day and Night* By: Graham Dolan (optional)
- ✓ *Come See the Earth Turn* By: Lori Mortensen (optional)
- ✓ *The Reasons for Seasons* By: Gail Gibbons (optional)
- ✓ *Season to Season* By: Jason Cooper (optional)
- ✓ *Sunshine Makes the Seasons* By: Franklyn M. Branley (optional)
- ✓ *How Do Birds Find Their Way?* By: Roma Gans
- ✓ Post-it notes (3 per science learning group)
- ✓ *Going Home* By: Marianne Berkes (optional)
- ✓ *On Earth* By: G. Brian Karas (optional)

lesson narrative:

engage – DOK Level 1 and 2

Copies to make:

Shadows student page (1 per student)

Pictures of More Shadows (1 set of pictures per group)

Materials to gather:

None

Pass out the Shadows student page and have students infer from the picture shown. Provide Pictures of More Shadows student pages to each group. These additional pictures of different shadows should be observed by each group member before asking the students to answer the following questions:

- What do you think caused the shadow in the picture?
- Do you think the shadow will ever look different? If so, how would it look different?
- What wonderings do you have about shadows?

Teacher Tip:

Pictures of More Shadows student pages could be laminated for repeated use, or shown to the class using an LCD projector instead of making copies.

Formative Assessment Alert:

After filling out the Shadows student page, the teacher will use this information to gain an understanding of the students' prior knowledge (schema) and experience with shadows.

explore – DOK Level 3

Copies to make:

Shadows Long & Shadows Short student journal (1 per student)

Shadows Long & Shadows Short Learning Lab student pages (1 set per science learning group)

Materials to gather:

flashlight (1 per science learning group)

small block of modeling clay (1 per science learning group)

toothpick (1 per science learning group)

large sheet of white paper (1 per science learning group)

science themed rubber stamp (*teacher use only*)

stapler

Prepare the materials that are needed for the Shadows Long & Shadows Short Learning Lab prior to the lesson. Divide the students into science learning groups. Distribute the Shadows Long & Shadows Short Learning Lab student pages and the Shadows Long & Shadows Short student journals to each student.

Teacher tip:

The journals should be folded and stapled prior to the lesson to maximize instruction time with students. Each student should be responsible for recording their own observations in their own journal.

Tell the students that you are going to investigate more about shadows by completing the Shadows Long & Shadows Short Learning Lab. Have the students complete the Learning Lab in science learning groups recording their observations in the journal.

Teacher tip:

The teacher can have previously assigned science learning groups to maximize instruction time with students. Students should already know who to work with if you tell them to work in pairs (groups of 2), trios (groups of 3), or quads (groups of 4).

Use a science themed rubber stamp when the students complete the steps for Part A of the Learning Lab. Place the stamp in the box to give them approval to move on to Part B of the Learning Lab. The teacher will then need to stamp the Learning Lab Part B sheet when the students have completed the necessary steps.

Teacher tip:

The STOP! point in the lab gives the teacher the chance to check in with the students to answer any questions they may have, or address any misconceptions that the students might have developed. This also gives students time for feedback on the Learning Lab allowing for corrections they might need to make in the quality of their work during Part B.

Formative Assessment Alert:

Students will complete the Shadows Long & Shadows Short Learning Lab constructed response questions in their journal. The conclusion page can then be used to gain an understanding of the student's understanding of the changing shadows created at different times of day based on the sun's position in the sky.

explain – DOK Level 1 and 2

Copies to make:

Seasons Survey student page (1 per student)

It's In the Tilt student page (1 per student)

Materials to gather:

pencil or pen

4 bamboo skewers or toothpicks

4 Styrofoam balls

4 plastic cups

flashlight

lamp with shade removed

extension cord for lamp(if needed)

Arctic Light Arctic Nights By: Debbie S. Miller (optional)

The Greenwich Guide to Day and Night By: Graham Dolan
(optional)

Come See the Earth Turn By: Lori Mortensen (optional)

The Reasons for Seasons By: Gail Gibbons (optional)

Season to Season By: Jason Cooper (optional)

Sunshine Makes the Seasons By: Franklyn M. Branley (optional)

The day before this activity assign the students the Seasons Survey student page as a homework assignment. The students will need to write the answers that they receive when interviewing three people using the following question:

What causes the pattern on Earth that we call seasons?

Teacher tip:

If any student does not complete the Seasons Survey homework assignment have them ask three students in their class during a time of the school day where students are working on other assignments, but prior to the science lesson.

When the students return to science class have them share the results with their class by using science learning groups.

Ask for the science learning groups to narrow down their results to the answer they believe is the most scientific. Record these answers on a piece of chart paper displayed at the front of the room.

Tell the students that many people have different reasons (or misconceptions) for why the Earth experiences different seasons. Give each student a copy of the It's In the Tilt student page to record their observations during the model.

Prepare the materials needed for It's In the Tilt model prior to the lesson. Guide the class through the following steps to model the accurate reason to their survey question.

Teacher tip:

Arrange the students in a circle with a copy of It's In the Tilt student page and a pencil to record their observations.

1. Skewer a Styrofoam ball with a bamboo skewer, or toothpick. Make sure that it runs from the North Pole to the South Pole. Draw an "equator" so you have a tiny representation of the Earth.

Teacher tip:

Explain to the students that if the class was to look at the Earth from space they would not see the axis, or the equator, as these are imaginary.

2. Ask the students to complete the picture of the Earth, axis, equator, and labeling of the Northern Hemisphere and the Southern Hemisphere on their copy of the It's In the Tilt student page.
3. Turn on the flashlight and set it on a table so it shines on your model Earth. Darken the room.
4. Explain that the Earth rotates around its axis counterclockwise. Demonstrate this by rotating the "Earth" around the bamboo skewer, or toothpick.

Teacher tip:

Explain the difference between clockwise and counterclockwise during this part of the model.

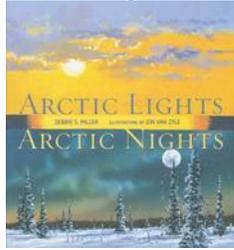
5. Stop rotating and ask the students the following questions:
 - What happens when the Earth is facing the sun? (*It is receiving direct sunlight. This side of the Earth is experiencing daytime and the other side of the earth does not get any light from the sun.*)
 - What is the other side of the Earth experiencing? (*darkness or nighttime*)
 - Can the sun be setting and rising at the exact same time? (*Yes, when it is setting in one location, it is rising in another location on the opposite side of the globe.*)
6. Have the students record their observations on the It's In the Tilt student page.

Teacher tip:

Have the students draw the source of light on their student page as well as the Earth, equator, and axis when making their observations.

Even More Picture Books:

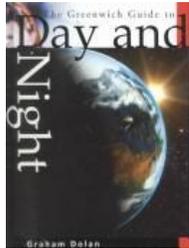
You could end this part of the lesson by reading aloud any of the following:



Arctic Light Arctic Nights By: Debbie S. Miller

Image: mymcpl.org

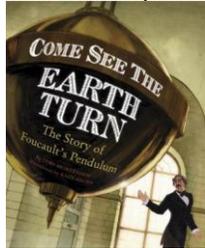
This book will help students to understand that locations closest to the North Pole experience long periods of daylight and long periods of darkness at different times during the year.



The Greenwich Guide to Day and Night By: Graham Dolan

Image: mymcpl.org

This book reviews the reasons for shadows, day and night, and day and night in different places on the Earth (including a time-lapse photo of the different positions of the sun at the North Pole).



Come See the Earth Turn By: Lori Mortensen

Image: mymcpl.org

This book tells the story of Leon Foucault's experiment proving the Earth is rotating.

7. Now tilt the "Earth" toward the flashlight asking the students to observe how much light shines on the Northern Hemisphere. Have the students record their observations and descriptions on the student page. *(The Northern Hemisphere is getting lots of direct sunlight, so it is experiencing the summer season. The Southern Hemisphere is experiencing the winter season.)*
8. Now tilt the "Earth" away from the flashlight asking the students to observe how much light shines on the Northern Hemisphere. Have the students record their observations and descriptions on the student page. *(The Southern Hemisphere is getting lots of direct*

sunlight, so it is experiencing the summer season. The Northern Hemisphere is experiencing the winter season.)

9. Explain to the students that the Earth is always tilted at $23\frac{1}{2}$ degrees as it rotates around the sun.
10. Move the "Earth" around the lamp with the shade removed tilting it in the same direction as it revolves around the "sun" like this:

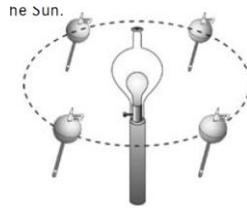


Image: Science and Children January 2007

11. Have the students record their conclusions and evidence on the student page.
12. Revisit the chart of misconceptions that was made at the beginning of the lesson. Reread the misconceptions together crossing out the misconceptions leaving only the statements that are scientifically accurate.

Teacher tip:

Show your students all four seasons at the same time. Set up the following model:

1. Place the lamp with the shade removed in the middle of the table.
2. Place each "Earth" in the cup to hold it off of the table. It should look like this:

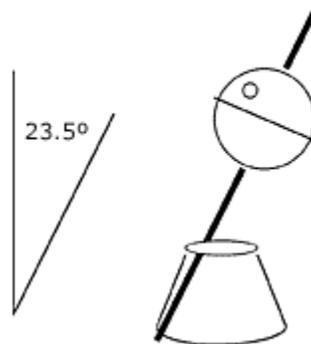


Image: exploratorium.edu/ancientobs/chaco/HTML/TG-seasons.html

3. Be sure that each model of the Earth is pointing to a reference point, such as the North Star. They should all remain pointing to that reference point throughout the entire activity.
4. Position each "Earth" around the lamp to show each of the seasons like this:

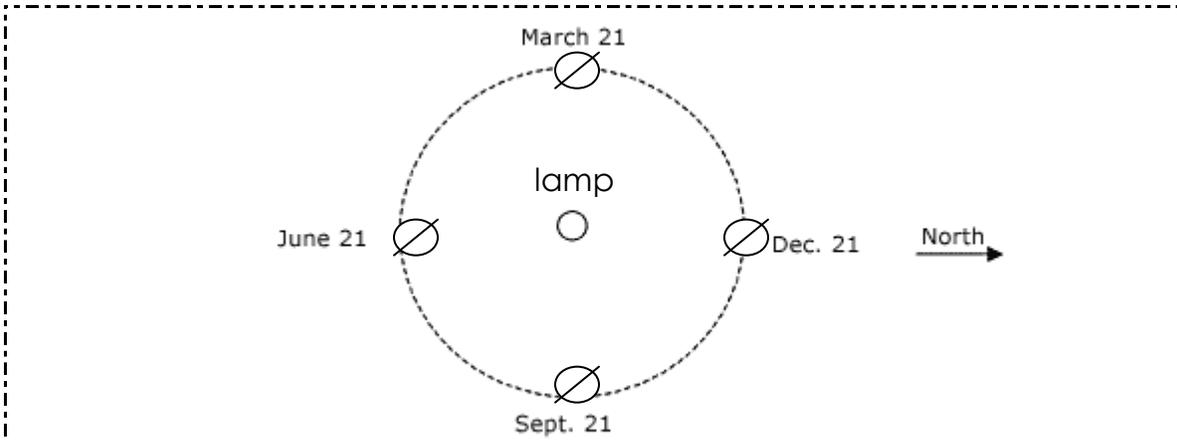


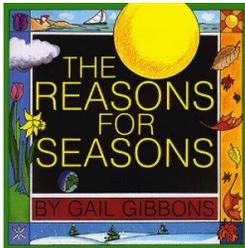
Image: exploratorium.edu/ancientobs/chaco/HTML/TG-seasons.html

5. Explain to the students the different calendar days that mark the start of each of the four seasons in the Northern Hemisphere:

- Summer solstice – June 21
- Winter solstice – December 21
- Autumn equinox – September 21
- Spring equinox – March 21

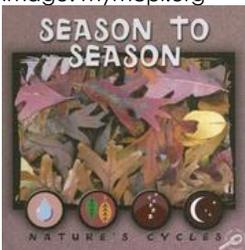
Even More Picture Books:

You could end this part of the lesson by reading aloud any of the following:



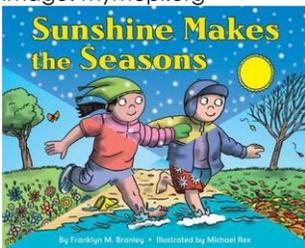
The Reasons for Seasons By: Gail Gibbons

Image: mymcpl.org



Season to Season By: Jason Cooper

Image: mymcpl.org



Sunshine Makes the Seasons By: Franklyn M. Branley

Image: mymcpl.org

These books review the reasons why the Earth's tilt is the reason the Earth experiences different seasons.

Formative Assessment Alert:

Students will complete the It's In the Tilt student page. The conclusion section of the student page can be used to assess the student's understanding of the tilting of the Earth's axis is what causes the four seasons.

elaborate/extend - DOK Level 1 and 2

Copies to make:

How Do Birds Find Their Way? Anticipation Guide student page (1 for each student)

Kestrel Readings and Phenology Data Collection Chart student page (1 chart for each month the students are taking Kestrel readings)

Copies of the completed Kestrel Readings and Phenology Data Collection Chart (1 copy per science learning group)

Materials to gather:

How Do Birds Find Their Way? By: Roma Gans

Post-it notes (3 per learning group)

Going Home By: Marianne Berkes (optional)

Teacher tip:

Have two students take Kestrel readings of the weather the same morning of each week for the duration of the observation period. Store the class Kestrel reading charts in a binder that can be easily carried outside to take the readings. Keeping all of the charts in one place will make organization of the data easier.

Have students complete the "before reading" column of the anticipation guide for the book, How Do Birds Find Their Way? By: Roma Gans prior to reading the book aloud to the students.

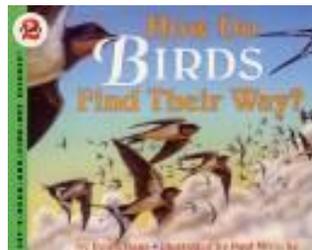


Image: mymcpl.org

Teacher tip:

Have the students answer the “before reading” questions using pen or marker. This is important so that they cannot change their answers after listening to the read aloud.

Formative Assessment Alert:

After filling out the How Do Birds Find Their Way? Anticipation Guide student page, the teacher will use this information to gain an understanding of the students' prior knowledge (schema) and experience with how predictable movements of the Earth affect the daily happenings of animals.

Explain to the students that you will be reading a book to find answers to the questions on the student page that they just filled out. Have the students touch their nose if they hear (or see) how the patterns of the Earth affect the daily happenings of animals while listening.

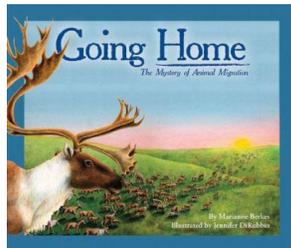
Teacher tip:

Having the students signal when they hear important information is a great way to practice **determining importance**. This is an important reading comprehension strategy in the upper elementary grades. By practicing this reading skill with a teacher read aloud, students can then listen to the story focusing on the information to gain more knowledge about the subject instead of concentrating on other reading skills the student might struggle with detracting from comprehension.

After reading have the students fill out the “after reading” column of the student page. Discuss each of the statements as a class revealing each answer. Have the students rewrite any of the statements that were found to be incorrect after listening to the read aloud. These statements should be written in the explanations from the reading section of the student page.

Even More Picture Books:

You could end this part of the lesson by reading aloud:



Going Home By: Marianne Berkes

Image: mymcpl.org

This book showcases nine migrating animals using rhyming verses and factual information about each animal.

Give each science learning group a copy of each of the Kestrel Readings and Phenology Data Collection Charts that have been completed during the observation period and three Post-it notes. Have the group members copy each of the following statements from the board onto the Post-it notes:

- *Moving from winter home to summer home to build nests, lay eggs, and hatch babies*
- *Eating a lot of food to store energy*
- *Moving from summer home to winter home*

Have the science learning group use the Post-it notes to mark where they predict these statements have happened based on the Kestrel Readings and Phenology Data Collection Charts.

Teacher tip:

Write these three statements on the board so the groups can easily copy them onto the three Post-it notes.

The teacher will need to log-on to Journey North web address: www.learner.org/jnorth/pde/PhenDataExchange.html and report the weather and Phenology data for the class.

evaluate - DOK Level 1, 2, and 3

Copies to make:

Sunrise, Sunset, Seasons & Shadows Quiz (1 per student)

Materials to gather:

On Earth By: G. Brian Karas (optional)

Give the students the Sunrise, Sunset, Seasons & Shadows Quiz.

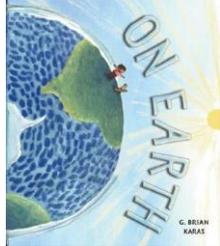
Answers (13 points)

- ✓ Jackie (1 point)
- ✓ Winter (1 point)
- ✓ Summer (1 point)
- ✓ The Earth is tilted on its axis at 23 ½ degrees. This tilt causes the Northern Hemisphere to experience summer when the Earth receives the sun's direct rays. At the same time the Southern Hemisphere experiences winter. The Southern Hemisphere experiences summer when this part of the Earth receives the sun's direct rays. At the same time the Northern Hemisphere is experiencing winter. (2 points)
- ✓ False – The Earth moves around the sun. (2 points)
- ✓ True (1 point)

- ✓ False – A revolution is one full orbit of the Earth around the sun. (2 points)
- ✓ True (1 point)
- ✓ Shadows change throughout the day due to the position of the sun in the sky. As the sun rises higher into the sky the shadows become shorter. The shadows grow longer as the sun sets. (2 points)

Even More Picture Books:

You could end this part of the lesson by reading aloud:



On Earth By: G. Brian Karas

Image: mymcpl.org

This book reviews objectives from this lesson, such as: shadows, day & night, and the reason the Earth experiences seasons.

Misconceptions:

Source: A list compiled by the [Operation Physics](http://www.eskimo.com/~billb/miscon/opphys.html) Elementary/middle school physics education outreach project www.eskimo.com/~billb/miscon/opphys.html

Shadows

- The sun is always directly overhead (or directly south) at twelve o'clock noon.
- The movement of the sun is causing our shadows to grow and shrink.

Day & Night

- Night occurs when the sun is covered by the clouds or the moon.
- Earth goes around the sun and the sun moves up and down.

Seasons

- Students often believe that a change in the distance from the Sun causes the change in the seasons (the Earth and the Sun are closer in the summer and further apart in the winter).
- All parts of the Earth experience the same season at the same time.

safety:

- The extension cord used in the **Explain** part of the lesson should be secured to the ground to prevent students from tripping over it while moving around the room.
- The lamp without the shade used in the **Explain** part of the lesson should be closely monitored so the bulb does not get too hot causing a burn to the skin if touched.

reading comprehension strategies:

Determining Importance

found in the **Elaborate/Extend** section of the lesson

Having the students signal when they hear important information is a great way to practice determining importance. This is an important reading comprehension strategy in the upper elementary grades. By practicing this reading skill with a teacher read aloud, students can then listen to the story focusing on the information to gain more knowledge about the subject instead of concentrating on other reading skills the student might struggle with detracting from comprehension.

bibliography of more information:

To further **elaborate/extend** the Sunrise, Sunset, Seasons and Shadows lessons teachers can find additional resources at:

Websites

- www.journeynorth.org
- www.k8science.org/resources/files/TSO_SD_01_s.pdf
- hea-www.harvard.edu/ECT/the_book/Chap1/Chapter1.html

Journal articles

- Shadows That Enlighten (Science and Children January 2011)
- Teaching Through trade Books: Sunrise, Sunset (Science and Children April/May 2009)
- A Week for Space (Science and Children September 2008)

student pages:

- Shadows student page
- Pictures of More Shadows
- Shadows Long & Shadows Short student journal
- Shadows Long & Shadows Short Learning Lab student pages
- Seasons Survey student page
- It's In the Tilt student page
- How Do Birds Find Their Way?* Anticipation Guide student page
- Kestrel Readings and Phenology Data Collection Chart student page
- Sunrise, Sunset, Seasons & Shadows Quiz

sources:

Lesson sources:

- Science 101: What Causes the Seasons? (Science and Children 2007)
- www.exploratorium.edu/ancientobs/chaco/HTML/TG-seasons.html

Sources for Student Pages:

- Kestrel Readings and Phenology Data Collection chart adapted from J. Sorensen (Hickman Mills Science Instructional Coach)
- Shadows Long & Shadows Short student journal adapted from Picture Perfect Science (Ansberry & Morgan)

Clip Art sources:

- Scott Foresman textbook picture
pearsonhomeschool.com
- Flashlight clipart
schoolnew.discoveryeducation.com
- Four Seasons clipart
valdosta.edu
- Girl's face clip art
clipartist.net
- Flagpole sundial clip art
commons.wikimedia.org
- Person with shadow
m.inmagine.com
- Even more picture books images
mymcpl.org
- Birds
uwsp.edu
- Shadows
pfosphene.com
alapan.com
trekearth.com
- Earth's seasons
exploratorium.edu/ancientobs/chaco/HTML/TG-seasons.html