

SEASONS DAY 1: SPACE-BASED PERSPECTIVES

Draw a space-based diagram that shows WHY we have day and night on Earth.

- Include all objects that you think are important for showing your reasoning.
- Label key parts of your diagram.
- Shade your diagram to show the unlit (nighttime) part.
- Draw a triangle on a location (city) that is experiencing daytime.
- Draw an x on a location (city) that is experiencing nighttime.
- Think about how a city like Boston experiences a day-night cycle.** Add arrows to your diagram to show the movement that explains WHY Boston experiences these changes. Think carefully about *which direction* things should move in.

North

East

south

West

Name: _____

SEASONS DAY 2-3: APPARENT PATH OF THE SUN IN THE SKY

A) PREDICT:

I think the Sun's apparent path in the sky each day is _____ throughout the year.
< the same / different >

If you think it is the same, explain *why*. If you think it is different, describe *how* it is different.

B) COLLECT DATA FOR BOSTON:

Season	Marker color on Suntracker	Sun angle at midday (degrees)	Length of day (hours)
Winter (<i>December 21</i>)	blue		
Spring (<i>March 21</i>)	green		
Summer (<i>June 21</i>)	red		
Fall (<i>September 21</i>)	black		

C) COMPARE AND ANALYZE DATA FOR BOSTON:

1. Which Season has the highest Sun angle at midday? _____
2. Which Season has the lowest Sun angle at midday? _____
3. Which Season has the longest day length? _____
4. Which Season has the shortest day length? _____
5. Which Seasons have the same day length and Sun angle at midday? _____
6. Was the Sun ever directly overhead in Boston? _____

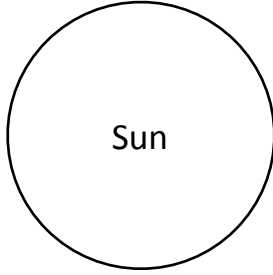
D) RECORD YOUR IDEAS:

In what ways do you think the Sun's height in the sky and length of day affect temperature?

Ways I think the Sun's height in the sky affects temperature:

Ways I think the length of day affects temperature:

Winter



Fall

Summer

Spring

Summer

Fall

Winter

Spring

SEASONS DAY 5 - EARTH'S TILTED AXIS

1. Model a Year

Model the Earth orbiting the Sun, using the Seasons sheet on your table as a guide. **Be sure to always point your Earth's axis in the direction given by the instructor.**

- Place your team's Seasons sheet on the table, matching the orientation with the signs around the room. Place your Sun on the Seasons sheet.
- Each team member should stand around your table at the Seasons positions marked.
- Summer team member: hold Earth on the side of the Sun that represents Summer, keeping the Earth's axis oriented correctly.
- Pass the Earth to the Fall team member, always keeping the axis pointed in the correct direction.
- Complete a Year by passing the Earth to the Winter and Spring team members, and back to Summer.

2. Model a Day at Different Times of Year

- Summer: Rotate Earth at the Summer position, so your Lego person experiences both night and day. Teammates should check that the axis orientation remains correct.
- Pass Earth to the Fall team member. Spin the globe on its axis to make your Lego person experience Day and Night during this season. Teammates should check that the axis orientation remains correct.
- Repeat for the other 2 seasons.

3. Observe from the Model

When Earth experiences SUMMER in the Northern Hemisphere,

- the Northern axis is tilted _____ the Sun
<towards/away from>
- the Southern axis is tilted _____ the Sun
<towards/away from>
- To see the Sun at midday, Lego person has to look _____ , _____ in the sky.
<up / ahead> <high/low>

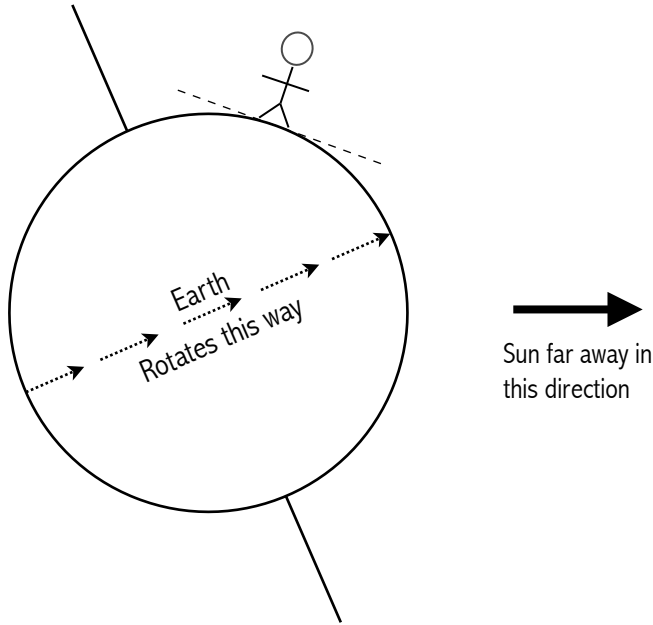
When Earth experiences WINTER in the Northern Hemisphere,

- the Northern axis is tilted _____ the Sun
<towards/away from>
- the Southern axis is tilted _____ the Sun
<towards/away from>
- To see the Sun at midday, Lego person has to look _____ , _____ in the sky.
<up / ahead> <high/low>

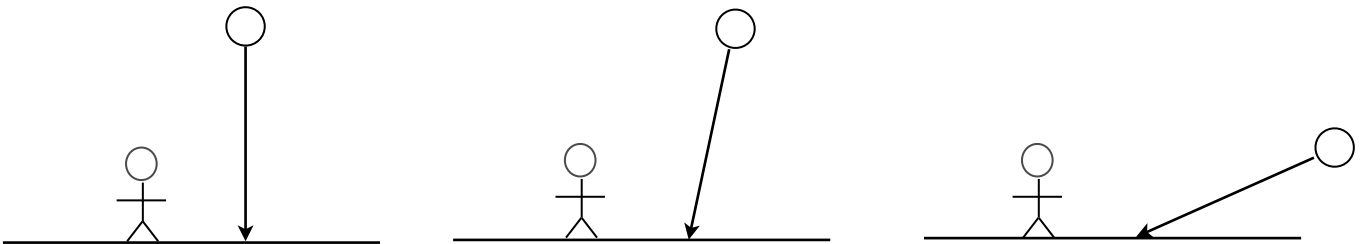
SEASONS DAY 6: TILTED AXIS AND SUN ANGLE

A. Interpret this diagram:

Diagram NOT to scale.



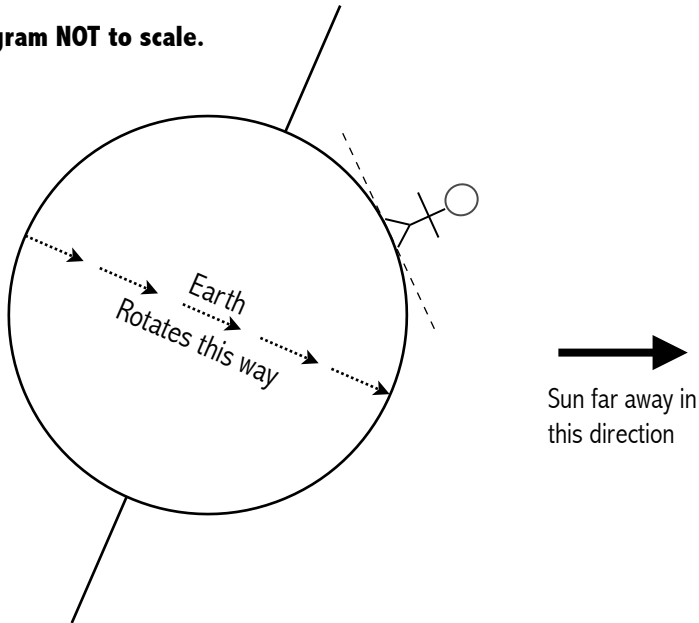
1. The northern hemisphere is tilted _____ the Sun.
<towards/away from>
2. Sketch in five light rays from the Sun, to show how you think Sunlight reaches the Earth.
3. Shade the diagram to show which part of the Earth is dark.
4. What time of day do you think it is for the stick person in the diagram? _____
<sunrise/midday/sunset/midnight>
5. Circle the figure that you think best represents the angle of sunlight hitting the person's ground (and therefore, the Sun in the person's sky) at the moment shown above.



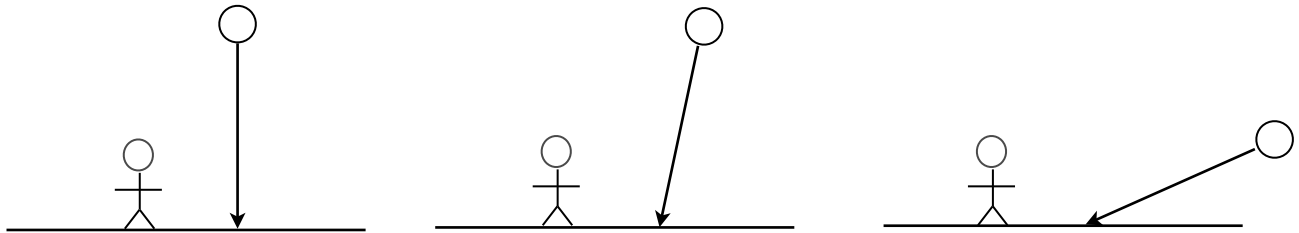
6. What season do you think it is for the person? _____
<summer/winter>

B. Interpret this diagram:

Diagram NOT to scale.



1. The northern hemisphere is tilted _____ the Sun.
<towards/away from>
2. Sketch in five light rays from the Sun, to show how you think Sunlight reaches the Earth.
3. Shade the diagram to show which part of the Earth is dark.
4. What time of day do you think it is for the stick person in the diagram? _____
<sunrise/midday/sunset/midnight>
5. Circle the figure that you think best represents the angle of sunlight hitting the person's ground (and therefore, the Sun in the person's sky) at the moment shown above.



6. What season do you think it is for the person? _____
<summer/winter>

C. Compare:

When the Northern Hemisphere is tilted **towards** the Sun, the Sun is

_____ in the sky at midday. This is _____ .
<high/low> <summer/winter>

When the Northern Hemisphere is tilted **away from** the Sun, the Sun is

_____ in the sky at midday. This is _____ .
<high/low> <summer/winter>

SEASONS DAY 6 - Bonus Questions

Figure I

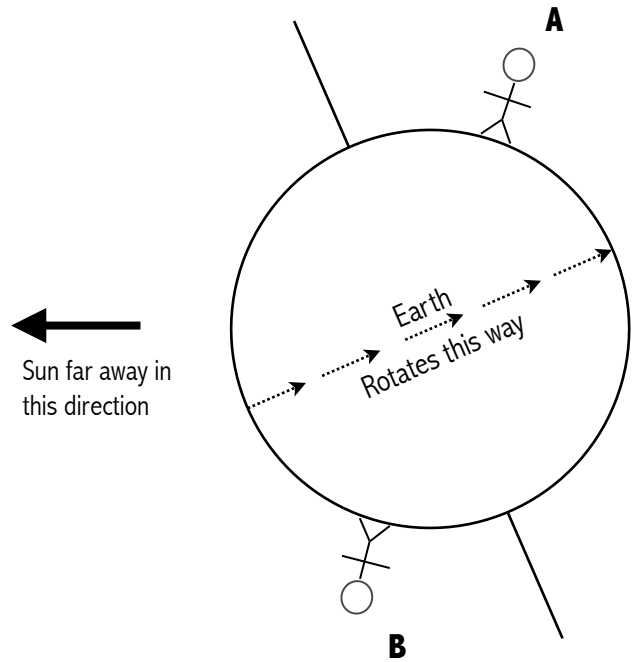


Diagram NOT to scale.

- Sketch in rays from the Sun
- Shade the dark part of Earth
- What time of day is it for Person A? _____
- What season is it for Person A? _____
Explain why you think so:

- What time of day is it for Person B? _____
- What season is it for Person B? _____
Explain why you think so:

Figure 2

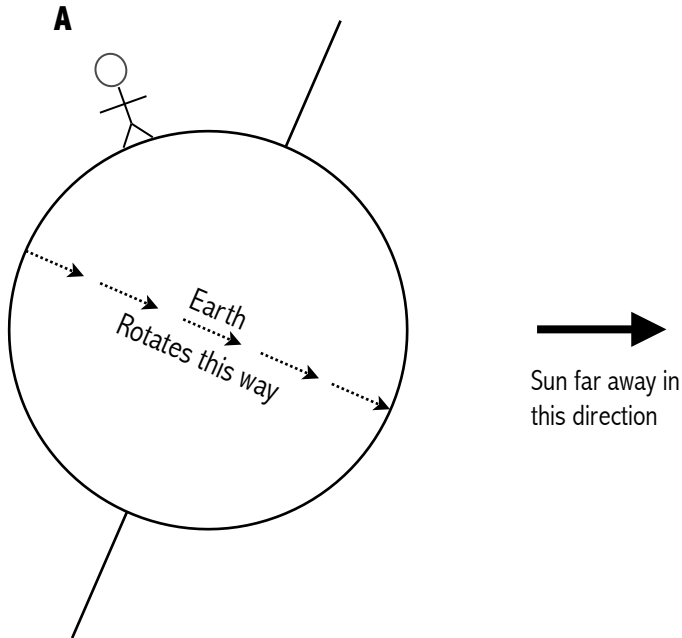


Diagram NOT to scale.

- Sketch in rays from the Sun
- Shade the dark part of Earth
- True or False? Figure 1 and Figure 2 show the same time of day and the same season for Person A.
- Sketch in a person for whom the Sun is directly overhead on this day. Label this Person B.
- Sketch in a person who will never see the Sun on this day. Label this Person C.
- Sketch in a person who will never experience darkness on this day. Label this Person D.

SEASONS DAY 7 - Tilt & Day Length

I. Collect Data: Length of Day around the World

On June 21:

A. The northern hemisphere is tilted _____ the Sun.
<toward/away from>

B. A place that spends this ENTIRE day in darkness (and never sees the Sun) is _____.

This place is in the _____ hemisphere, close to the _____.
<Northern/Southern> <equator/pole>

C. A place that spends less time in daylight than darkness is _____.

This place is in the _____ hemisphere, which is tilted _____ the Sun.
<Northern/Southern> <toward/away from>

On December 21:

D. The northern hemisphere is tilted _____ the Sun.
<toward/away from>

E. A place that spends more time in daylight than darkness is _____.

This place is in the _____ hemisphere, which is tilted _____ the Sun.
<Northern/Southern> <toward/away from>

F. A place that spends the same amount of time in daylight as darkness is _____.

This place is located near the _____.
<North Pole/South Pole/Equator>

G. A place that spends the ENTIRE day in daylight (and never sees the Sun set) is _____.

September 21:

H. Barrow, Alaska spends _____ time in daylight than darkness.
<more/the same amount of/less>

I. Puerto Montt, Chile spends _____ time in daylight than darkness.
<more/the same amount of/less>

2. Compare

A. When the Northern Hemisphere is tilted toward the Sun, the Southern Hemisphere is tilted

_____ the Sun.
<toward/away from>

B. Cities in the hemisphere that is tilted **toward** the Sun, have _____ hours
<more/the same amount of/fewer>
of daylight than darkness.

C. Cities in the hemisphere that is tilted **away from** the Sun, have _____
<more/the same amount of/fewer>
hours of daylight than darkness.

D. Some places on Earth have roughly equal amounts of daylight and darkness every day.

These places are close to the _____.
<equator/poles>

E. There are places on Earth where the Sun never rises or never sets for an entire day. These
places are close to the _____.
<equator/poles>

F. On September 21 and March 21, there are _____ hours of daylight than
<more/the same amount of/fewer>
darkness every where on Earth. These dates are known as the _____.

SEASONS DAY 8: EARTH'S ORBIT

What shape is Earth's Orbit?

- Draw a diagram of Earth's orbit around the Sun from an **overhead** perspective.
- Label key parts of your diagram.
- Label where you think Earth is in September, December, March, and June.

Distance from Earth to Sun:

Predict: At what time of year (if any) do you think Earth is closest to the Sun? _____.

Date	Collect Data distance from Earth to Sun (in kilometers)
December 21 (<i>Boston winter</i>)	
March 21 (<i>Boston spring</i>)	
June 21 (<i>Boston summer</i>)	
September 21 (<i>Boston fall</i>)	

Compare and Analyze:

Use the data in your table to answer these questions:

Earth is closest to the Sun in the Northern Hemisphere's _____.
<Fall/Winter/Spring/Summer>

Earth is farthest from the Sun in the Northern Hemisphere's _____.
<Fall/Winter/Spring/Summer>

Reflect:

A common explanation for why we experience Seasons is that Earth is closer to the Sun in the summer, and farther away in the winter. Do you agree or disagree with this? _____

<agree/disagree>

Explain your reasoning. If you disagree, please tell us why you think we experience Seasons:

Recap:

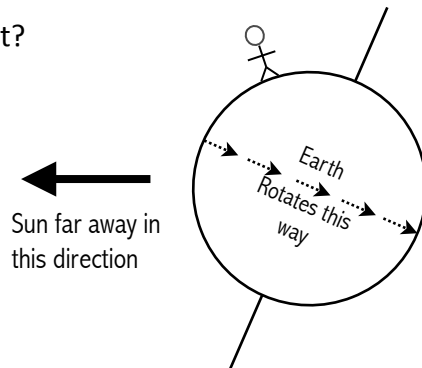
1. What season is it for the person in the diagram to the right?

<Fall/Winter/Spring/Summer>


2. The person in the diagram will experience:

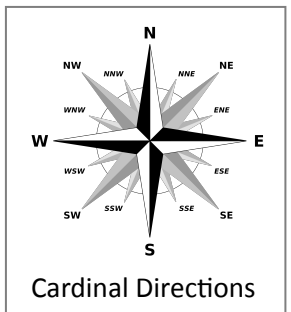
- A. A longer day and shorter night.
- B. Roughly equal day and night
- C. A longer night and shorter day

3. Sketch a side-view of the Earth and Sun when the southern hemisphere is experiencing winter:



SEASONS KEY TERMS

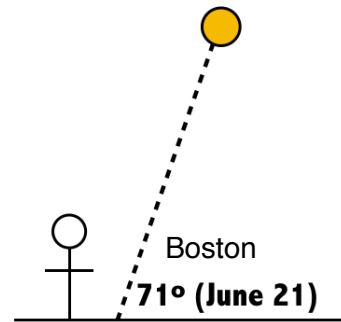
<u>Rotation:</u>	turning or spinning on an axis; Earth's rotation is the reason we experience night/day .
<u>Revolution/ Orbit:</u>	movement or path around another object; Earth's revolution around the sun takes one Earth year (365 days).
<u>Axis:</u>	an imaginary line around which the Earth spins or rotates
<u>Sunrise:</u>	when a given point on Earth rotates from the unlit half to the lit half; "daytime" begins.
<u>Sunset:</u>	when a given point on Earth rotates from the lit half to the unlit half; "nighttime" begins.
<u>Cardinal Directions:</u>	Directions of north, east, south, and west. (See diagram to right).
<u>Horizon:</u>	An imaginary line where the sky and the ground appear to meet. (Has a sky angle of 0 degrees.)
<u>Directly Overhead:</u>	The point in the sky that is straight above. (Has a sky angle of 90 degrees.) Unless you live within 23.5° latitude of the equator, the sun is NEVER directly overhead.
<u>Sky Angle:</u>	Measure (in degrees) of how high above the horizon an object is in the sky.
<u>Sun Angle:</u>	Sky angle of the Sun.
<u>Equinox:</u>	2 days of the year when we experience equal hours of daylight and night time (12 hours each) - March 21 and Sept 21
<u>Tilted Axis:</u>	Earth's axis is tilted at 23.5 degrees and is always pointed toward the North Star, Polaris. 



SEASONS KEY IDEAS

Summer - Hot

- Higher sun angle at midday
 - Light concentrated over a small area -> more intense -> warmer
- Longer sun path -> Longer hours of daylight
 - More time to heat up the ground



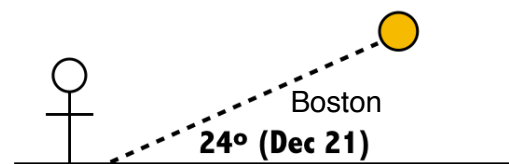
High Sun Angle → More Intense Light → Summer

Fall/Spring - In between

- Medium height sun angle at midday
- Medium length sun path -> medium hours of daylight
- Equinoxes: September 21/March 21 - Equal hours of day/night - 12 hours each

Winter - Cold

- Lower sun angle at midday
 - Light spread out over a larger area -> less intense -> cooler
- Shorter sun path -> Fewer hours of daylight
 - Less time to heat up the ground



Low Sun Angle → Less Intense Light → Winter