

Teacher Notes- “Seasons-Two Reasons For The Four Seasons”

The seasons. Is there another topic as misunderstood, as elegant, or as frustrating to teach?

Teaching the seasons to our students involves getting most of them to let go of a commonly-held notion: that how hot and cold we are is caused by how close we are to the sun. Undoing that learning is difficult. And doing a good job with this lesson means that you will have to do more than just present this one lesson. To push those old ideas out for good you’ll need to revisit this a few more times.



Materials per student/group:

- 1-Student Handout
- 1-Ruler
- 2-Calculators
- Red and blue colored pencils
- Ring stand and jaws clamp (optional)
- Flashlight
- Globe

And...

PowerPoint-Seasons

An orbiter would be a perfect compliment (item #WW63873M01 at sciencekit.com), but they are pricey. (optional)

Beforehand:

1. Round up enough globes for students in groups of 4 to have one. The ones shown in the PowerPoint slides are 12 inches across but any size will work.
2. If you’re using the PowerPoint, we put some hidden cues on the slides to help in your presentation. In the lower left it states what’s on the next slide, and the red dot in lower-right corner appears when the next click (or space bar tap) changes to the next slide. That way your talk can flow from one thing right into the next.
3. Closing the blinds in your room will help students see the light on the globes better.

4. Keep a flashlight, globe, and stand setup for yourself up front so you can *show* students what to do.
5. If you're limited on flashlights or globes, or just want a simpler way of doing this, you can have just 1 flashlight/globe set up that you the teacher operate in Part 1. That's not a bad way to do the lesson. In fact, it has some advantages- like being quicker and requiring fewer instructions and therefore confusion. But students won't see up close how the light intensity changes, and won't get the thrill of doing it themselves.
6. The first PowerPoint slide is very simple- title on black. You might want to add a seasonal picture or two to the background to spruce it up. If it's larger than the title, right-click it and go to "Order" → "Send to Back".

Procedure:

1. Announce to everyone that you're taking an imaginary field trip right now to the mall (close your eyes if you want):

"But we're not going for fun this time. We have business to do. We're going to talk to some unsuspecting shoppers about the seasons. See that clipboard in your hand? I want you to ask 10 random shoppers what causes the seasons. After you're done and everyone reports back, we'll discover that almost everyone is wrong.

Class, the cause of the seasons is one of the most misunderstood things in all of science. Most people, even the super intelligent, think that we experience summer when... (earth is closer to the sun), and that we experience winter when... (we're further away). Makes sense, but it's not true.

We can disprove it right now with two statements. Ready? When it's summer here, what is it like in Australia? (winter). So how can the thing that causes us to be hot cause them to be cold at the same time?

The other thing is even more devastating. You know how it's always cold here in January? Well, it turns out that January 4th is when earth is the closest to the sun (~91,000,000 miles) it will be on its journey around the sun (its orbit is slightly eccentric, or oval, causing this effect). And 6 months later, in the middle of summer, is when we're furthest (95,000,000 miles)*¹.

2. Go right into filling in the blanks next to "1.". The sub-points below it are meant to reinforce the first, most important idea- the earth's axis is tilted.*²

1. The tilt of earth's axis.

•It leans 23 ½ °

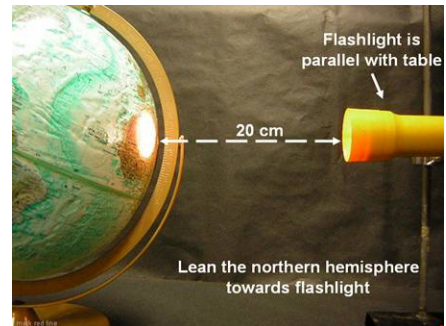
•Is the result of a massive collision, perhaps the same one that created the moon

3. Have students label the equator, axis, latitudes at 15, 30,

and 45 north and south, north and south pole on their earth maps. Notice the arrows, indicating sunlight coming from the right.

4. Now it's time to use the flashlights. First, make sure you have everyone's attention. Students not listening have no business touching anything. The concept we're about to show is simple, but it still needs to be done properly.

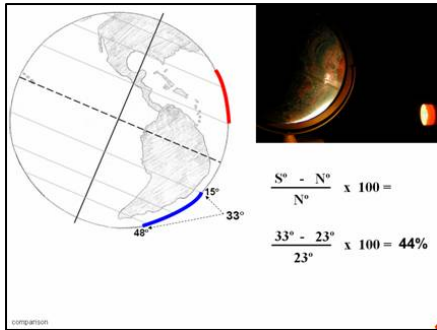
Have each student group clamp the flashlight in the jaws of the utility clamp and set it parallel to the table. Then move it 20 centimeters away from the globe, which should have the northern hemisphere leaning towards it. *It also works about as well if students just hold the flashlight in their hands about 20 cm away from the globe as they do the next step.*



5. Turn off the lights and ask students for their attention:

“Now that our flashlights are ready, let me demonstrate what I want you to do, and how to do it. Watch as I loosen the nut holding the clamp and then slowly slide it with the flashlight up and down the post. Notice I'm not moving the ring stand base or the globe, just the height of the flashlight. (*demonstrate*). Now, when you do this, what I want you to notice is when the circle of light on the globe is smallest and when it's the largest. You'll notice as you move it from the north pole slowly and steadily to the south pole that the beam of light keeps changing size. Again, when/where is the beam of light biggest and smallest. Ready? Go ahead and do that now.”

6. Walk around the room and make sure students are doing what you asked the way you asked, and are noticing the beam is most focused/smallest around 15° north, and most spread towards the poles, especially south.
7. In the next few PowerPoint slides the size of a beam of light beginning at 15° north and 15° south are compared mathematically. It's best to have students just watch the screen (or listen to you) and copy these notations on their handout. It's a much easier and neater process when everyone is using the same numbers (believe us- it doesn't work nearly as well when each group uses their own observations and numbers!)
8. Here is a summary of those results: when the northern hemisphere leans towards the flashlight and the beam begins at 15° north, it stretches to 38°. In other words, it covers an area of 23° (the difference between the numbers). When you get to this, *have students take a red colored pencil and shade that same section on their papers.* When the same flashlight is adjusted down so the beam begins at 15° south, it stretches to 48° south. The difference between those is 33°. *Have students shade this part of their papers blue.*



When you plug those numbers into a comparative math formula $(33-23/23 * 100)$, you get 44. What that tells you is that beam number 2 in the southern hemisphere is 44% bigger, or more spread, than beam 1. Put another way, in both cases the same amount of “heat” from the sun was broadcast to 2 places. Which area is going to be warmer- the one under the smaller, focused beam or under the larger one? (hint-not the second)

(end of Teacher Notes preview)

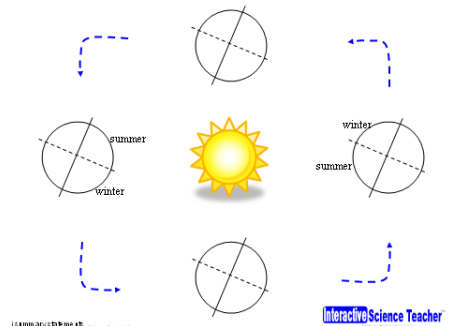
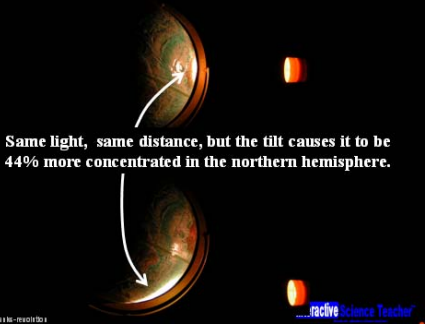
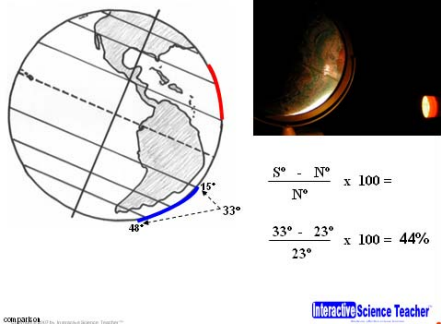
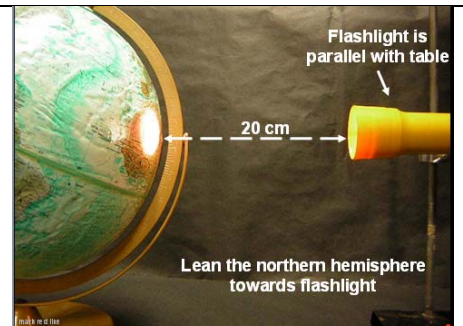
Come back and visit InteractiveScienceTeacher.com and for just .99¢ you can download the entire set of Teacher Notes right now, along with:

◆ PowerPoint (16 slides) Don't have PowerPoint? Download it FREE: [Mac / PC](#)

Seasons

1. The tilt of earth's axis.

- It leans 23 1/2 °
- is the result of a massive collision, perhaps the same one that created the moon

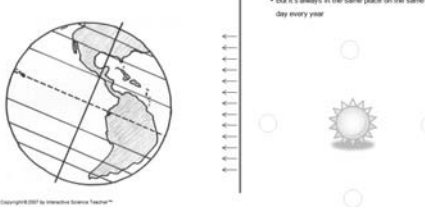


◆ Student Handout

Seasons

















Two factors cause Earth's seasons:

- The _____ of earth's axis.
 - It leans _____.
 - Is the result of a massive _____ perhaps the same one that created the _____.
- The _____ of earth around the sun.
 - Average speed _____ mph.
 - It takes earth _____ days to make the _____ mile journey.
 - But it's always in the same place on the same day every year.



Copyright © 2007 by Interactive Science Teacher™

◆ Drawings & Pictures

 1. Tilt- Blank	 Comparing North And South Beams	 Drawing-Earth-Land... Shaded	 Drawing-Earth-Unshaded
 Flashlight And Globe	 Flashlight Clamped	 Globe	 Globe With Equator & Axis
 Homework Question 1-No Tilt	 Homework Question 1-No Tilt, 1	 Homework Question 2-No Revolution	 Light On Northern-Dark
 Light On Northern-Light	 Light On Southern-Dark	 Light On Southern-Light	 Setting Up Flashlight

◆ Quick Notes

Teacher Quick Notes- "Seasons"

Materials per student/group:

- 1-Handout- "Student Handout-Seasons" (located in the *Resource* folder)
- 1-Ruler
- 3-Calculators
- Red and blue colored pencils
- Ring stand and jaws clamp (optional)
- Flashlight
- Globe

And...

PowerPoint-Seasons (located in *Resource* folder, optional)
An orbiter would be a perfect compliment

Procedure:

- Filling in the blanks on the student sheet next to 1, dealing with earth's tilted axis.
- Have students label the equator, axis, latitudes at 15, 30, and 45 north and south, north and south pole on their earth maps.
- Have each student group clamp the flashlight in the jaws of the utility clamp and set it 20 centimeters away from the globe, which should have the northern hemisphere leaning towards it. *It also works about as well if students just hold the flashlight in their hands.*
- Have students now move a flashlight beam up and down the globe, noticing where the beam is smallest and largest (most spread).
- Use the PowerPoint slides to compare mathematically the size of the beams at 15° north and 15° south.
- Have students shade with red and blue the areas of the north and south covered by the beam, just like on the PowerPoint slide.
- Now move onto point 2, and fill in those blanks for revolution.
- Have them draw an equator and axis on the 4 earths below the revolution blanks.
- Put arrows in between the earths to note the earth moving around the sun.
- Summarize the lesson with the 2 statements on the top of the back.
- Homework- do the matching section (for fun) and then the 2 "what if" questions. Ideally leave 5 minutes for students to play with globes/flashlights to help them with their answers.

Copyright © 2007 by Interactive Science Teacher™

