SkyQuest: Hands-on activities

Scale of the Solar System

Nearly every illustration or diagram of the Solar System is a lie! How? They terribly misrepresent the relative sizes and distances between objects – but for good reason! Space is so unfathomably vast and empty that an honest picture of the solar system would be really boring.

Imagine that the sun is a large beach ball, about a yard in diameter. What's the size of the earth in comparison? Ask kids to guess: if they're guessing based off common images they've seen, then they might guess that the Earth is between the size of a soccer ball or baseball. In reality, the earth is much smaller: the size of a marble. In relation to this, the moon is the size of a peppercorn, and Jupiter would be the size of a grapefruit. Even the largest planet in the solar system pales in comparison to the size of the sun!

But what about distances? Ask students how far away they think the earth and moon are in this scale. Answer: A whole foot! That's part of why the moon landings were so hard: the moon is not as close to earth as you might think! It took the Apollo missions 3 full days just to get to the moon. (vs. 10 minutes to get into outer space).

How about the earth from the sun? This is where it'd be helpful to be outside: The beachball and the marble have to be separated by a full football field! It's truly amazing to see this with your own eyes. The solar system really is remarkably empty – and it only gets emptier the further you get from the sun. Pluto has a very eccentric orbit; but on average, it is about 5 miles away from the beachball. The distance to the next nearest star (Proxima Centauri) is hard to envision. If the beach ball were in Raleigh, and you took a plane to Hawaii, you would've traversed 1/4 the distance you need to go to get to Proxima Centauri. Compare this to the size of a beach ball!

Day and Night

Put a globe and a bright lamp about a yard from each other in a dark room. Tape a small toy figure onto North America and slowly rotate the globe. Ask questions: when it is noon for the toy person? When is it midnight? Tape another figure in Australia. When it's midnight for the American, what time is it in Australia?

This is a crude graphic but hopefully it communicates the idea:

Insolation and Seasons

The crucial idea behind why seasons has anything to do with the Earth's tilt is unearthed by asking the following straightforward question. When does it feel hotter: when the sun is directly overhead, or when the sun is lower in the sky? Make sure that all the students agree: the sun feels hottest when it's right above us. (This idea is closely related to the *angle of insolation*, which is usually taught in 8th grade).

Populate the globe with a few figures at various latitudes. Now (with the north pole tilted towards the sun), rotate the globe and ask the students: try to step into the shoes of the toy figures. Which of them see the sun directly above them? Which of them see the sun lower in the sky? This can be tricky to visualize, but eventually students should see that the people in the northern hemisphere see the sun almost directly overhead (at noon), whereas the people in the southern hemisphere only ever see it at an angle. In fact, people living on the northern tropic will see the sun exactly directly overhead at noon. The further you are from this tropic, the more at-an-angle you'll see the sun.

There's another factor. As you rotate the globe, people in the northern hemisphere experience sunlight for a larger portion of the day, whereas people in the southern hemisphere have sunlight for less than half the day. You can see this directly by tracking a particular figure and how much time he/she spends in darkness vs. light. You can also see that the north pole sees 24 hours of sunlight, and the south pole see 24 hours of night.

So we've seen two different phenomena: the people in the northern hemisphere see the sun higher in the sky, AND they see it for longer. Now ask kids to think back to the first question. This means that it is going to be hotter, every day, in the northern hemisphere than the southern. In otherwise, the north is experiencing summer, while the south is experiencing winter!

The last thing to do is to show how this changes as the earth revolves around the sun. You can repeat some/all of these activities when the earth has made half an orbit and show that now, everything is reversed: the north has winter, while the south has summer.

Going back to the idea of insolation, you can point out that in fact, this explains why it gets colder the closer you get to the poles: these places ALWAYS see the sun low in the sky, so they never heat up. Meanwhile, the equator sees the sun very close to zenith all throughout the year: that's why there are so many hot, tropical climates there.