Ponder the Sky With Paul

Written Just for Teacher Liaisons by a 2005 teacher liaison.

Here is a little thirteen-minute exercise I do with my students to help them understand the FUNdamental Motions of the Sky that we live under our entire lives.

First I take them outside with a notebook and writing utensil in hand.

When they are comfortable outside I have them open to a blank page in their notebook and have them write DAY on top, MONTH in the middle of the page, and YEAR toward the bottom of the page (leaving room for notes by each word).

You try this as you read this. It will not take long so please play along like you are the student.

PART I DAY

DAY

Under DAY I ask the students how the idea of DAY was invented. Usually at least one student is willing to share that a day the time it takes the Earth to spin once on its axis. (24 hours)

How many degrees does the Earth spin in 24 hours? Student's answer: 360^o
If the Earth spins 360^o in 24 hours, how many degrees does it spin in one hour?
Students: 360/24 = 15 degrees/hour

Side Note: I explain to them that this is the fastest motion of the sky by far. This is why after one student is done looking at an object in a telescope that the next person that looks says the object is gone. This is why we have time zones every fifteen degrees. This is why sundials have the hour lines every fifteen degrees.

How far is 15^o in the sky?
Hold your fist out at arms length with the thumb end up. A fist at arms length is about ten degrees. To prove it hold one arm parallel to the ground for zero degrees, set your other fist on top of it and count ten degrees, then place your bottom fist on top again for twenty degrees, repeat setting the under fist on top until you get to ninety degrees and note you are looking straight up your final fist.

Your pointer finger at arms length is about one degree.

Which way does the Earth spin on its axis? Students: Toward the East as this makes the Sun and stars appear to rise in the East and set in the West.

Side Note: At this point I explain that yes the Earth does spin toward the East but because the axis of the Earth points to the North Star Polaris all the celestial objects are making perfect circles around Polaris in a counterclockwise direction motion 360 degrees every 24 hours. Polaris is your latitude above the Northern Horizon and half way between due East and due West. Thus I quickly point out that stars to the left of Polaris are moving North, the stars under Polaris are moving East, the stars to the right of Polaris are moving South, the stars south of Polaris (which are the majority of the stars we see) are moving West in order to circle Polaris each day.

Finally it is important to point out that if all celestial objects (sun, moon, planets, comets, and asteroids) are moving 15 degrees in 60 minutes (or one hour), how many minutes does it take for them to move one degree? Students: 60/15 = 4 minutes per degree.

Side Note: If the sun and moon both take up exactly ½ degree in the sky (as is evident during a total solar eclipse when the moon can exactly cover the sun) and it takes 4 minutes for them to move one degree in the sky, how long would it take the moon to set if the base of the moon was setting on the western horizon?
Student: If the moon is ½ degree and 1 degree is 4 minutes then ½ degree would be only 2 minutes.

PART II MONTH

MONTH:

Where do we get the idea of a month?
Students: The time it takes for the Moon to orbit the Earth.

About how many days in a month?
From Full Moon to Full Moon is exactly 29.5 days but we'll round to 30 days to make the math easier.

How many degrees does the Moon move in a Month?
Students: 360 degrees again.

So if the Moon moves 360 degrees in about 30 days, how many degrees does the Moon move in one day?
Students: 360/30 = 12 degrees per day

What direction does the Moon move 12 degrees per day in?
Hint to the students if the need it: The Moon moves around the Earth the same direction the Earth spins on its axis.

Students: The Moon moves EAST 12 degrees per day then.

I point to a spot in the sky and say: What if the Moon were right there tonight at 10 PM, at what time would the Moon be in the same spot tomorrow using what you know from your notes above?
Students: Well the moon would be 12 degrees East of the spot at 10 p.m. so it would take 12 degrees times 4 minutes per degree or 48 minutes for the Earth to spin getting the Moon back in the same spot which would make it 10:48 p.m.

If the Moon moves East 12 degrees in 24 hours, how many degrees does the Moon move in one hour?

Student: 12/24 = ½ degree per hour

How much sky does the Moon and Sun subtend again?

Student: ½ degree

Thus the Moon moves its full diameter EAST per hour. COOL!

PART III YEAR

YEAR

Where do we get the idea of a **YEAR**?

Students: A year is how long it takes for the Earth to get around the Sun.

How many degrees does the Earth have to move in a year to get around the Sun?
Students: 360 degrees again

If the Earth takes 360 degrees to get around the Sun in a year, **about** (round to the nearest degree) how many degrees does the Earth move in one day?

Students: 360/365 = about one degree per day

Which way does the Earth revolve around the Sun?
Hint: The Earth revolves around the Sun the same direction the Earth spins on its axis and the same way the Moon revolves around the Earth.

Students: Toward the East if you are facing North then.

Correct. Because the Earth is moving around the Sun about one degree per day toward the East all the celestial objects appear to go about one degree counterclockwise around Polaris per day.

Think about it: It is this one-degree per day that causes us to see different stars during different seasons.

BIG THOUGHT: Really put your thinking cap on now!!!

Picture an individual star at night (as I pretend to point at one in the sky).

That star has to make one trip around Polaris (360 degrees) counterclockwise each DAY because of the Earth spinning on its clockwise, and about one extra degree around Polaris because of the Earth going around the Sun.

That star in a year's time would have to make 365 trips around Polaris because of the Earth spinning on its axis and one more full trip around Polaris because of the Earth going around the Sun.

Now you understand the FUNdamental Motions of the Sky and WHY these motions exist. I will give you extra credit points now if you can explain these notes to friends and/or family because in teaching them you will commit them to memory.

Note to Liaisons: Since students at a very young age know there are 360 degrees in a full circle and know that the Earth spins on its axis, the moon goes around the Earth, and the Earth around the Sun; this lecture can be given to practically any audience and age group in a few short period of time.
I call the teaching it to others G.N.A.T.S. Go Now And Teach Someone.
I wrote this for you tonight to GNATS whenever you get the opportunity, as I believe everyone can benefit from understanding these FUNdamental motions of the sky.

If you would like more information similar to this about the sky just reply back and I'd be happy to send you some more.

Thanks.

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