Ancient Observatories: Timeless Knowledge Activities

Introduction
It is important in the study of relationships to look into possible connections between items. Throughout history different cultures have looked to the sky for answers that may determine their survival and livelihood. Patterns in solar observations helped to determine crucial times such as when to plant and when to harvest the food to ensure the survival of the group.

Benchmarks – Grades 6-8 (Habits of Mind)

- Scientist differ greatly in what phenomena they study and how they go about their work. Although there is no fixed set of steps that all scientists follow, scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected evidence.
- Scientific knowledge is subject to modification as new information challenges prevailing theories as a new theory leads to looking at old observations in a new way.
- Some knowledge is very old and yet is still applicable today.

Materials
Drawing paper
Ruler
Compass
Calculator (optional)
Protractor (optional)

Prior Knowledge
Radius
Vertical Angles
Right Angles
Diameter
Perpendicular
Tangent
Four Seasons
12 Months

Student Activity One

This activity is designed to help you make connections between events in your life and the seasons of the year. One major connection relates the concept of the seasons to past observations.

For this activity we will look at a connection between months and seasons. Follow the directions below to construct a diagram to help you make this connection. Make a check on the line in front of each bullet as you complete each step.

1. _____ Construct a circle of radius 5 cm in the space below.
2. _____Divide the circle into 12 equal sections. Hint: divide the number of degrees in a circle by the number of sections desired.
3. _____ Label each section with a month in order starting with January.
4. _____ List the four seasons below.

    ____
    ____
    ____
    ____

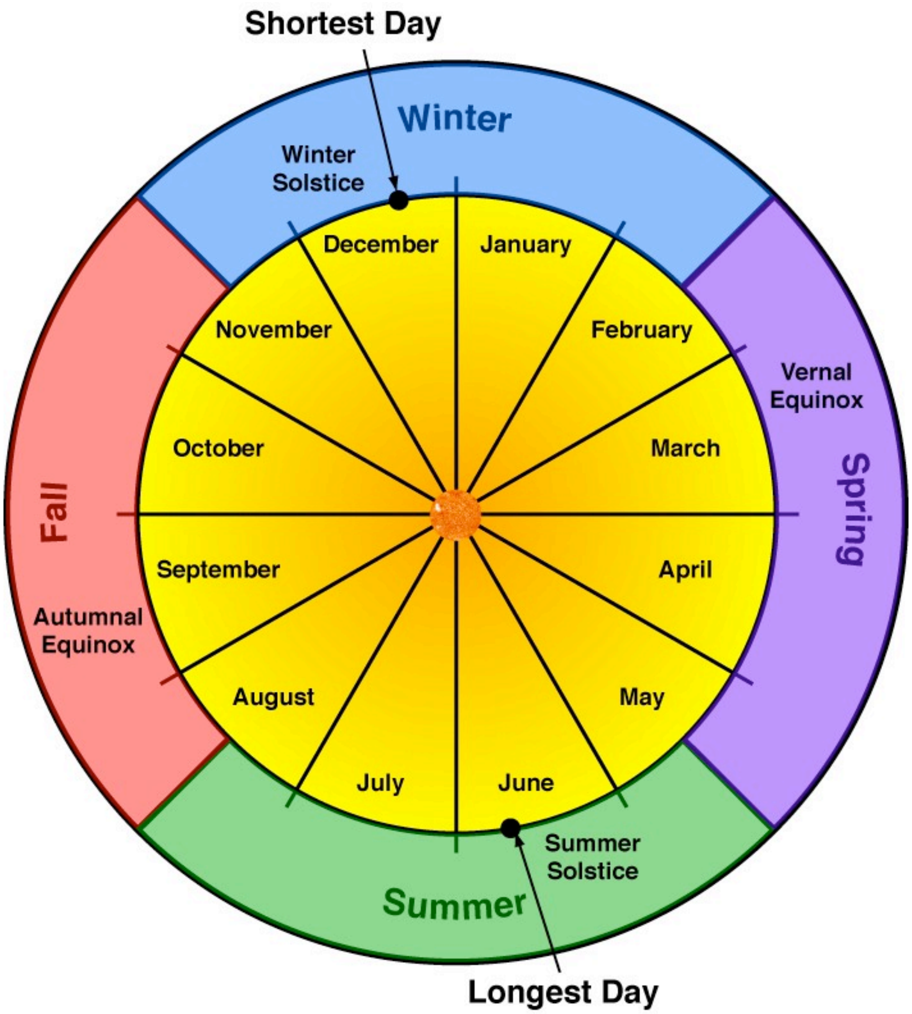
5. _____ Determine which months are in which season and identify them on the diagram.
6. _____ The longest day of the year is in June. Place a mark outside the section of the circle with June in it and label it the longest day of the year.
7. _____ The shortest day of the year is in December. Place a mark outside the circle and label it the shortest day of the year.

What do you observe about the location of these two days on the diagram?

8. _____ Locate March on the diagram. Determine which month would correspond to March like December corresponds to June. Label this the fall equinox and March as the spring equinox.

In ancient observatories, the four months identified above were very significant and predictable. The winter solstice occurs on December 21st. This is the shortest day of the year. The summer solstice occurs on June 21st. This is the longest day of the year. In September, the fall (autumnal) equinox occurs and in March the spring (vernal) equinox occurs. The following activities will help show you how these dates are significant in relation to the Sun and the Earth.

Teacher Key (Activity One)



Student Activity Two

For our purposes a circle will be used to depict the Earth's orbit, but keep in mind the orbit is really an ellipse.

This activity will help you visualize the four key observation dates located in activity one. This construction is from a viewpoint in space looking down on the circle. Let the center of the circle, S, be the Sun and the circle represent the Earth's orbit. As you complete the drawing, check off the steps that are completed.

1. ____ Draw a horizontal diameter. Label the left side of the chord as A and the right side of the chord as P.
2. ____ Draw a diameter perpendicular to AP. Label the top of the chord as X and the bottom of the chord as Y.
3. ____ Measure and draw an angle 66.5 degrees counterclockwise from P. Label angle VSP.
4. ____ What is the complement of the 66.5 degree angle? Label the sector above the 66.5 degree angle with this measure. What angle is this? ____________
5. ____ Measure and draw a 66.5 degree angle counterclockwise from A. Label the angle ASE.
6. ____ What is the complement of this angle. Label the complement in the appropriate sector. What angle is this?
7. ____ Measure an angle 23.5 degrees clockwise from A. Label the angle ASN.
8. ____ Measure an angle 23.5 degrees clockwise from P. Label the angle PSW.
9. ____ Write ":Spring (Vernal) Equinox March" at V.
10. ____ Write "Winter Solstice Dec. 21st" next to W.
11. ____ Determine where to place "Summer Solstice June 21st" and Fall (Autumnal) Equinox Sept." and write them on the diagram.
12. ____ Place the following on your diagram. Between V and W label 88.0 days. This number means that between the Vernal Equinox and the Winter Solstice there are 88.0 days.
13. ____ Place 90.825 days between the W and the E on the diagram. This means that there are 90.825 days between the Winter Solstice and the _____________________.
14. ____ Place 93.625 days on the diagram between the E and the N. This means that there is 93.625 days between the _______________ and the ______________________.
15. ____ Place 92.75 days between the N and V on the diagram. This means that there are 92.75 days between the ______________ and the _____________________.

Answer the following questions based on the drawing you made.

1. What type of angles are angle XSV and angle ESY? ___________________________
2. What types of angles are angle ESW and angle and angle NSV?_____________________________
3. What do you notice about the Vernal Equinox and the Autumnal Equinox? ____
4. What do you notice about the Summer Solstice and the Winter Solstice? ____
5. What is the total days did you place on the diagram? ___________________
6. What do you think this number represents in this situation? ____
7. What percent of the year is between the Vernal Equinox and the Summer Solstice?___________________________________
8. What percent of the year is between the Summer Solstice and the Autumnal Equinox? __________________________________
9. What percent of the year is between the Autumnal Equinox and the Winter Solstice? ___________________________________
10. What percent of the year is between the Winter Solstice and the Vernal Equinox? ____
11. Are these percentages constant? _________________
12. Can you think of a reason to explain your answer to question #11? ____ ____ ____ ____
13. Do you know the angle of the Earth's tilt? If so, what is this angle? ___________
14. Perihelion is the point on the Earth's orbit closest to the Sun. Point P on the diagram represents Perihelion. It is important to remember that the Earth's orbit is an ellipse , not a circle. Which Equinox or Solstice occurs closest to Perihelion and why do you think it is significant to Perihelion? ____ ____ ____
15. Aphelion is the point on the Earth's orbit farthest to the Sun. Point A on the diagram represents Aphelion. It is important to remember that the Earth's orbit is an ellipse , not a circle. Which Equinox or Solstice occurs closest to Aphelion and why do you think it is significant to Perihelion? ____ ____ ____
16. Do you think that the Earth revolves in a clockwise or counterclockwise motion as it orbits the Sun? ____

Scientists and Astronomers frequently discuss and defend ideas and findings. Take five minutes at this time to discuss with the group any patterns or observations that you have uncovered in either Activity One or Activity Two as well as any connections between the two of them.

Write a summary of any observations and connections that have been observed between Activity One and Activity Two.

Teacher Key (Activity Two)