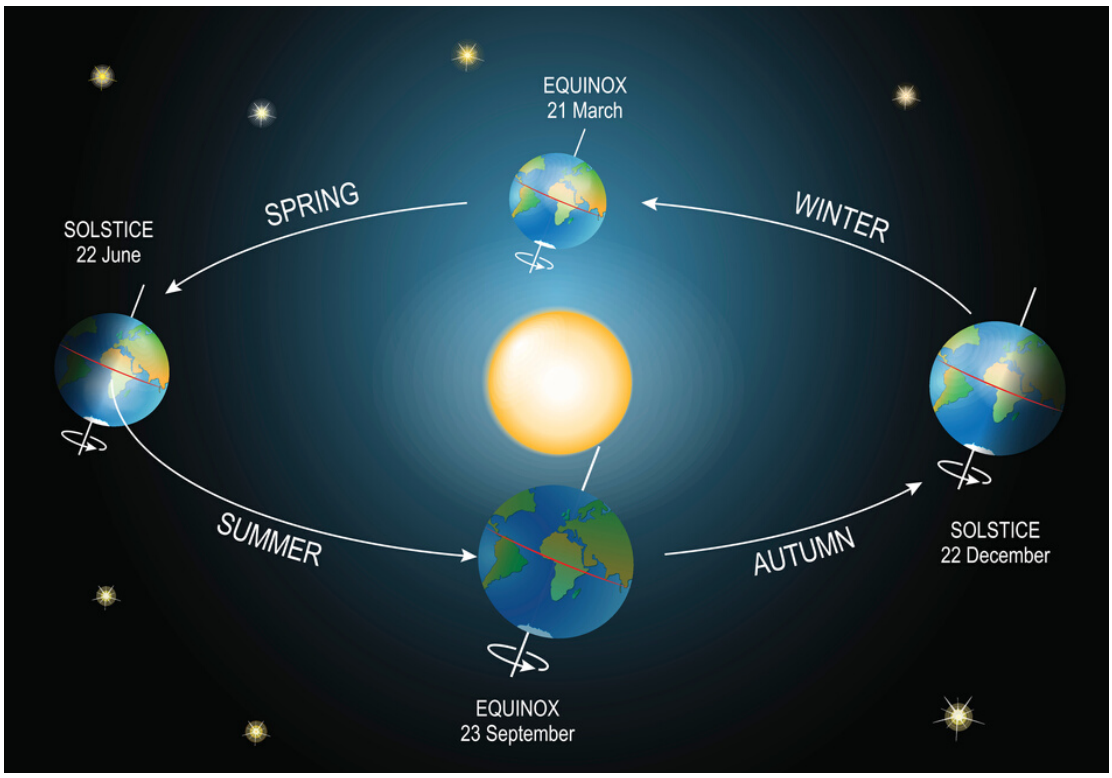
Name: _____

How Solar Calendars Work

- Throughout the year, the length of the shadow at noon changes. In the Northern Hemisphere the shadow at noon is the longest in December when the North Pole is pointed away from the Sun, and the Sun appears low in the sky. In the Northern Hemisphere, the shadow at noon is shortest in June when the North Pole is pointed toward the Sun, and the Sun is almost straight up.
- Every year, the location of the Sun tells us if it is winter, spring, summer or fall. This is because the Earth is tilted in comparison to the Sun. As you read the descriptions below, the location of the Sun at noon for anyone living in the Northern Hemisphere is in parenthesis.
  - In December the North Pole is pointed away from the Sun. (low in the south)
  - As the Earth revolves around the Sun, the tilt moves toward the Sun until in June the North Pole is toward the Sun. (high in the south, almost straight up)
    - Note: Remember that the tilt of the Earth doesn't actually move. Instead, the Earth's revolution around the Sun causes Earth's tilt to line up with the Sun differently throughout a calendar year.
  - As the Earth continues to revolve around the Sun, the tilt moves away from the Sun, until in December, the North Pole is again pointed away from the Sun (low in the south).
- It takes the Earth 365 ¼ days to make one complete orbit of the Sun. So if you start counting on Dec 21 when the North Pole is pointed away from the Sun, it will be in the exact same place 365 ¼ days later. After 4 years, that extra ¼ of a day adds up to a whole day, so we add an extra day to the calendar once every four years.
- The length of the shadow at noon is also effected by your location. If you live closer to the equator your shadows will be shorter. If you live further from the equator, your shadows will be longer. The distance from the equator is measured in degrees of latitude. For example, Ecuador in South America is at a latitude of 0, Miami Florida is at a latitude of 26, and Chicago Illinois is at a latitude of 42.



Name: _____

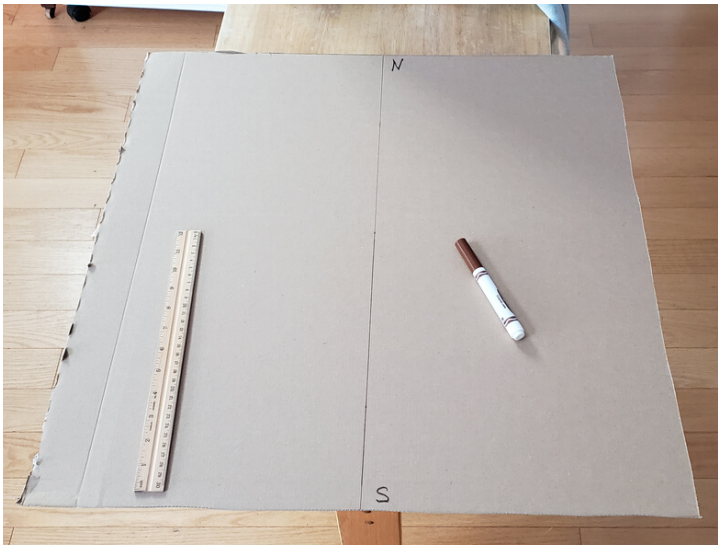
Creating and Testing a Solar Calendar

Step 1: Build your Solar Calendar

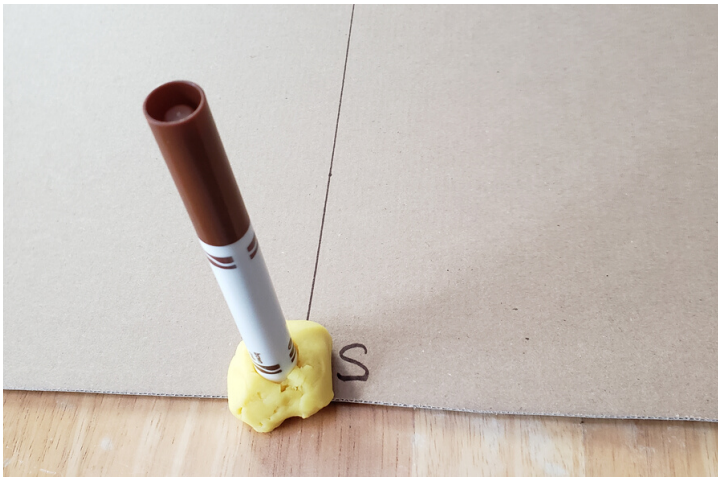
- Collect the following materials from your teacher:
  - 24"x 24" piece of cardboard
  - Ruler
  - Washable Marker (standard, not thin tipped)
  - 1" round ball of clay
  - Flashlight

- Get a "location assignment card" from your teacher and write your location on the line below.
  - The location I am using is: _____

- Lay your piece of cardboard flat on a table or other surface.
- Use a ruler and a marker to make a straight line dividing the cardboard into 2 sections.
- Label one end of the line N for North and the other end S for South.
  - This "north-south line" represents the directions north and south for your solar calendar.



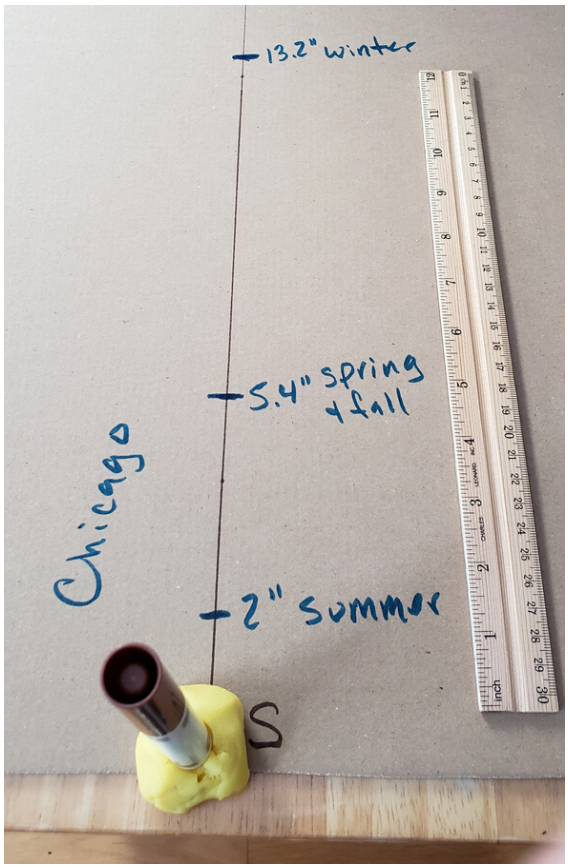
- Use a ball of clay to attach the marker to the cardboard where the end of the line labeled S meets the edge of the cardboard.



Name: _____

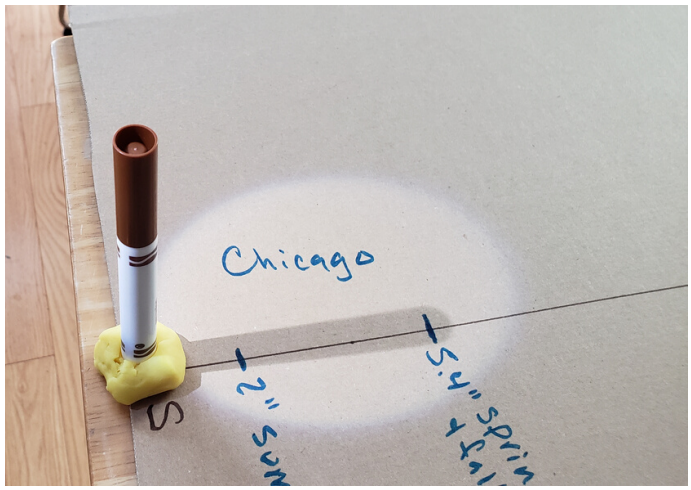
Follow the steps below to mark the length of the shadow at noon during different seasons for your location.

- Look at your location card.
- Find the length of the shadow on Dec 21st
- Lay your ruler on the cardboard with the zero end touching the ball of clay.
- Measure the distance found on your card from the marker and put a mark on your paper.
- For example, if your location is Chicago, put a mark on the line 13.2 inches away from the marker.
- Label the line “Dec 21”
- Repeat this process for Mar 21st, June 21st and Sept 21st
- Notice that Mar 21st and Sept 21st shadows are the same length!



Step 2: Test Your Solar Calendar

- Hold a flashlight so that the shadow of the marker falls on the north south line.
  - To do this you will need to hold the flashlight on the side of the marker that is in the opposite direction to the north south line.
  - Hint: The "sun angle" measurement can help you determine at what angle you should hold your flashlight. Use a protractor to help!
- Next, move the flashlight so that you can create a shadow that represents each season. Notice that the angle that you have to hold your flashlight is lowest for the winter and highest for the summer.
- Once you have successfully created each shadow, see if you can simulate the light your city receives during an entire year by creating each season, one after another.



Location Cards for Students

Each student needs one of the 5 cards below. Print off enough copies so that each student can have one card.

Chicago, Illinois, USA

Latitude: 42 degrees

Winter: December 21
Sun Angle: 24.5 degrees
Shadow Length: 13.2 inches

Spring: March 21
Sun Angle: 48 degrees
Shadow Length: 5.4 inches

Summer: June 21
Sun Angle: 71.5 degrees
Shadow Length: 2 inches

Winter - December 21
Sun Angle: 48 degrees
Shadow Length: 5.4 inches

Miami, Florida, USA

Latitude: 26 degrees

Winter: December 21
Sun Angle: 40.5 degrees
Shadow Length: 7 inches

Spring: March 21
Sun Angle: 64 degrees
Shadow Length: 2.9 inches

Summer: June 21
Sun Angle: 87.5degrees
Shadow Length: 0.3 inches

Winter - December 21
Sun Angle: 64 degrees
Shadow Length: 2.9 inches

Los Angeles, California, USA

Latitude: 34 degrees

Winter: December 21
Sun Angle: 32.5 degrees
Shadow Length: 9.4 inches

Spring: March 21
Sun Angle: 56 degrees
Shadow Length: 4.1 inches

Summer: June 21
Sun Angle: 79.5 degrees
Shadow Length: 1.1 inches

Winter - December 21
Sun Angle: 56 degrees
Shadow Length: 4.1 inches

Houston, Texas, USA

Latitude: 29 degrees

Winter: December 21
Sun Angle: 37.5 degrees
Shadow Length: 7.8 inches

Spring: March 21
Sun Angle: 61 degrees
Shadow Length: 3.3 inches

Summer: June 21
Sun Angle: 84.5 degrees
Shadow Length: 0.6 inches

Winter - December 21
Sun Angle: 61 degrees
Shadow Length: 3.3 inches

Vancouver, British Columbia, Canada

Latitude: 49 degrees

Winter: December 21
Sun Angle: 17.5 degrees
Shadow Length: 19 inches

Spring: March 21
Sun Angle: 41 degrees
Shadow Length: 6.9 inches

Summer: June 21
Sun Angle: 64.5 degrees
Shadow Length: 2.9 inches

Winter - December 21
Sun Angle: 41 degrees
Shadow Length: 6.9 inches