Astronomy

Science & Technology Branch – Step 4

Purpose

The "Astronomy" Step provides a basic knowledge of celestial objects and how they benefit us in various ways. Upon completion of this step, Trailmen should understand many of the basic objects in the day and night sky and how to utilize these objects.

1. What is the Sun?
2. What is the Moon?
3. What are stars?
4. What are constellations and how are they used?

Notes to the Trail Guide //

1. The goal is not for the boys to be experts on these topics but to gain an increased knowledge and awareness of the Step.
2. Make it relative to your patrol.
3. Remember, these lessons should build from Fox to Hawk and from Hawk to Mountain Lion.
4. See the Leaders Guide for more information on Steps.

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Skill Progression

	1. Constellations – Recognize photo with constellation image superimposed over the stars 2. Nomenclature
	1. Constellations – Recognize photo of stars only 2. Sky orientation techniques
	1. Constellations – Recognize outside in the night sky 2. Memorize a few relevant constellations

Helps

1. What is the Sun?
    a. **Goal**: To understand the purpose of the Sun and how it provides for us.
    b. **Lesson**: The Sun provides many forms of energy for the Earth such as light and heat.
    c. **Examples**:
        i. Light to see
        ii. Light for food (Photosynthesis, Vitamin D)
        iii. Heat
2. What is the Moon?
    a. **Goal**: To understand what the Moon is and how it affects us.
    b. **Lesson**: The Moon provides an important benefit to Earth.
    c. **Examples**
        i. Light during the night (Reflected from the Sun)
        ii. Tidal Forces
        iii. Climate (by slowing the Earth's rotation)
3. What are stars?
    a. **Goal**: To understand what stars are and how they can benefit us.
    b. **Lesson**: Stars can provide a means of direction and location. There are many objects that look like stars but are not.
    c. **Examples**:
        i. Stars
            1. Polaris (North Star)
            2. Sirius (Dog star)
            3. Betelgeuse
        ii. Non-stars
            1. International Space Station (ISS)
            2. Comets
            3. Airplanes
4. What are constellations and how are they used?
    a. **Goal**: To understand what constellations are and how to identify some of them.
    b. **Lesson**: Constellations are used to help remember where stars are located in the sky.
    c. **Examples**:
        i. Orion
        ii. Cassiopeia
        iii. Ursa Minor (Polaris, the North Star is in Ursa Minor), the Little Bear
        iv. Ursa Major (The Big Dipper)
        v. Pegasus

Scripture Ideas

Genesis 1:16

- Fox – God created the universe and is all-powerful (Omnipotent)
- Hawk – God's creation is a wonderful reminder of his power and grace. He also made it so wonderfully that it shows us direction.
- Mt Lion – His greatness shines continuously even when the Sun is out. During the day, we cannot see the stars, but they still shine. His glory and grace are the same.

Isaiah 40:26

- Fox – God created the universe and is all-powerful (Omnipotent)
- Hawk – God's creation is a wonderful reminder of his power and grace. He also made it so wonderfully that it shows us direction.
- Mt Lion – Remember that He calls all the stars by name and He knows you by name as well. You are just as great a creation as the multitudes of stars in the universe.

Activity Ideas

- See the relevant patrol and branch section of the activities
- Or, create your own activity relevant to your troop and region

Game Ideas

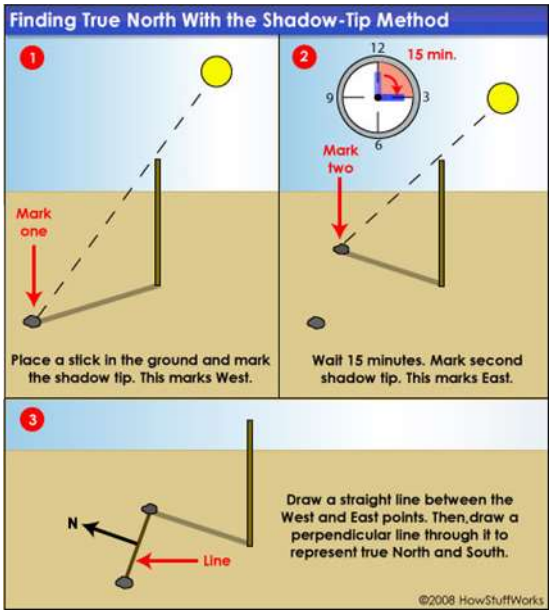
- Check the games section online for game ideas
- Or, create a game that works for your patrol
- A couple of ideas are listed below

Name Activity: Using the sun to find North

Summary: There are several ways to find North.

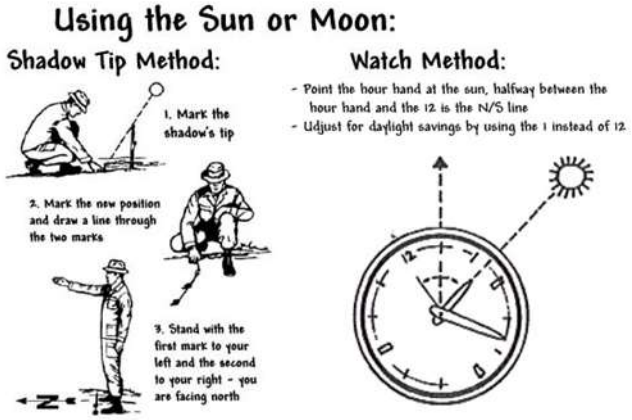
Method 1: Shadow Stick Method

Time: 5 minute set up, check back in 30 or more minutes.



Method 2: Watch Method

Time: 5 minutes



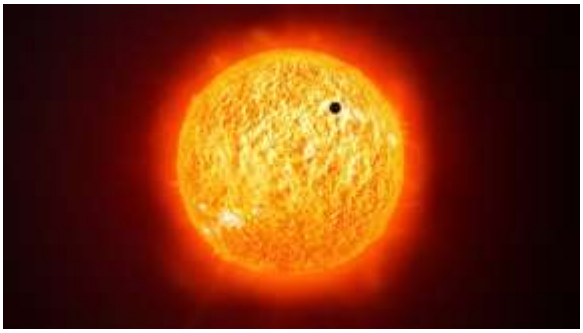


Figure 1 - The Sun

Sun

- The Sun is a star found at the center of the Solar System.
- It makes up around 99.86% of the Solar System's mass.
- At around 1,392,000 kilometers (865,000 miles) wide, the Sun's diameter is about 110 times wider than Earth's.
- Around 74% of the Sun's mass is made up of hydrogen. Helium makes up around 24% while heavier elements such as oxygen, carbon, iron, and neon make up the remaining percentage.
- Light from the Sun reaches Earth in around 8 minutes.
- The Sun's surface temperature is around 5,500 degrees Celsius (9,941 degrees Fahrenheit)
- The Sun's core is around 13,600,000 degrees Celsius!
- The Sun generates huge amounts of energy by combining hydrogen nuclei into helium. This process is called nuclear fusion.
- The Sun produces a solar wind which contains charged particles such as electrons and protons. They escape the Sun's intense gravity because of their high kinetic energy and the high temperature of the Sun's corona (a type of plasma atmosphere that extends into space).
- Planets with strong magnetic fields such as Earth manage to deflect most of these charged particles as they approach.
- A solar eclipse occurs when the Moon is between the Sun and the Earth.

Figure 2 - The Moon

Moon

- The Moon is the Earth's only natural satellite. A natural satellite is a space body that orbits a planet, a planet like object or an asteroid.
- It is the fifth largest moon in the Solar System.
- The average distance from the Moon to the Earth is 384,403 kilometers (238,857 miles).
- The Moon orbits the Earth every 27.3 days.
- Mons Huygens is the tallest mountain on the Moon, it is 4,700 meters tall, just over half the height of Mt Everest (8,848m).
- The Moon rotates on its axis in around the same length of time it takes to orbit the Earth. This means that from Earth we only ever see around 60% of its surface (50% at any one time).
- The side that we can see from Earth is called the near side while the other side is called the far side (it is sometimes called the dark side even though it is illuminated by the Sun just as much as the near side).
- The effect of gravity is only about one-sixth (17%) as strong on the surface of the Moon compared to the strength of gravity on the surface of the Earth.
- The USA's NASA Apollo II mission in 1969 was the first manned Moon landing.
- The first person to set foot on the Moon was Neil Armstrong.
- The surface of the Moon features a huge number of impact craters from comets and asteroids that have collided with the surface over time. Because the Moon lacks an atmosphere or weather these craters remain well preserved.
- Although research is continuing, most scientists agree that the Moon features small amounts of water.
- The Moon is very hot during the day but very cold at night. The average surface temperature of the Moon is 107 degrees Celsius during the day and -153 degrees Celsius at night.
- The Earth's tides are largely caused by the gravitational pull of the Moon.
- The phases of the Moon are: New Moon, Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Last Quarter, Crescent, New Moon.
- A lunar eclipse occurs when the Earth is between the Sun and the Moon.

Figure 3 - The Stars

Stars

- A star is a massive, bright, sphere of very hot gas called plasma which is held together by its own gravity.
- Stars radiate energy created from nuclear fusion, which is a process that takes place in a star's core and involves hydrogen fusing (burning) to make helium.
- As a star is near the end of its life, it begins to change the helium into heavier chemical elements, such carbon and oxygen, and the star will begin to change color, density, mass, and size.
- The nearest star to Earth is the Sun, which is classified as a G2 yellow dwarf star.
- After the Sun in our Solar System, the nearest star to Earth is Proxima Centauri. It is about 39.9 trillion km away or 4.2 light years. This means it takes light from this star 4.2 years to reach Earth. Using the newest, fastest space probe propulsion systems would still take a craft about 75,000 years to get there.
- There are approximately 200-400 billion stars in our Milky Way Galaxy alone.
- Each galaxy contains hundreds of billions of stars, and there is estimated to be over 100 billion galaxies in the universe. The total number of stars in the universe is mind boggling, estimated to be at least 70 sextillion and possibly as high as 300 sextillion, that's 300,000,000,000,000,000,000,000!!!!!
- The most common star, are red dwarfs. They are less than half the size and mass of our Sun and burn their fuel very slowly so live longer than any other type of star. Red dwarfs are cooler than most stars, and so shine less, eventually getting dimmer they do not explode.
- Red supergiants, such as Betelgeuse in the constellation Orion make our Sun look small, 20x its mass, and 1,000x larger. Red hypergiants such as the largest known star VY Canis Majoris are even bigger, over 1,800x the size of the Sun.
- When smaller stars such as red dwarfs or red giants use up all their fuel, and nuclear fusion slows they start to die, and become small “white dwarf” stars which will emit white light until they finally darken into "black dwarfs."
- Big stars like supergiants and hypergiants have shorter lives as they consume their fuel at a faster rate than smaller stars. As these massive stars die they explode as a massive bright supernova.
- Stars range in color depending on how hot they are, in order from lowest to highest temperature they are can be brown, red, orange, yellow, white, or blue in color.

Figure 4 - Constellations

Constellations

What is a constellation?

A constellation is a group of visible stars that form a pattern when viewed from Earth. The pattern they form may take the shape of an animal, a mythological creature, a man, a woman, or an inanimate object such as a microscope, a compass, or a crown.

How many constellations are there?

The sky was divided up into 88 different constellations in 1922. This included 48 ancient constellations listed by the Greek astronomer Ptolemy as well as 40 new constellations.

Star Maps

The 88 different constellations divide up the entire night sky as seen from all around the Earth. Star maps are made of the brightest stars and the patterns that they make which give rise to the names of the constellations. The maps of the stars represent the position of the stars as we see them from Earth. The stars in each constellation may not be close to each other at all. Some of them are bright because they are close to Earth while others are bright because they are very large stars.

Hemispheres and Seasons

Not all of the constellations are visible from any one point on Earth. The star maps are typically divided into maps for the northern hemisphere and maps for the southern hemisphere. The season of the year can also affect what constellations are visible from where you are located on Earth.

All photos from pixabay.com