

ANCHORAGE MUSEUM

STARS: INTERDISCIPLINARY EXPLORATION UNIT 3. STARS

BACKGROUND INFORMATION

The sun is arguably the most important ingredient for life on Earth. Our sun is one of billions upon billions of stars in the universe. Studying these objects can reveal how our universe, stars, and even planets and life on Earth, have evolved over billions of years. In this unit, you will learn about what stars are made out of and how they are important factories for seeding the universe with most elements found on the periodic table.

STUDENTS WILL:

- Investigate the composition and anatomy of stars
- Learn about the life cycle of stars and stellar evolution
- Explore the night sky and discover examples of different types of stars

MATERIALS

- Computer or tablet with internet connection
- Stars Challenge Activity Sheet
- Printer and scissors (optional activity)

RECOMMENDED GRADE LEVEL

- Sixth through eighth grade

KEY TERMS

Star: a hot, dense ball of gaseous material that emits light created by nuclear fusion reactions

Nuclear fusion: the process by which multiple nuclei join together to form a heavier nucleus; this process takes place at the center of all stars and releases energy in the form of heat and light

Nebula: a giant cloud of gas and dust out in space; often, nebula are both the birthplaces for stars and the remains left after a star dies

Protostar: a dense, hot core of gas and dust, not yet hot enough to start nuclear fusion; this object is almost a star but has not started nuclear fusion

ACTIVITIES

This lesson provides four activity sets and explains each of them in detail on the following pages. Activities should be completed in order. Challenge questions are listed under each activity. You can also print the Challenge Activity sheet, which follows the Stellarium Appendix.

1. **Activity 1:** Structures of the Sun and Stars
2. **Activity 2:** The Sun Now
3. **Activity 3:** Life Cycle of Stars Part I
4. **Activity 4:** Life Cycle of Stars Part II



ACTIVITY 1

Structure of the Sun and Stars

[10-15 minutes]

Investigate the layers of the sun and discover the anatomy of a star using this website:

<https://www.dkfindout.com/us/space/solar-system/inside-sun>

Challenge Questions:

1. How many layers make up the sun's atmosphere?
2. About how long does it take energy from the sun to get through the radiative zone?
3. How long does it take light to leave the photosphere of the sun and make it to the Earth?
4. What is a naturally occurring phenomenon that allows us to view the corona without specialized viewing equipment?

ACTIVITY 2

The Sun Now

[10-15 minutes]

The website below connects users to NASA's Solar Dynamics Observatory (SDO):

<https://sdo.gsfc.nasa.gov/data/>

View the most current Sun data (images & videos) from this spacecraft. NASA uses a variety of colors to help people visualize different wavelengths of light that are invisible to the human eye.

Challenge Questions:

1. What layers of the sun do the first two images show?
2. What wavelength of light is captured in each image?
3. Do any of the SDO images show the photosphere? If so which one(s)?

ACTIVITY 3

Life Cycle of Stars Part I

[20-30 minutes]

Stars, including the sun, are not static objects. They are born, change and evolve over time, and die, sometimes in spectacular form. Using the two websites below, explore the life cycles of stars to answer the following questions.

Star life cycle website:

<https://imagine.gsfc.nasa.gov/science/objects/stars1.html>

Watch this NASA launchpad video:

<https://www.youtube.com/watch?v=je8oiV8VYYc>

Challenge Questions:

1. What are the two ways stars that are at least seven times more massive than the sun end their lives?
2. Will the sun ever turn into a black hole? Why or why not?
3. Explain how humans (and most things) are made of 'star stuff'.

Take it further: Optional hands-on activity

Print out the resource from the following website and match up the terms with the correct descriptions:

<https://www.lpi.usra.edu/education/skytellers/stars/activities/starcards.pdf>

ACTIVITY 4

Life Cycle of Stars Part II

[20-30 minutes]

Look at the night sky of Anchorage to find examples of stars that are at different life stages. For this activity, we will use an online free resource called Stellarium. Refer to **Stellarium Appendix** to learn the basics. Use the Stellarium's search box to find the stars in the Challenge Questions.

Website:

<https://stellarium-web.org/>



ACTIVITY 4 CONTINUED

Challenge Questions:

1. The Eagle nebula is an example of an area where stars are being born. What is another name for this object?
2. The sun is a yellow main sequence star. What is the radius (in Km) and distance (in AU) from the Earth?
3. Find these stars, all of which are on the main sequence but vary in temperature and color: Procyon, Sirius, Spica, Barnard's star, and Proxima. What constellations are these stars in or closest to? *(Hint: You might need to turn off 'Atmosphere' and 'Landscape' to see stars. To find the constellations these stars are in or closest to, turn on 'Constellations' and 'Constellation Art' in the toggle toolbar at the bottom of the Stellarium screen. Once you locate a star, use your mouse to zoom out and see what constellation it is in or near.)*
4. Arcturus, Aldebaran and Pollux are three stars in their red giant phase. Which constellations are between Arcturus and Pollux?
5. Betelgeuse is a red super giant star and Rigel is a blue super giant star. Both are found in the constellation of Orion. What body parts of Orion do Betelgeuse and Rigel represent?

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STELLARIUM APPENDIX

Stellarium is a free, open source planetarium for your computer. Stellarium works on multiple computer operating systems including Windows, Mac and Linux, as well as through an online interactive, stellarium-web. The below How To Guide offers basic instruction for how to utilize the online software and an introduction to the different interactive elements.

1. GETTING STARTED

This is the home screen for stellarium-web. There are five main menus and a search box visible at all times. The following images go through each menu and interactives for each.



STELLARIUM APPENDIX

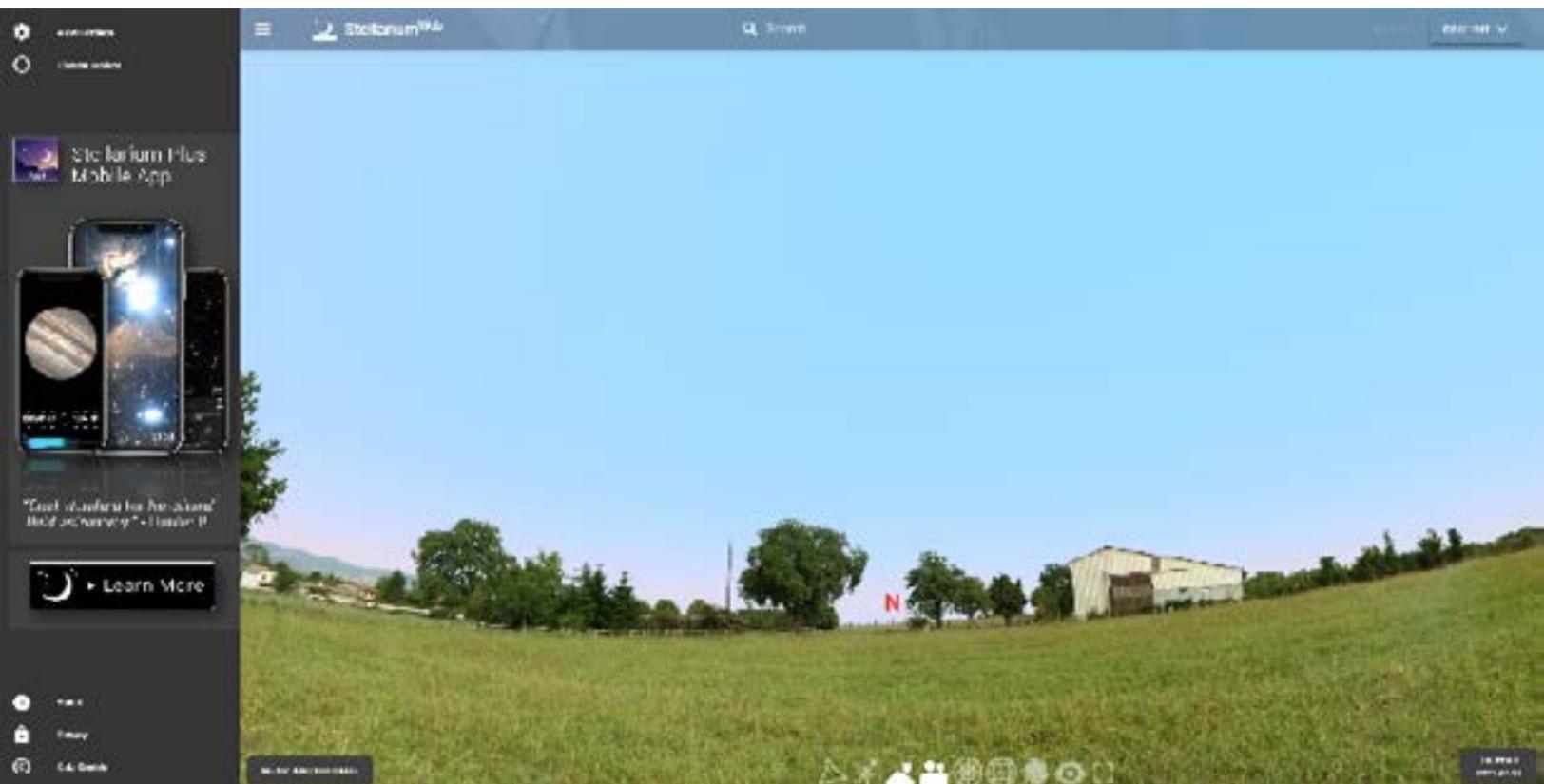
2. SETTINGS MENU

View Settings

Turn on/off milky way, deep sky objects, meridian line, ecliptic line and if you want to simulate the atmosphere's refraction (bending) of light.

Planets Tonight

See which planets are visible and what time they will rise and set.



STELLARIUM APPENDIX

3. OBSERVER TOOLS

My Observations

Option to use NoctuaSky to keep a journal of night observations.

Calendar

Displays a list of night sky events to look forward to including moon phases and locations of planets in their orbits.

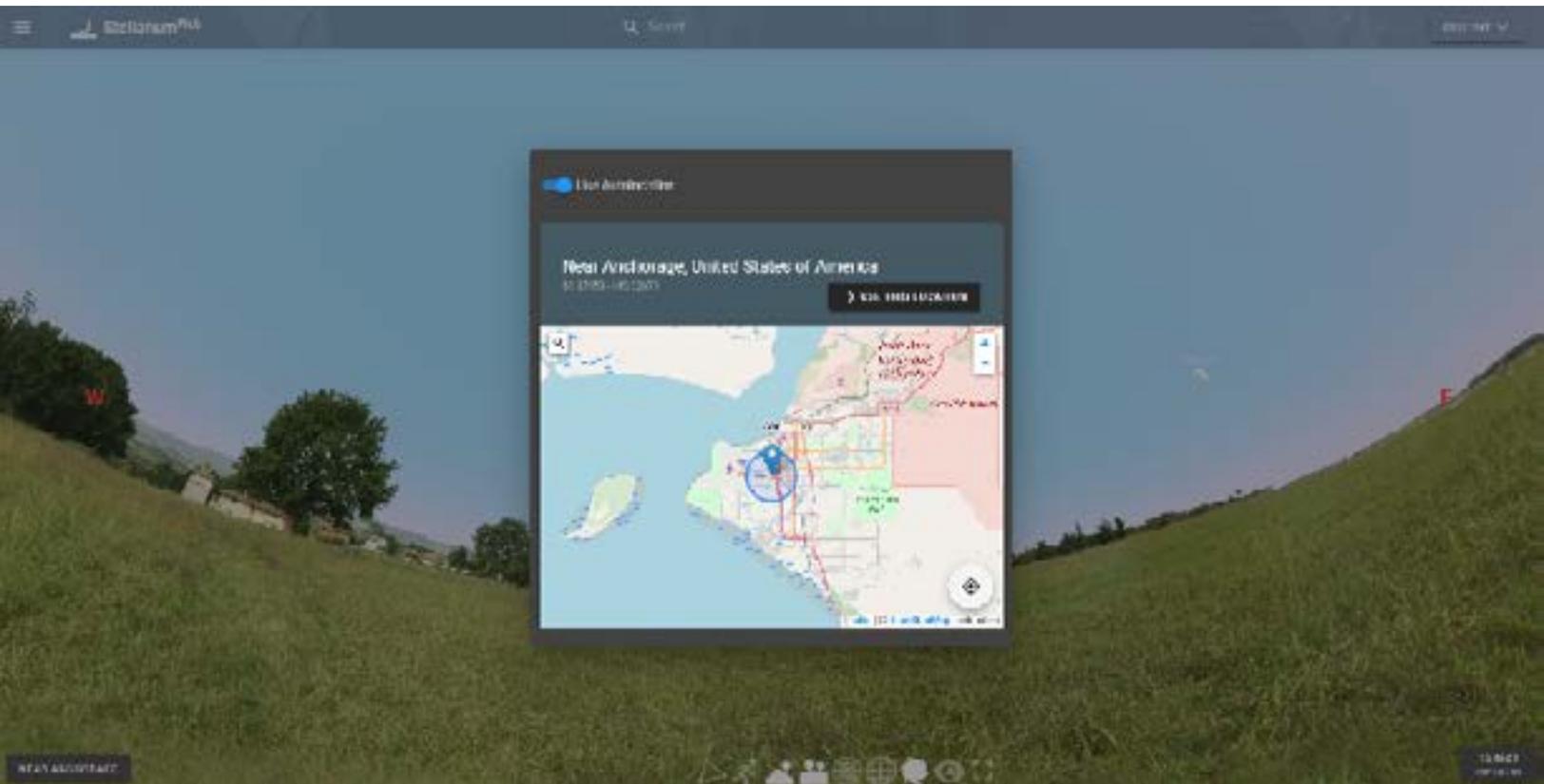


STELLARIUM APPENDIX

4. LOCATION ON EARTH

Location on Earth

Pick your location on Earth or choose to use autolocation.



STELLARIUM APPENDIX

5. DATE/TIME MENU

Date

Change the date by clicking the up or down arrows.

Time

Change the time by clicking the up or down arrows, or by dragging the blue slider bar. Stellarium uses the 24-hour clock.

Pause/Now

The center buttons can either pause time or go back to the current time.



STELLARIUM APPENDIX

6. MOUSE ZOOM IN/OUT AND CHANGING PERSPECTIVES

Zoom in

Use the scroll wheel on the mouse to zoom in to an object, or make the ground/horizon flat.

Zoom out

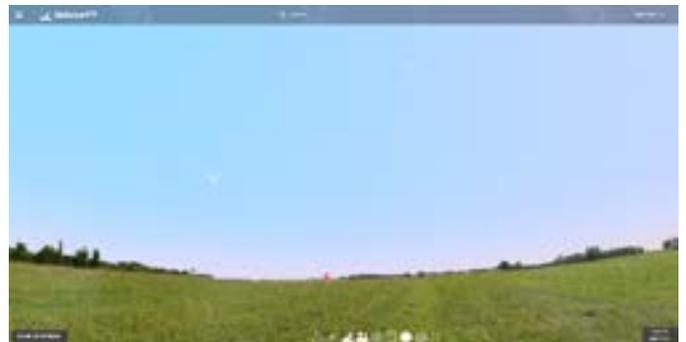
Use the scroll wheel on the mouse to zoom out and get 'planetarium' perspective.



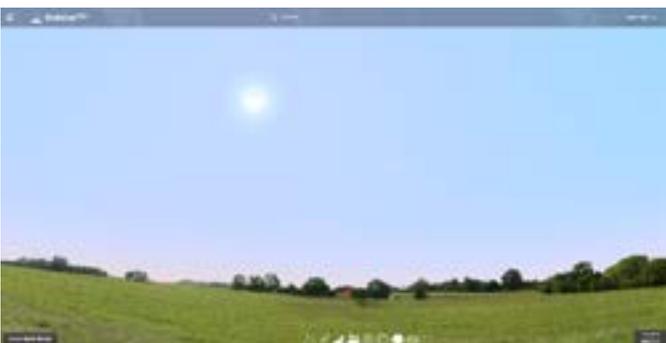
Zoomed out all the way looking straight up ('planetarium')



Zoomed in looking North



Zoomed in looking East



Zoomed in looking South



Zoomed in looking West

STELLARIUM APPENDIX

7. LEARNING MORE ABOUT OBJECTS: INFORMATION BOX

Left mouse click

Use the mouse to select objects like stars, planets, and deep sky objects to learn more. Once an object is selected, an information box appears in the upper left corner of the screen. In this box, there are facts about the object and helpful links to discover more information.

Bullseye icon

The bullseye button, located below the lower right corner of the information box, centers the object that you have selected.



STELLARIUM APPENDIX

8. BOTTOM CENTER TOOLBAR: NINE TOGGLE BUTTONS

1. Constellations

Turns all constellation lines on/off

2. Constellations Art

Turns all constellation art on/off

3. Atmosphere

Turns Earth atmosphere on/off

4. Landscape

Turns Earth landscape on/off

5. Azimuthal Grid

Turns azimuthal grid on/off

6. Equatorial Grid

Turns equatorial grid on/off

7. Deep Sky Objects

Turns DSO (i.e. galaxies) on/off

8. Night Mode

Turns a red light on/off

9. Fullscreen

Covers entire screen



STARS CHALLENGE ACTIVITY SHEET

ACTIVITY 1. Structure of the Sun and Stars

1. How many layers make up the sun's atmosphere?
2. About how long does it take energy from the sun to get through the radiative zone?
3. How long does it take light to leave the photosphere of the sun and make it to the Earth?
4. What is a naturally occurring phenomenon that allows us to view the corona without specialized viewing equipment?

ACTIVITY 2. The Sun Now

1. What layers of the sun do the first two images show?
2. What wavelength of light is captured in each image?
3. Do any of the SDO images show the photosphere? If so which one(s)?

ACTIVITY 3. Life Cycle of Stars Part I

1. Stars that are at least seven times more massive than the sun could end their lives in which two ways?
2. Will the sun ever turn into a black hole? Why or why not?



STARS CHALLENGE ACTIVITY SHEET

ACTIVITY 3 CONTINUED

3. Explain how humans (and most things) are made of 'star stuff'.

ACTIVITY 4. Life Cycle of Stars Part II

1. The Eagle nebula is an example of an area where stars are being born. What is another name for the object?
2. The sun is a yellow main sequence star. What is the radius (in Km) and distance (in AU) from the Earth?
3. Find these stars, all of which are on the main sequence but vary in temperature and color. Procyon, Sirius, Spica, Barnard's star, and Proxima. What constellations are these stars in or closest to? *(Hint: You might need to turn off 'Atmosphere' and 'Landscape' to see stars. To find the constellations these stars are in or closest to, turn on 'Constellations' and 'Constellation Art' in the toggle toolbar at the bottom of the Stellarium screen. Once you locate a star, use your mouse to zoom out and see what constellation it is in or near.)*
4. Arcturus, Aldebaran, and Pollux are three stars in their red giant phase. Which constellations are between Arcturus and Pollux?
5. Betelgeuse is a red super giant star and Rigel is a blue super giant star. Both are found in the constellation Orion. What body parts of Orion do Betelgeuse and Rigel represent?



STARS ANSWERS SHEET

ACTIVITY 1. Structure of the Sun and Stars

1. Two layers make up the atmosphere: the chromosphere and the corona
2. ~100,000 years
3. ~8 minutes
4. During a solar eclipse, the moon blocks the light from the photosphere which allows us to see the faint corona layer of the sun's atmosphere.

ACTIVITY 2. The Sun Now

1. First image, AIA193 shows the corona and the second image, AIA304 shows the chromosphere.
2. Both use a filter to observe the Extreme Ultraviolet wavelength.
3. AIA1700 shows the photosphere and AIA1600 shows the upper photosphere.

ACTIVITY 3. Life Cycle of Stars Part I

1. Stars that are at least seven times more massive than the sun will either end as a neutron star or a black hole. Both of these objects form after a supernova explosion.
2. The sun is not massive enough to ever turn into a black hole. Instead, it will end by forming a planetary nebula and turning into a white dwarf.
3. Stars constantly release material, including elements like carbon and oxygen, into space during their lives and through supernova explosions. These natural elements would not exist without stars creating them, and we are made up of elements.

ACTIVITY 4. Life Cycle of Stars Part II

1. M16, Star Queen Nebula, NGC6611, IC 4703, OCI 54, CTB 51, LBN 67, LMH 22, MM 21, NRL 14, OCISM 10, LBN 016.96+00.78, GRS G017.00+00.30
2. 696,000Km, 1.00AU (An Astronomical Unit (AU) is the distance from the Earth to the Sun, almost 93,000,000 miles).
3. Procyon = Canis Minor; Sirius = Canis Major; Spica = Virgo; Barnard's star = Serpens and Ophiuchus; Proxima = Centaurus
4. Going from Pollux to Arcturus we pass through Lynx, Leo Minor, the leg of Ursa Major, and Coma Berenices. Cancer and Canes Venatici are both just outside of a straight line connecting Pollux and Arcturus.
5. Betelgeuse = shoulder of raised arm, Rigel = foot

