



DISCOVER



4-H DARK SKY CLUBS



DISCOVER

Justina Parsons-Bernstein | Kate Croft
Utah Division of Parks and Recreation

André Walker Bravo | Steven Price | Stacey MacArthur
Utah State University Extension

Description

The Discover 4-H Clubs series guides new 4-H volunteer leaders through the process of starting a 4-H club or provides a guideline for seasoned volunteer leaders to try a new project area. Each guide outlines everything needed to organize a club and hold the first six club meetings related to a specific project area.

Purpose

The purpose is to create an environment for youth and families to come together and participate in learning activities while spending time together as a multi-family club. Members will be able to experiment with new 4-H project areas.

What is 4-H?

4-H is one of the largest youth development organizations in the United States. 4-H is found in almost every county across the nation and enjoys a partnership between the U. S. Department of Agriculture (USDA), state land-grant universities (e.g., Utah State University), and local county governments.

4-H is about youth and adults working together as partners in designing and implementing club and individual plans for activities and events. Positive youth development is the primary goal of 4-H. The project area serves as the vehicle for members to learn and master project-specific skills while developing basic life skills. All projects support the ultimate goal for the 4-H member to develop positive personal assets needed to live successfully in a diverse and changing world.

Participation in 4-H has shown many positive outcomes for youth. Specifically, 4-H participants have higher participation in civic contribution, higher grades, increased healthy habits, and higher participation in science than other youth (Lerner et al., 2005).

Utah State University is committed to providing an environment free from harassment and other forms of illegal discrimination based on race, color, religion, sex, national origin, age (40 and older), disability, and veteran's status. USU's policy also prohibits discrimination on the basis of sexual orientation in employment and academic-related practices and decisions. Utah State University employees and students cannot, because of race, color, religion, sex, national origin, age, disability, or veteran's status, refuse to hire; discharge; promote; demote; terminate; discriminate in compensation; or discriminate regarding terms, privileges, or conditions of employment, against any person otherwise qualified. Employees and students also cannot discriminate in the classroom, residence halls, or in on/off campus, USU-sponsored events and activities. This publication is issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Kenneth L. White, Vice President for Extension and Agriculture, Utah State University.



Utah 4-H

4-H is the youth development program of Utah State University Extension and has more than 90,000 youth participants and 8,600 adult volunteers. Each county (Daggett is covered by Uintah County) has a Utah State University Extension office that administers the 4-H program.

The 4-H Motto

"To Make the Best Better!"

The 4-H Pledge

I pledge: My HEAD to clearer thinking, my HEART to greater loyalty, my HANDS to larger service and my HEALTH to better living, for my club, my community, my country, and my world.

4-H Clubs

What is a 4-H Club? The club is the basic unit and foundation of 4-H. An organized club meets regularly (once a month, twice a month, weekly, etc.) under the guidance of one or more volunteer leaders. The 4-H club elects its own officers, plans its own programs, and participates in a variety of activities. Clubs may choose to meet during the school year, only for the summer, or for both.

Club Enrollment

Enroll your club with your local Extension office. Each member will need to complete a Club Member Enrollment form, Medical History form, and a Code of Conduct/Photo Release form. (Print these from the www.utah4h.org website or get them from your county Extension office).

Club Officers

Elect club officers during one of your first club meetings. Depending on how many youth are in your club, you can decide how many officers you would like. This will typically include a president, vice president, pledge leader, and secretary. Other possible officers or committees are: song leader, activity facilitator, clean-up supervisor, recreation chair, scrapbook coordinator, contact committee (email, phone, etc.), field trip committee, club photographer, etc. Pairing older members with younger members as Sr. and Jr. officers may be an effective strategy to involve a greater number of youth in leadership roles and reinforce the leadership experience for all ages. Your club may decide the duration of officers (6 months, 1 year, etc.).



A Typical Club Meeting

Follow this outline for each club meeting:

- Call to order – President
- Pledge of Allegiance and 4-H Pledge – Pledge Leader (arranges for club members to give pledges)
- Song – Song Leader (leads or arranges for other club member to lead)
- Roll call – Secretary (may use an icebreaker or a “get acquainted” type of roll call to get the meeting started)
- Minutes of the last meeting – Secretary
- Business/Announcements – Vice President
- Club Activity – Activity Facilitator arranges this. It includes a project, lesson, service, etc. These are outlined by project area in the following pages.
- Refreshments – Refreshment Coordinator
- Clean Up – Clean-up Supervisor leads others in cleaning up



Essential Elements of 4-H Youth Development

The Essential Elements are about healthy environments. Regardless of the project area, youth need to be in environments where the following elements are present in order to foster youth development.

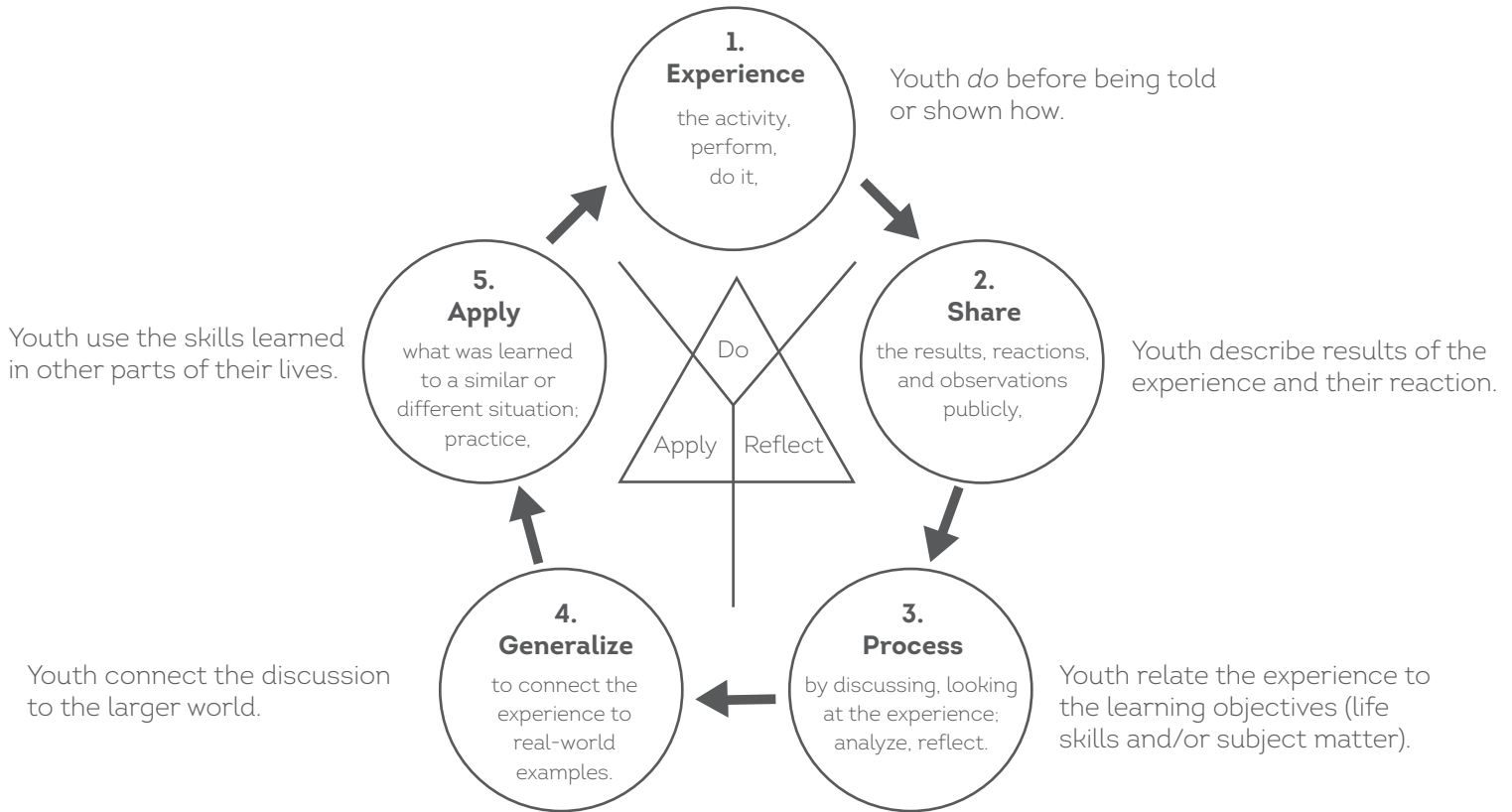
1. **Belonging:** a positive relationship with a caring adult; an inclusive and safe environment.
2. **Mastery:** engagement in learning, opportunity for mastery.
3. **Independence:** opportunity to see oneself as an active participant in the future, opportunity to make choices.
4. **Generosity:** opportunity to value and practice service to others.

(Information retrieved from: <http://www.4-h.org/resource-library/professional-development-learning/4-h-youth-development/youth-development/essential-elements/>)



4-H “Learning by Doing” Learning Approach

The Do, Reflect, Apply learning approach allows youth to experience the learning process with minimal guidance from adults. This allows for discovery by youth that may not take place with exact instructions.



4-H Mission Mandates

The mission of 4-H is to provide meaningful opportunities for youth and adults to work together to create sustainable community change. This is accomplished within three primary content areas, or Mission Mandates - citizenship, healthy living, and science. These mandates reiterate the founding purposes of Extension (e.g., community leadership, quality of life, and technology transfer) in the context of 21st century challenges and opportunities. (Information retrieved from: http://www.csrees.usda.gov/nea/family/res/pdfs/Mission_Mandates.pdf)

- 1. Citizenship:** connecting youth to their community, community leaders, and their role in civic affairs. This may include: civic engagement, service, civic education, and leadership.
- 2. Healthy Living:** promoting healthy living to youth and their families. This includes: nutrition, fitness, social-emotional health, injury prevention, and prevention of tobacco, alcohol, and other drug use.
- 3. Science:** preparing youth for science, engineering, and technology education. The core areas include: animal science and agriculture, applied mathematics, consumer science, engineering, environmental science and natural resources, life science, and technology.

Getting Started

1. Recruit one to three other families to form a club with you.
 - a. Send the 4-H registration form and the medical/photo release form to each family (available at utah4h.org).
 - b. Distribute the Discover 4-H Clubs curriculum to each family.
 - c. Decide on a club name.
 - d. Choose how often your club will meet (e.g., monthly, bi-monthly, etc.).
2. Enroll as a 4-H volunteer at the local county Extension office (invite other parents to do the same).
3. Enroll your club at the local county Extension office.
 - a. Sign up to receive the county 4-H newsletter from your county Extension office to stay informed about 4-H related opportunities.
4. Identify which family/adult leader will be in charge of the first club meeting.
 - a. Set a date for your first club meeting and invite the other participants.
5. Hold the first club meeting (if this is a newly formed club).
 - a. See the previous section, *A Typical Club Meeting*, for a general outline.
 - i. Your activity for this first club meeting will be to elect club officers and to schedule the six project area club meetings outlined in the remainder of this guide. You may also complete a-d under #1 above.
 - b. At the end of the first club meeting, make a calendar outlining the adult leader in charge (in partnership with the club president) of each club meeting along with the dates, locations, and times of the remaining club meetings.
6. Hold the six project-specific club meetings outlined in this guide.
7. Continue with the same project area with the 4-H curriculum of your choice (can be obtained from the county Extension office) OR try another Discover 4-H Club project area.



Other Resources

Utah 4-H website: www.utah4-h.org

National 4-H website: www.4-h.org

4-H volunteer training:

To set up login to:

<http://utah4h.org/volunteers/training/>

To start the modules: (password = volunteer)

References

Information was taken from the Utah 4-H website (utah4h.org), the National 4-H website (4h.org), the Utah Volunteer Handbook, or as otherwise noted.

Lerner, R., M. et al. (2005). Positive youth development, participation in community youth development programs, and community contributions of fifth grade adolescents: Findings from the first wave of the 4-H Study of Positive Youth Development. *Journal of Early Adolescence*, 25(1), 17-71.

We would love feedback or suggestions on this guide; please go to the following link to take a short survey:

Go to <https://goo.gl/iTfiJV> or [Click here to give your feedback](#)

4-H DARK SKY CLUB *Meetings*



Club Meeting 1

The Ballooniverse: Expansion, the Big Bang Theory, and the Origins of the Universe 2



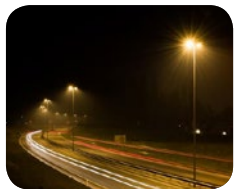
Club Meeting 2

Starstruck: Discovering Astronomy 9



Club Meeting 3

Aim for the Stars: Observing & Exploring Space 20



Club Meeting 4

The More Light at Night, the Less We Can See: Understanding Light Pollution 44



Club Meeting 5

Don't Be Afraid of the Dark: Making Outdoor Lighting Better for Dark Skies 55



Club Meeting 6

Star Party: Celebrate the Night Sky! 66

Justina Parsons-Bernstein | Kate Croft
Utah Division of Parks and Recreation

André Walker Bravo | Steven Price | Stacey MacArthur
Utah State University Extension





The Ballooniverse



Supplies

- Bicycle pump(s)
- Electrical tape
- Colored pencils/crayons
- Paper
- Vacuum cleaner
- Safety goggles for each participant
- Ear plugs for each participant
- Dust mask
- Ballooniverse materials to assemble kits:
 - Balloons (use same size balloon for all kits)
 - 4 large pompoms, 6 medium pompoms, 10 small pompoms
 - 10 small foam stars

INTRODUCTION

In this club meeting, we will learn about the Big Bang Theory and how to form a hypothesis through a fun, hands-on activity.

PRIOR TO MEETING

1. Choose a large space to use for this meeting.
2. Gather materials and print a copy of the Big Bang Theory timeline.
3. Explore NASA's fun explanation page all about the Big Bang: <https://spaceplace.nasa.gov/big-bang/en/>
4. Create Ballooniverse Kits (one per participant). Kit quantities are suggestions. Just make sure each kit contains the same number and type of materials. Do not put any sharp or hard objects such as rocks or pins in the balloons.

BACKGROUND

What is a Hypothesis?

A hypothesis is a testable explanation or prediction of how the world works. Scientists create a hypothesis to guide their experiments as part of the scientific method. By looking for evidence that does or does not support our hypothesis, we can test whether our prediction was true or if we need to rethink our hypothesis. If scientists find a lot of evidence indicating that a hypothesis is true, we refer to that explanation as a theory.

What is the Big Bang?

Physicists are people who study how the universe works. In the early 1900s, some physicists suggested that our universe was once a very dense, tiny dot. About 14 billion years ago, an inflation reaction occurred. Space expanded everywhere at once and all the matter in the speck was released. The expansion doubled in size over 90 times in a fraction of a second. This process is how most physicists think our universe was created. It is referred to as the Big Bang Theory, but maybe it should be called the Big Expansion Theory. In fact, our universe is STILL expanding and will continue to expand!





How Do People Study the Universe?

The study of the origin and nature of the universe is called cosmology. Cosmology is studied by scientists such as astronomers and astrophysicists. You have probably heard of NASA (the National Aeronautics and Space Administration). NASA scientists are trying to answer three main questions:

1. How did we get here? NASA scientists explore the origin and development of galaxies, stars, and planets that make up our universe.
2. How does the universe work? NASA scientists investigate the forces and mechanics of our universe, including the nature and function of black holes, dark energy, dark matter and gravity.
3. Are we alone? NASA scientist search for and study planets in other solar systems and explore whether those planets could harbor life.

Why Are Patterns Important for Studying Space?

Scientists looking for clues about how our universe came to be need to study both similarities and differences in patterns in astronomical phenomena. For instance, in looking for other habitable planets in the universe, scientists search for a pattern that follows our own solar system: a planet with liquid water and an oxygen atmosphere that is not too far away or too close to a sun.

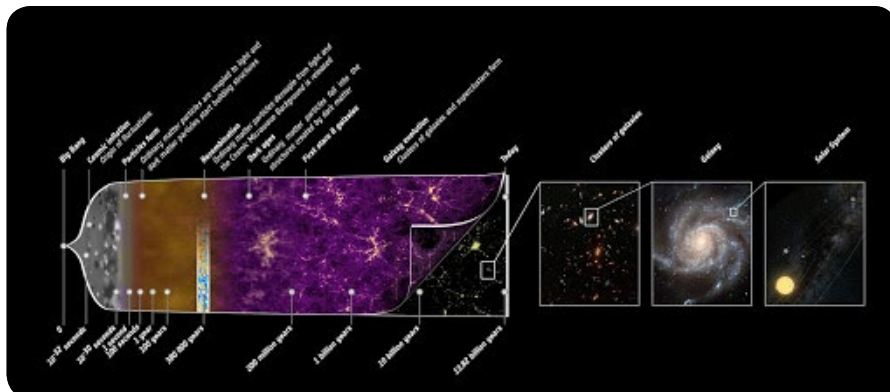
Activity #1



THE BALLOONIVERSE

TIME: 1 HOUR

1. Start by dividing the group into four teams. Give each team their Ballooniverse Kit.
2. Explain to the teams that they will be creating their own universe simulating the inflation of space, the release of matter and expansion of the universe (i.e. the Big Bang Theory).
3. Team members will cram their uninflated balloon as full as they can with the Ballooniverse Kit elements representing objects in the universe (i.e. stars, planets, comets, asteroids, etc.).
4. At the end of this module, you will find a larger version of this Big Bang graphic to print out.





5. Emphasize to club members that, though they will be inflating their balloon until it pops, if they were simulating what exactly happened (and is still happening) in the Big Bang, their balloon would inflate forever and never pop. So think of what happens when your balloon pops as a sort of Big Bang snapshot simulation of a single slice of time in the formation of our universe.
6. Ask your club members: "What patterns will emerge in your Ballooniverse's Big Bang?" Have each team form a hypothesis about how the elements will be grouped or scattered after their balloon pops and why. They should write these reasons down on a large sheet of paper (one sheet per team). This will be their team hypothesis. If the groups are struggling to create a hypothesis, discuss the different characteristics of the materials in the balloon and how these objects may affect each other.
7. Ask each team to draw a picture or map illustrating how their universe materials will be arranged after their Big Bang: (e.g. will the components be grouped randomly, or will there be some sort of predictable order to the way things scatter? Will larger components be clumped together? Will lighter components scatter farther? Will objects form straight lines or swirls? etc.).
8. Once the pictures or maps are complete, have each team pick a corner of the room, or spread out as far as possible from each other in the space you have. Explain that you will inflate each team's balloon until it pops. Remind them that if this were a real simulation of the Big Bang, their balloon would keep expanding for billions of years.
9. Make sure all club members put on safety equipment (ear plugs, safety goggles, and a mask) before anyone inflates the balloons.
10. For extra fun, record each team's Big Bang in slow motion to watch afterwards.
11. Each team member will take turns inflating their balloon with the bicycle pump. Be sure to use the electrical tape or duct tape to secure the balloon to the pump. Have the team members rotate taking a few pumps each until their "Big Bang" happens.
12. Have each team stay in place until all the Big Bangs have taken place and draw a map of the patterns they are seeing.
13. Each team should then take their drawing to their Big Bang site and compare their hypothesis to what actually happened.
14. Next, teams should rotate around the room and compare how each team's universe is similar to and different from their own team's results.



Reflect

- What happened to your team's universe elements after your Big Bang? What similarities were there to your hypothesis of what would happen? What were the differences? Does this evidence support your hypothesis?
- Was another team's universe more similar to your hypothesis than yours turned out to be?
- What were the similarities in all teams' universes? Were there repeated patterns or groupings of objects? What were the differences?
- What types of forces and actions do you think were at work to shape your team's universe (such as propulsion, gravity, collision, etc.)
- Go around the room and have each club member share one of the most interesting things they learned from this activity.

Apply

- Go to a very dark place outside at night and observe the sky. Look at the positions of the planets, moons and stars. If you have a pair of binoculars or a telescope you can get a more detailed look. Do you see any patterns of celestial objects in the night sky that are similar to any patterns you observed in your team's universe or the universes of the other teams in your club?
- Have you ever used a hypothesis in everyday life? How does thinking through an entire duty/task/assignment and the potential results before you do it help you be successful?



4-H MISSION MANDATES

Science

This lesson introduces club members to STEM activities and demonstrates STEM career paths. Youth practice scientific inquiry by forming a hypothesis through critical thinking and making observations.

Healthy Living

Healthy relationship skills gained from group participation include critical thinking, problem solving, teamwork, cooperation, communication to reach a goal, and conflict resolution, to name a few.

ESSENTIAL ELEMENTS

Belonging

Club members work together as a team through discussion and compare their ideas with peers.

Independence

Creating hypothesis and honing critical thinking skills help youth to have better decision-making skills in the future as independent investigators that can evaluate observational evidence for themselves. By making observations, youth are intuitively investigating potential mechanisms (e.g., mass, density, interactions) that ultimately dictate the distributions of their objects.

References and Other Resources

The Universe: An Introduction

http://www.smithsonianeducation.org/educators/lesson_plans/universe/smithsonian_siyc_spring2010.pdf

Big Bang Theory Diagram found at:

https://www.nasa.gov/mission_pages/planck/multimedia/pia16876b.html#.XebKUuhKhPY



EXPLORE MORE ON YOUR OWN!

Mapping the Big Bang:

<https://www.skyandtelescope.com/astronomy-news/mapping-the-big-bang/>

Cosmic Inflation: How It Gave the Universe the Ultimate Kickstart (Infographic):

<https://www.space.com/25075-cosmic-inflation-universe-expansion-big-bang-infographic.html>

What Was There Before the Big Bang?:

<https://www.youtube.com/watch?v=wPuhJ98VjoA>

Cosmic Inflation: How It Gave the Universe the Ultimate Kickstart (Infographic):

<https://www.space.com/25075-cosmic-inflation-universe-expansion-big-bang-infographic.html>

NASA space video simulation of big bang theory forming a disk galaxy 13.5 million years old:

<https://www.youtube.com/watch?v=7pMe64Reito>

New map of the universe confirms the Big Bang, finds the universe is older than we thought:

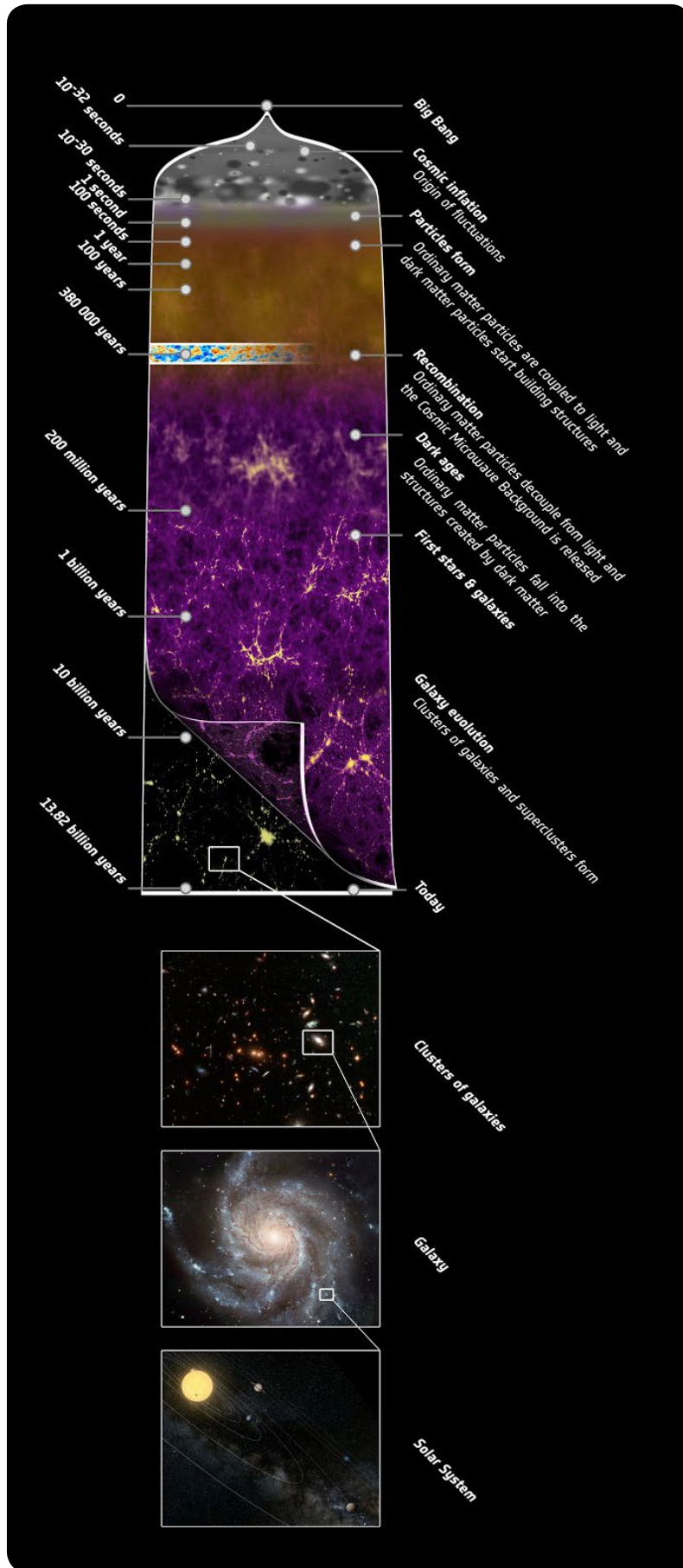
<https://www.extremetech.com/extreme/151314-new-map-of-the-universe-confirms-the-big-bang-finds-the-universe-is-older-than-we-thought>

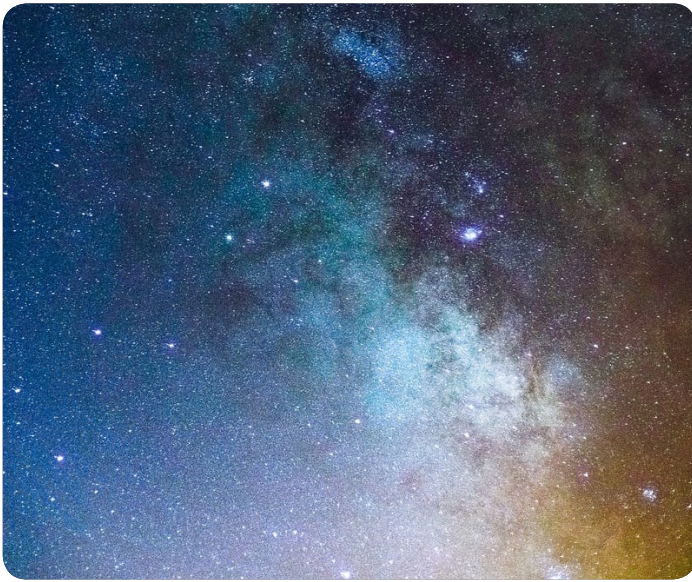
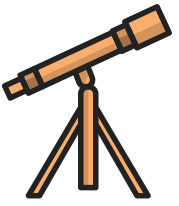
Big Bang Timeline Slideshow:

<https://slideplayer.com/slide/7109786/>

NASA Astrophysics:

<https://science.nasa.gov/astrophysics>





Supplies

- Colored pencils/crayons
- Paper
- Seasonal star chart without constellations
- Printed astronomical records from cultures around the world throughout time

INTRODUCTION

This club meeting will focus on Astronomy. Astronomy is the study of celestial objects, space, and the physical universe as a whole. (Don't confuse astronomy with astrology, which is the belief that stars and planets may influence events on Earth and people's lives.) In this club meeting, we will explore a variety of fascinating ways people around the world have related to stars, planets, and other celestial objects through time.

PRIOR TO THE MEETING

- Gather materials.
- Print the pictures of astronomical records included in this activity plan.
- Watch: The Aboriginal Creation Story:
<https://www.nationalgeographic.com.au/videos/story-of-god/the-aboriginal-creation-story-4214.aspx>

BACKGROUND

Many cultures have studied celestial objects, space, and the physical universe. The constellations we recognize in the night sky today have been handed down through ancient Greek and Roman traditions. Other people around the world and throughout time have developed their own names and ways of looking at and explaining the cosmos. The following celestial objects are commonly seen and known by people in the United States.

Star: A huge, luminous ball of basic elements fusing together to form more complex elements while generating radiation, light and heat.

Constellation: A group of stars, or the dark spaces between stars, forming a recognizable pattern or shape. Many different cultures around the world throughout time have identified constellations and used them to complement their agricultural, hunting, navigation, courting, and religious practices.

Sun: The star around which the earth orbits.





Moon: A smaller celestial body that orbits around a planet. Some planets have many moons. Earth has only one moon that is about one fourth the size of our planet.

Planet: A large celestial body orbiting around a star.

Galaxy: A system of millions or billions of stars held together by gravity. There are at least one hundred billion galaxies in the universe.

The Milky Way: The galaxy that contains Earth.

Nebula: A giant cloudy formation made up of dust and gasses like hydrogen and helium. Nebula can be remnants of a supernova or a nursery for the formation of new stars.

Comet: A celestial object consisting of ice and dust. Each comet has two tails created by the Sun. One tail is made of the dust and the other tail is made of ions. The tails point in slightly different directions.

Asteroid: A rocky body orbiting the sun. Asteroids can range in size from nearly 600 miles (1,000 km) across to tiny dust particles. A few asteroids pass close to the earth and sometimes enter the atmosphere as meteors.

Meteor: A small rocky mass from outer space that enters the earth's atmosphere, appearing as a streak of light. Meteors are also called falling or shooting stars.

Activity #1



OUT OF THIS WORLD

TIME: 30 MINUTES

1. Hand out blank paper and colored pencils.
2. (10 minutes) Each member of the club will quickly draw their favorite celestial object such as the sun, the moon, another planet, nebula, an asteroid, a comet, a constellation, a falling star, a rocket, a satellite, or the International Space Station.
3. (20 minutes) Each member will share their drawing with the group and reveal whether or not they have seen this object in real life. If they have, they should describe when they saw the object and what they were doing (camping, stargazing in their backyard, attending a star party, using a telescope, etc.).





Reflect

- Why is the object you chose important to you?
- When you think about your celestial object, how does it make you feel? How does it affect the way you think about your connection to the universe?
- Why do you think your object is important to the Earth?

Apply

- If you have not seen the object in real life, where could you go or what could you do in order to see it?
- What other objects in your life can help you have a feeling of connectedness?
- Are there other benefits to observing celestial objects?

Activity #2



IN MY MIND'S SKY

TIME: 30 MINUTES

1. Club members will look at the culture cards (provided below) showing the way different cultures have used astronomy to track, record, and use the study of celestial objects to benefit agriculture, navigation, religion, social stature, etc.
2. After viewing the culture cards, each club member will take a blank copy of a star chart (without constellation outlines) for the current season, outline their own original constellation (not one that is already defined and known), and come up with a short story explaining what it is.
3. Have the club members think about how their constellation would be used in a cultural context (agriculture, navigation, religion, etc.). Members should then write their constellations stories and cultural purpose down.
4. The original constellations and their accompanying stories and cultural purposes will be shared at the star party at the last club meeting. Club members can continue to work on their constellation stories until then.





Reflect

- Astronomers have served different roles in different cultures around the world through time. Some cultures revered astronomers as priests or shamans because they could predict seasonal changes and astronomical events such as solar and lunar eclipses. Many cultures today use astronomy to enhance their societies. What types of jobs use astronomy, and how?
- Is understanding what you see in the night sky a useful skill? Why or why not?
- Why is it important to understand different cultural views and uses of the night sky?

Apply

- Make a list of ways understanding what you see in the night sky benefits you personally.
- Using your star chart with your constellation on it, go outside at night in a dark place and find the constellation you have created. Can you find it? Does it look like what you have drawn? Are all the points of light there? If you can't see your constellation or parts of it are missing, what are the reasons for this?

4-H MISSION MANDATES

Citizenship

Youth are engaged with both their personal and societal connections to celestial objects while considering perspectives from a diversity of other cultures and how these beliefs positively shape their social structure.

Healthy Living

Youth are encouraged to consider explanations and beliefs that may be different than their own regarding how night sky phenomenon are tied to differences in cultural lifestyles.

Science

Youth learn the basics of astronomy and celestial objects while exploring other external resources available for information.

ESSENTIAL ELEMENTS

Belonging

Youth identify and explore their connection to celestial objects and how that provides them with a sense of place and belonging in an inclusive, sharing environment.

Independence

Youth practice creative writing while independently reflecting on their personal feelings about their chosen object.

Generosity

Club members practice sharing their ideas and valuing others' contributions to the group effort.

References and Other Resources

https://astrosociety.org/file_download/inline/948789fe-6198-4ce6-a0e0-44f85f8c2eac





EXPLORE MORE ON YOUR OWN!

Aboriginal Australians are the world's oldest astronomers:

<https://www.australiangeographic.com.au/topics/science-environment/2017/07/a-guide-to-aboriginal-astronomy/>

The Amerindian Sky:

http://astro-canada.ca/le_ciel_des_amerindiens-the_amerindian_sky-eng

The Inuit Sky:

http://astro-canada.ca/le_ciel_des_inuits-the_inuit_sky-eng

Hawaiian Voyaging Traditions:

http://archive.hokulea.com/ike/hookele/hawaiian_star_lines.html

Australian Aboriginal Astronomy Video:

<https://www.youtube.com/watch?v=Wv8hKMj6ikA>

Longer Video—Before Galileo:

<https://www.youtube.com/watch?v=4HgloELAoNM>

Under One Sun: Culture as Context for Science Learning:

<https://www.youtube.com/watch?v=8AUrDL1aDKY>

Longer Video: Maori Astronomy Science and Traditions:

<https://www.sciencelearn.org.nz/resources/1274-revitalising-maori-astronomy>

Ancient Greek:

<http://lasp.colorado.edu/~bagenal/1010/SESSIONS/5.ScienceAstronomy.html>

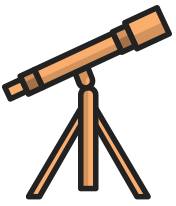
Mayan Astronomy:

<https://www.historymuseum.ca/cmhc/exhibitions/civil/maya/mmc07eng.shtml>

Differences between Astrology and Astronomy:

<https://spaceplace.nasa.gov/starfinder2/en/>





MAGNITUDES

☀	☆	★	✧	✦	✧
0	1	2	3	4	5



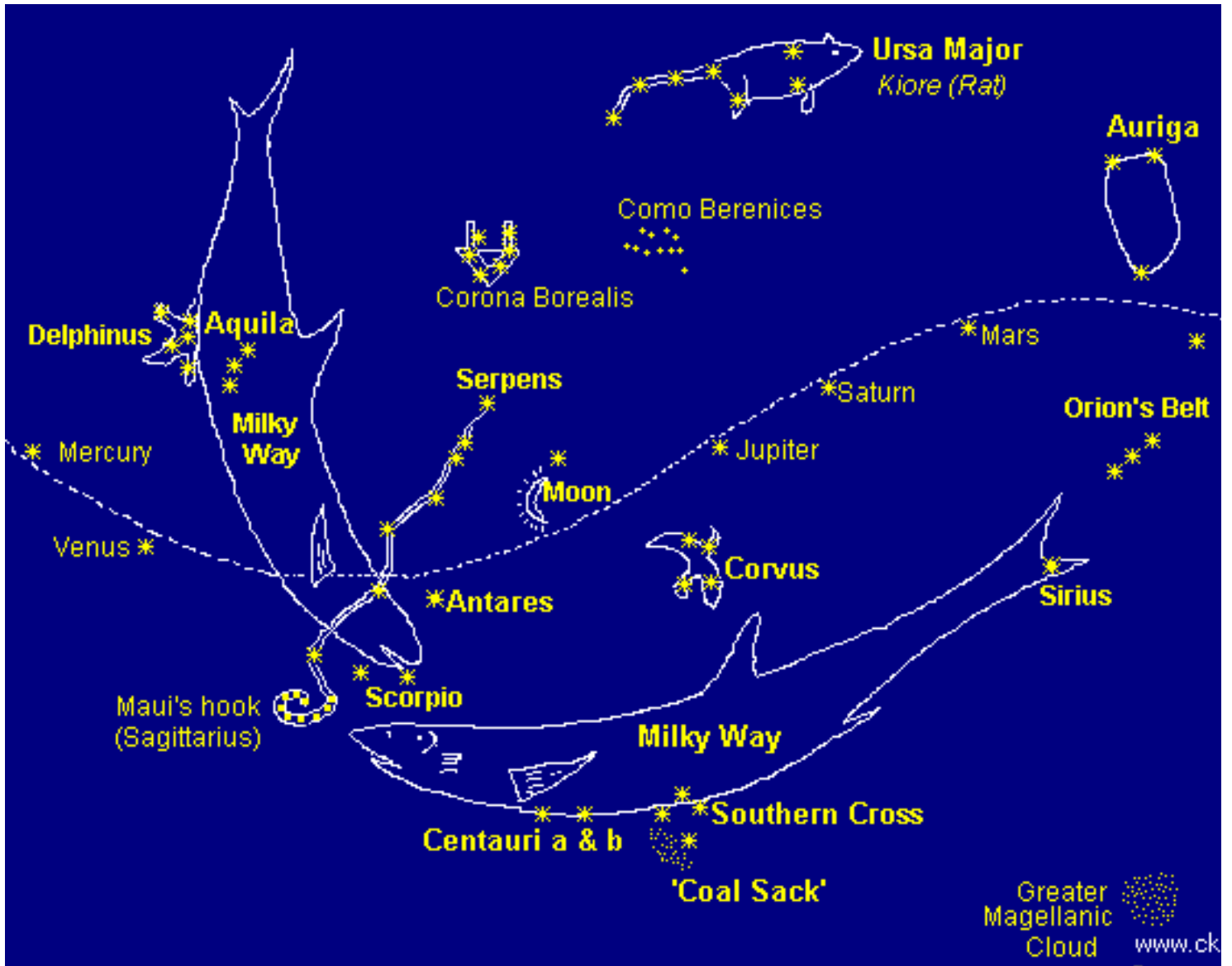
Star Chart Image Source: H.A. Rey, *The Stars: A New Way to See Them*. *We recommend purchasing this book or checking it out from the library.

What Does Star Magnitude Mean? Brightness of stars is assigned a number starting with the brightest star starting at about -1 magnitude. Dimmer stars are zero or positive numbers. The larger the number is, the dimmer the star.





PUKAPUKAN STAR CHART



Pukapuka is a beautiful remote island in the Cooks Islands group in the Pacific Ocean. The Island harbors a lagoon with water so clear you can see great forests of coral deep below the ocean's surface. Humans have inhabited the island since at least 300 BC. The Pukapukans are famous sailors and navigators. This version of a Pukapukan star map shows the names of the constellations we use in the United States, but with the Polynesian references using the legends, and ocean creatures with which they were familiar. For instance, they saw the Milky Way as two large sharks. What else might you be able to tell is important to Pukapukan culture by their constellations outlined on this chart? <http://www.ck/pukapuka.htm>





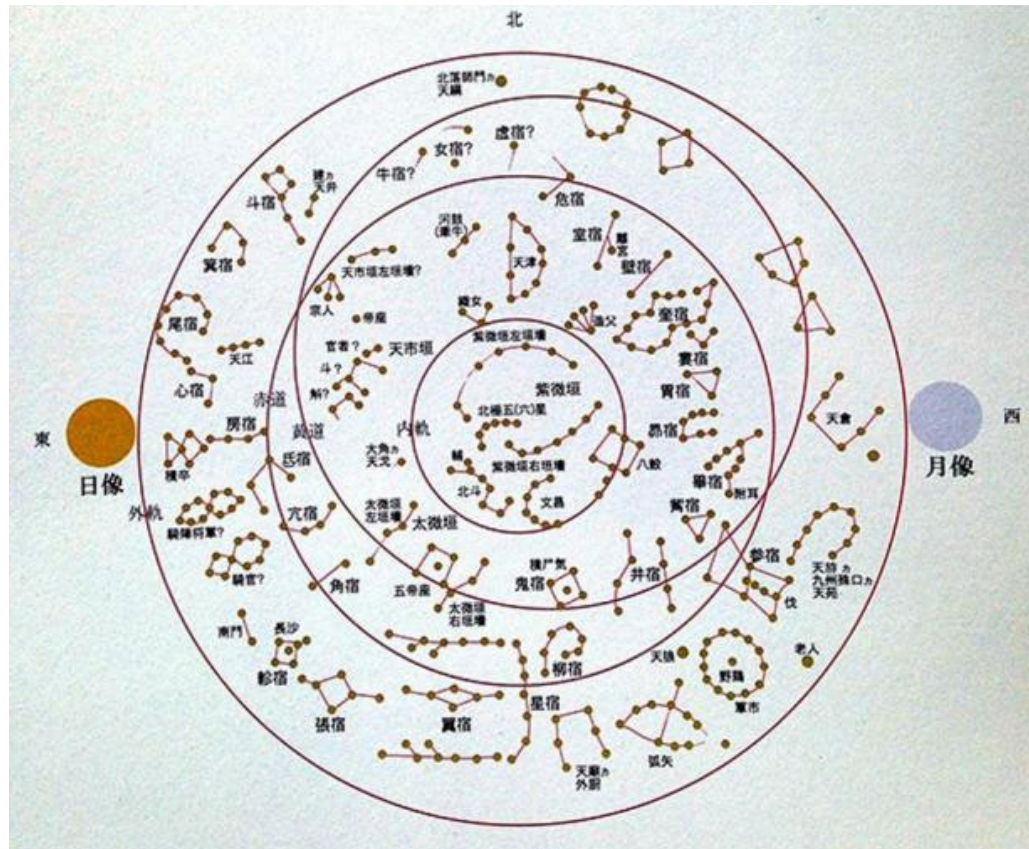
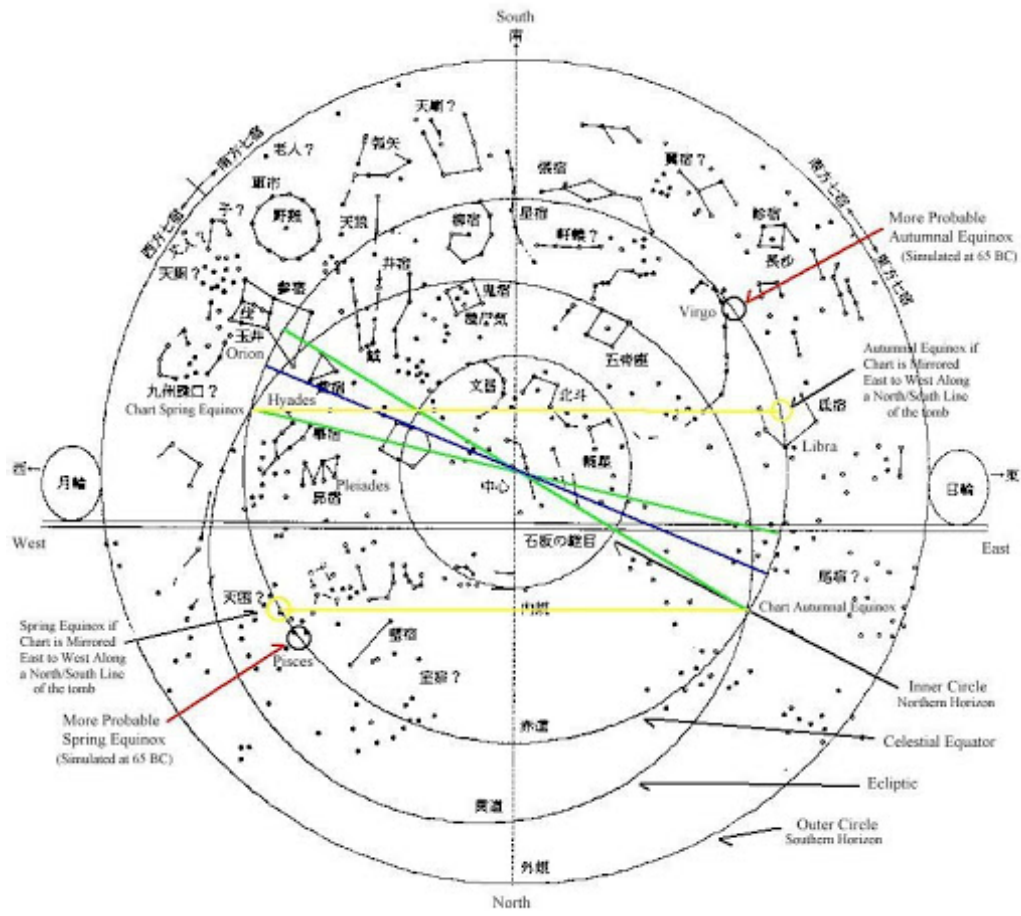
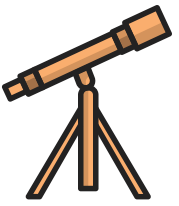
ASTRONOMICAL CHART ON THE CEILING OF THE KITORA TOMB

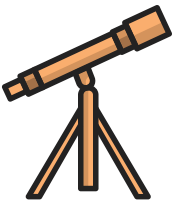


This star chart carved into the ceiling of the Kitara Tomb located in Asuka, Japan, is believed to be one of the world's oldest. The map of the night sky charts 68 constellations with the stars represented in gold leaf. Three concentric circles are drawn with red pigment, showing the movement of celestial objects, one of which is the sun. One thing that has confused researchers is the area of sky the chart depicts. Some researchers say the chart depicts the night sky as it was in China 1,500 to 2,100 years ago. Other researchers think the chart depicts night sky as it was in Korea about 2,000 years ago. The Kitara chart was redrawn with explanations by University of Iowa research fellow Steve Renshaw. Can you find the sun on this star chart?

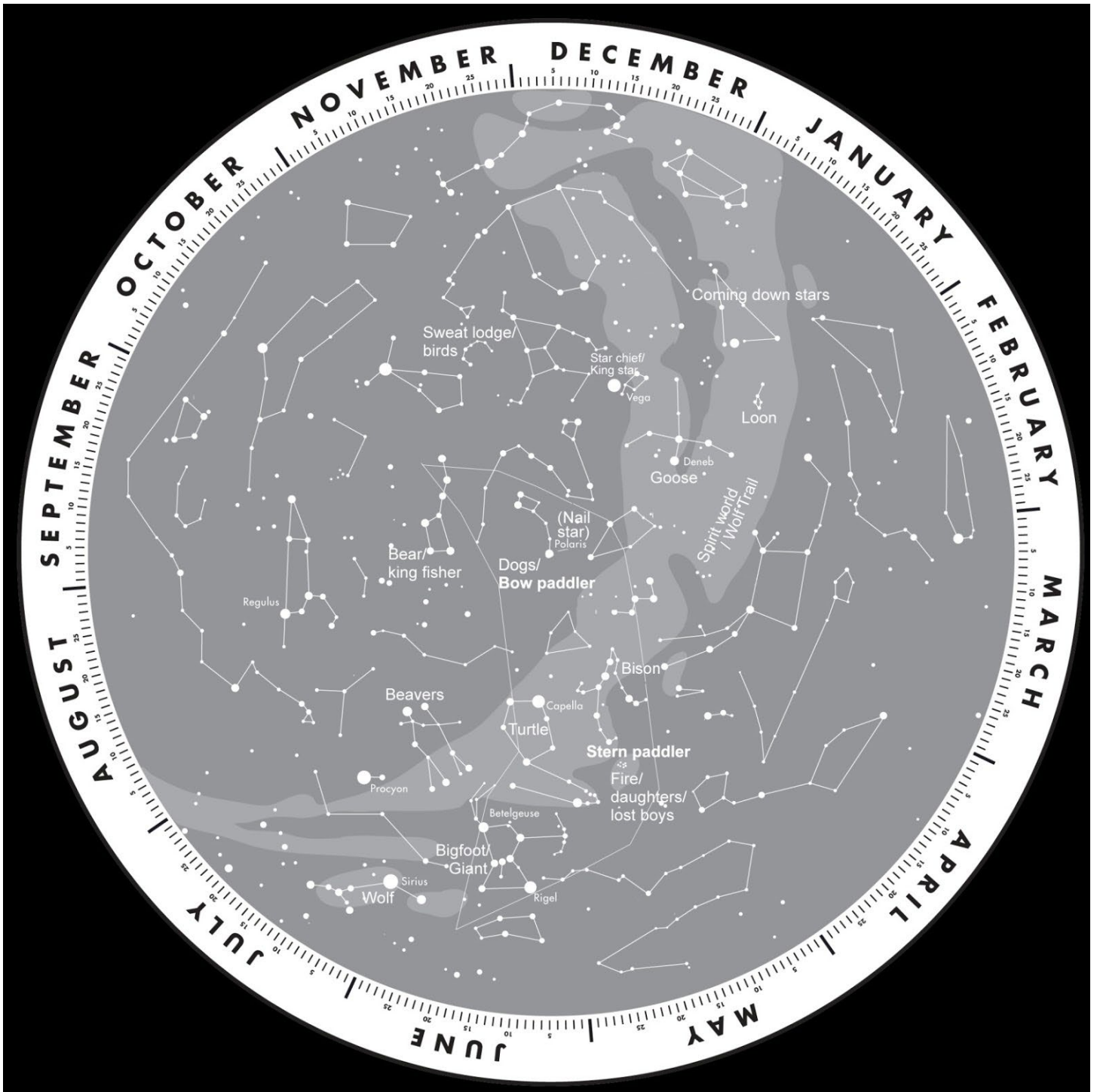
<https://www.cnet.com/news/mysterious-ancient-star-chart-shows-foreign-skies/>







FIRST NATIONS STAR CHART



These are the constellations of the Ojibway, Cree, Blackfoot, and other First Nations of what is now known as Canada. From the names of these constellations, what are some things you can tell are important to folks from these cultures?

<https://wildernessastronomy.com/resources/starchart-first-ever-overview-of-the-canadian-constellations/>





INCAN NEBULAE ASTRONOMICAL CHART



Photo by Koricancha Sun Temple/Cusco

The Incas grouped constellations into two different types - luminous and dark. The first was made up of sparkling stars that depicted geometric forms in the sky. These luminous constellations were seen as inanimate. The other kind - the dark cloud constellations - were contained within the dark blotches of the Milky Way, and were considered living forms, representing animals the Incas knew. These dark patches represented the silhouettes of animals that came to drink from the waters of celestial river, obscuring the heavenly glow of Mayu.

<https://futurism.com/the-dark-constellations-of-the-incas>





Supplies

- Paper
- Pencils
- Binoculars
- Craft supplies for spacecraft creation (This list is just a start!)
- Cardboard boxes of all sizes (juice boxes, pudding boxes, shoeboxes)
- Cardboard tubes (paper towel rolls, toilet paper rolls)
- Aluminum foil
- Construction paper
- Butcher paper
- Transparent colored plastic film (for example, mylar)
- Popsicle® sticks
- Wooden chopsticks
- Bamboo plant stakes
- Markers, crayons and colored pencils
- Egg cartons
- Styrofoam balls
- Clay
- Paper cups
- Paper bowls and plates
- Screws
- Bolts

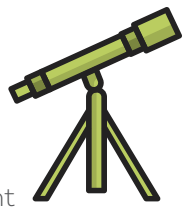
INTRODUCTION

In this club meeting, we will explore how people view celestial objects and travel to space. Members will learn how to use binoculars for stargazing and also design their own spacecraft.

PRIOR TO MEETING

- Gather materials.
- Pre-activity #1 setup (you can ask members to bring a pair of binoculars from home if they have one).
- Print off the pictures of the Moon, Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune, etc. It's a bonus if you can print them off representing their various relative sizes. Or you can use various round objects such as baseballs, basketballs, golf balls, marbles, and star-like objects such as holiday ornaments.
- Position the pictures or objects at various distances around your yard or in an open space so that club members can practice focusing their binoculars. Put the picture of the moon (or a fairly large round object) closest to where the members will be standing. Put Neptune the farthest away, and the other planets in order between. Then position stars on the outer periphery.
- Watch "Top Tips for Binocular Stargazing"
<http://earthsky.org/human-world/top-tips-for-using-ordinary-binoculars-for-stargazing#planets-binoculars>
- Watch "How Do Astronauts Live, Eat, Sleep, and Use the Bathroom in Space?"
<https://www.youtube.com/watch?v=KsNajvy3Z7Y>
- Read NASA Assignment: Build a Spaceship
<https://www.nasa.gov/centers/langley/news/factsheets/Design-Spaceship.html>





BACKGROUND

1. Binoculars are simply two small telescopes side by side, one for each eye. But there's a catch! When light rays from a distant object pass through a convex lens (a lens that curves outward), they cross over. That's why distant things sometimes look upside down. To solve this problem, binoculars have two pairs of prisms (large wedges of glass) inside them. One prism flips the image 90 degrees (onto its side), then the next prism flips it another 90 degrees. The two prisms work together to turn the image right-side up.
<https://www.explainthatstuff.com/binoculars.html>
2. Every spaceship is different! Spacecraft are specially designed for the mission they need to accomplish, how far they will be travelling, and whether or not there are people on board. For instance, the Space Shuttle Discovery consists of three major components:
 - a. the orbiter, which houses the crew and contains life support systems, computers, food, workspace, etc.
 - b. a large external tank that holds fuel for the main engines
 - c. two enormous rocket boosters that provide most of the shuttle's lift during the first two minutes of flight
3. All aircraft and spacecraft are designed, evaluated, prototyped, and tested by aerospace engineers. There are two categories of aerospace engineering: aeronautics and astronautics. Aeronautical engineers design airplanes; astronautical engineers design spaceships, satellites, and missiles.

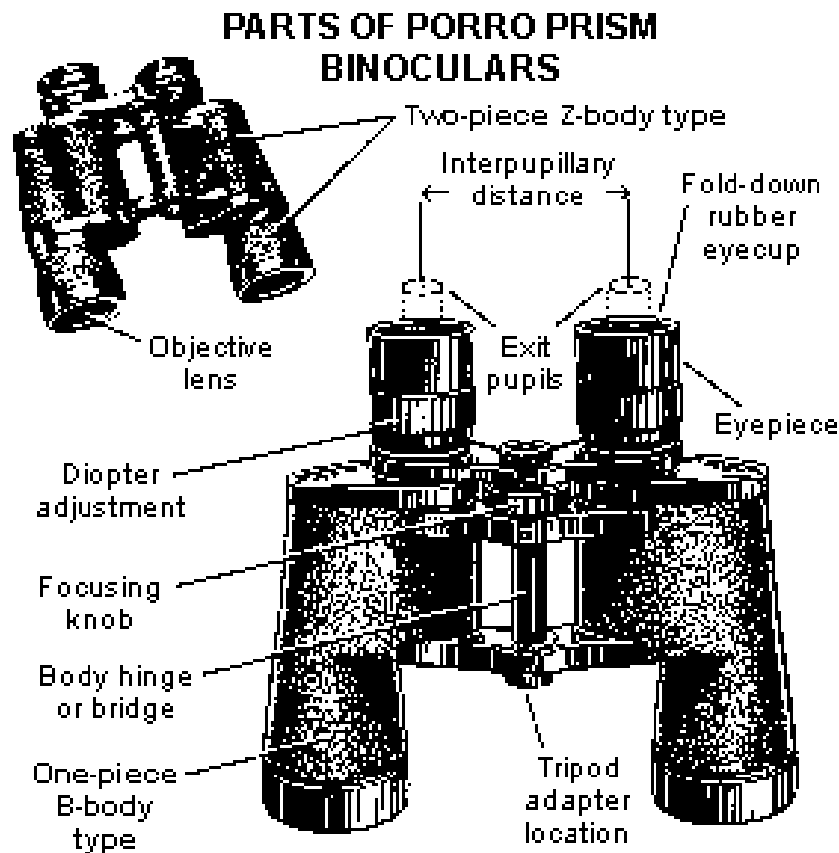


Image Source: <https://lovethenightsky.com/best-binoculars-for-astronomy/>





STARS IN YOUR EYES

TIME: 30-60 MINUTES, depending on group size

1. Give each person a pair of binoculars, or ask club members to take turns using binoculars.
2. Explain that binoculars are a common, affordable, household version of a telescope. Many people use binoculars for hunting or birdwatching, but you can also use them to look at the moon, planets and stars.
3. Provide a safety warning: **NEVER LOOK DIRECTLY AT THE SUN BECAUSE IT WILL DAMAGE YOUR EYES! DO NOT use your binoculars to look at the sun.**
4. Walk the club members through the following steps:
 - a. Start by adjusting the distance between the two barrels of the binoculars so they are the right width for the user's eyes. If they are too far apart or too close together, you will see black edges in your field of view. If the spacing is right, their view will be a perfect circle. If a club member simply can't find good focus, have them close one eye while looking through and just use the binoculars for that one eye.
 - b. Next, have the participants find the image of the moon (posted in your yard) and focus with both eyes (or one eye if they can't make it work with two) open by turning the focus wheel.
 - c. Now it's time for the fine focusing. Close your right eye and, using only your left eye, adjust the focus wheel. Next, close your left eye and, using the diopter adjustment, bring your view into sharp focus.
 - d. Now open both eyes and see if your focus is crystal clear. If the image is not clearly focused, repeat these steps, making small adjustments using one focus wheel or the other.
 - e. Repeat the steps above, moving on to each planet as they get farther and farther away.
 - f. **BONUS: If the moon is up at daytime, you can practice looking at the moon in the sky! REMEMBER NEVER TO LOOK AT THE SUN!**

Reflect

- What additional information would you need to know in order to use your binoculars for stargazing? (For example, which planets are visible at different times of the year, where to look in the sky, etc.)
- Go around the group and ask members to list other inventions humans have created in order to get a better look at planets, stars, space, etc. For each invention, have club members discuss how they think it helps us better understand celestial objects and space.

Apply

- If club members have access to binoculars at home, have them set a goal to observe the night sky looking at the moon and stars using their binoculars before the next club meeting. Have them report back on a couple of the coolest things they observed in the night sky through their binoculars at the next meeting.





DESIGN YOUR OWN MISSION TO SPACE!

TIME: 1 HOUR

Originally published in *The Technology Teacher*, October 2000, by the International Technology Education Association

1. Ask club members what they think would be important to include on a spacecraft in order to get safely into space, work comfortably while aboard the craft, and then return to Earth and land safely.
2. Show charts of actual spacecraft. Use the following sources to get you started.
 - a. Space Shuttle Diagrams
<https://www.history.nasa.gov/SP-4225/diagrams/shuttle/shuttle-diagram.htm>
 - b. A Peek Inside the Orion Spacecraft that Will Fly Us to Mars
<https://www.popsci.com/peek-inside-orion-spacecraft-that-will-fly-us-to-mars>
 - c. Look at Lots of Different Spacecrafts from Around the World
<https://historicspacecraft.com/>
 - d. Voyager Diagram
<https://airandspace.si.edu/multimedia-gallery/web12084-2011640jpg>
 - e. Mars Rovers: Curiosity and Opportunity (Some of the videolinks do not work, but the diagrams and photos and the videos that do work are worth visiting the link.)
<http://graphics.latimes.com/storyboard-mars-rover/>
3. Explain to club members that spacecrafts have different parts that do specific jobs, and review the list below with them. Most spacecrafts need:
 - a. A container (like a box) to be the body of the spacecraft and hold the computer, electronics, and sometimes astronauts. This part is called the spacecraft "bus."
 - b. Something to keep the computer and electronics warm in the vacuum of space, where it is very cold.
 - c. Something to supply electric power (for example, solar panels).
 - d. Some instruments to make scientific measurements or take pictures.
 - e. Some way to communicate with Earth (both to send data and to receive commands).
 - f. Some way to slow down, speed up, or change the direction of the spacecraft (like thrusters) to keep it on course or in the right orbit.
 - g. Something to let the spacecraft know where it is and where it is going (for example, a star finder camera). For Earth orbiters, it might be a receiver for signals from the network of Global Positioning Satellites).
 - h. There are many other parts, but the ones above are some of the basics.
4. Tell club members that they now have the chance to build their own spacecraft.





5. Before they start building, have club members think about the intent of their mission to space. What do they plan to do on the mission? Is the spacecraft unmanned, or does the mission require astronauts? If so, what would astronauts or other organisms need to be able to live in space? How long will the mission be? What types of data will be collected (e.g. images, physical samples, remote sensing data, topographical data, climatic data, etc.). What kinds of instruments will the mission need? What physical properties will it need to leave Earth and travel through space? Thinking through the intent will help them know what components are important for their spacecraft.
6. Provide the group with the materials to start building. It may be a good idea to post the above list of spacecraft components, as a reference.
7. After the club members have completed their spacecrafts, ask each person to present their craft, describe its mission, and explain each feature on their spacecraft and its function.

Reflect

- What challenges did you have in designing your spacecraft?
- From what you learned today, do you think you would like to design spacecrafts as a job? Why or why not?
- Can technology can be used for space exploration benefit populations on Earth? If so, which technologies provide benefits and what are those benefits?

Apply

- Take what you learned today about thoroughly planning for a space mission and put those pre-planning skills to use the next time you are going to go on a family outing or vacation. Make sure to prepare for every scenario you might encounter and bring only the equipment and supplies you will need for the trip.





4-H MISSION MANDATES

Healthy Living

Club members will learn and implement safe practices for eye protection when using binoculars. Youth reflect on human needs that sustain life on Earth that we take for granted and how those needs would have to be met in an extraterrestrial environment. Thinking about the possible physical properties of objects in space can lead to excellent observations about Earth's environment and how it affects life.

Science

Club members learn basic information on optical physics as they use their binoculars to see objects. While engineering their spacecraft, youth identify and solve problems to meet the technological and biological needs of space exploration.

ESSENTIAL ELEMENTS

Belonging

Youth share their thoughts and designs to reach common goals while investigating space.

Independence

Members will work independently in designing and creating their own spacecraft to achieve their self-directed goal.

Generosity

Members learn by the example of their adult volunteers that volunteering is valuable to our communities. They also learn to take turns, share binoculars, and work.

Mastery

Members will gain a mastery of using binoculars. Youth apply their knowledge gained of celestial objects by predicting what types of available data might be present and gathered using the appropriate instrumentation.





EXPLORE MORE ON YOUR OWN!

How Do Binoculars Work?

<https://www.explainthatstuff.com/binoculars.html>

Antikythera mechanism--2,000 year old sophisticated moon, sun and celestial object tracker.

<http://mentalfloss.com/article/81445/15-intriguing-facts-about-antikythera-mechanism>

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

Telescope as Time Machine!

https://spaceplace.nasa.gov/review/classroom-activities/pdf/galex_puzzles.pdf

Space Telescopes!

<https://spaceplace.nasa.gov/review/classroom-activities/pdf/sirtf.pdf>

Dark Side of the Earth--How a United State Astronaut and a Russian Cosmonaut Had to Work Together to Save their Lives Stuck Outside the MIR Space Station! From Radiolab.

<https://www.youtube.com/watch?v=WiUfe92D0gk>

Watch Real Canadian Astronaut Chris Hadfield Play a Song about Astronauts and Space Flight while He Was Really in Space Aboard the International Space Station. It is awesome!

<https://www.youtube.com/watch?v=KaOC9danxNo>

How Do People on Spacecrafts Communicate with People Back on Earth?

https://spaceplace.nasa.gov/review/classroom-activities/pdf/dsn_signal_mod_web.pdf

See All the Elements that Go into Space Travel as Astronauts Leave the International Space Station and Travel Back to Earth Aboard the Soyuz Spacecraft.

<https://www.youtube.com/watch?v=-l7MM9yoxII>

Packing for a L-O-O-O-N-G Trip to Mars

https://spaceplace.nasa.gov/review/classroom-activities/pdf/mars_packing.pdf

Using Gravity to Help Spaceships Reach Their Destinations

<https://spaceplace.nasa.gov/review/classroom-activities/pdf/gravityassist.pdf>

Want to Design Spacecrafts for Real? Here Is What You Need to Know About the Job

<https://www.bls.gov/ooh/architecture-and-engineering/mobile/aerospace-engineers.htm>

Trace Space Back to You: How NASA Technologies Benefit Our Daily Lives

https://spinoff.nasa.gov/Spinoff2008/tech_benefits.html



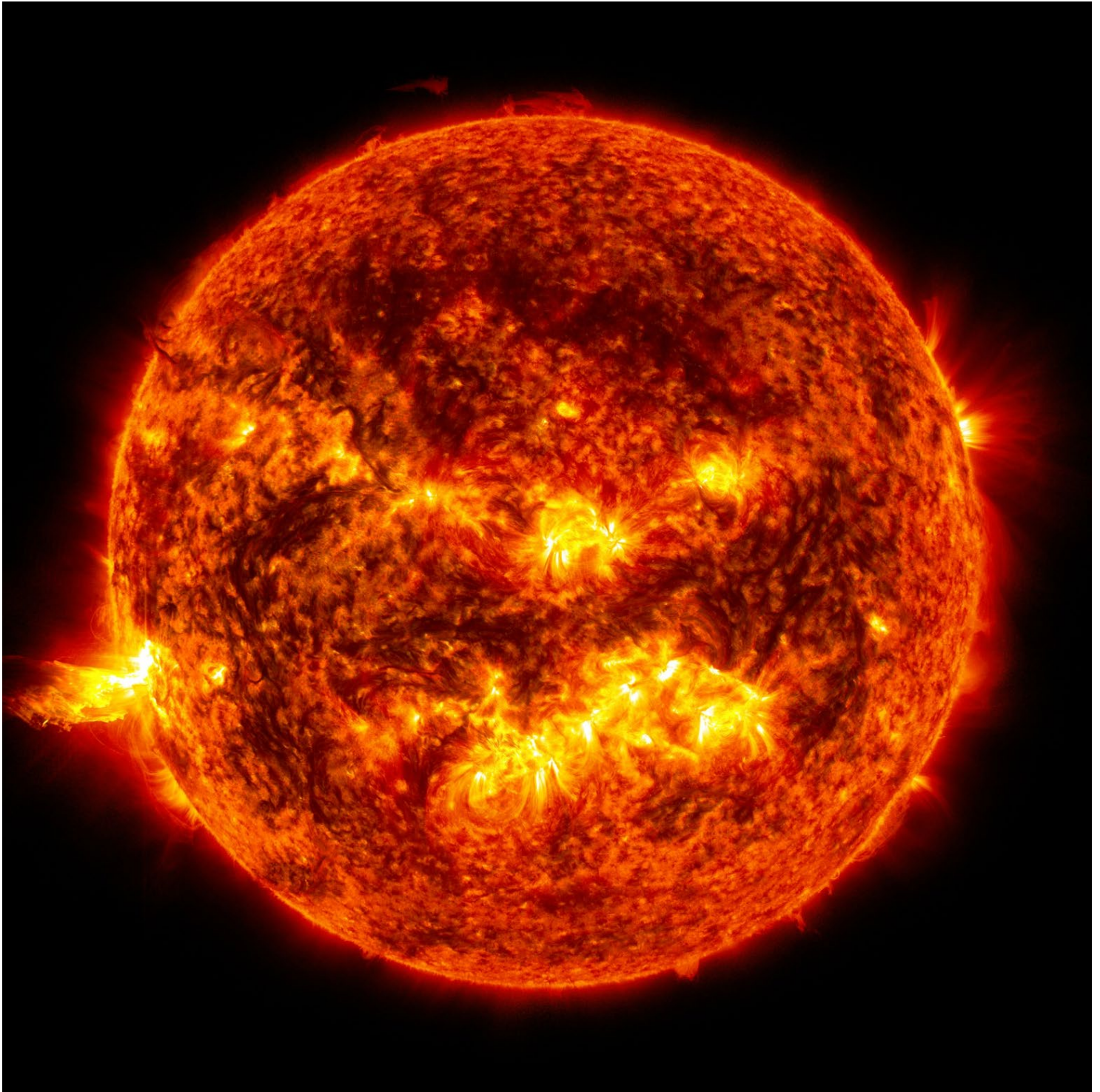
EARTH'S MOON



Picture taken from: <https://moon.nasa.gov/resources/77/the-near-side-of-the-moon/>



SUN

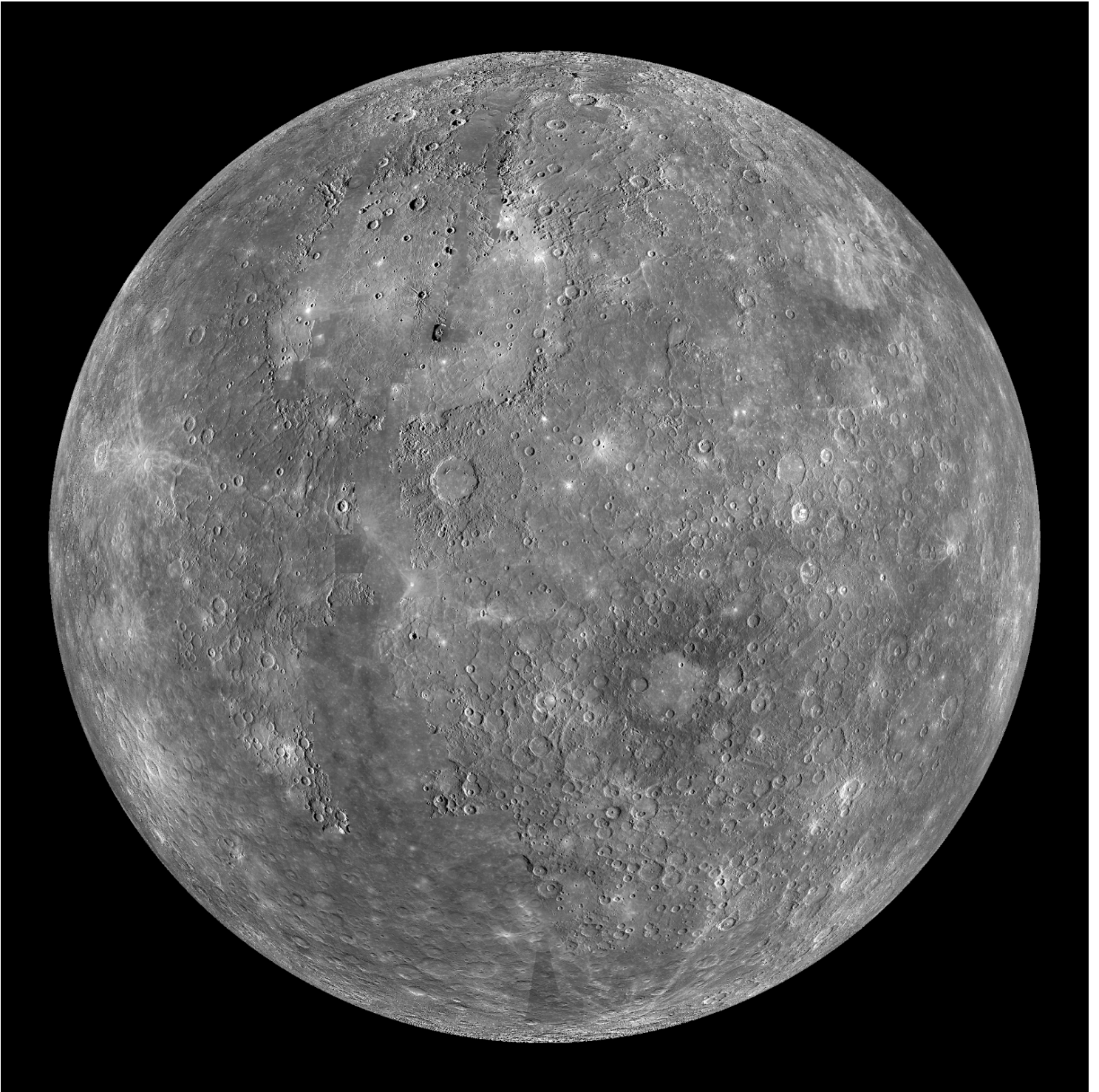


Picture taken from: https://solarsystem.nasa.gov/resources/386/sun-emits-a-solstice-flare-and-cme/?category=solar-system_sun





MERCURY

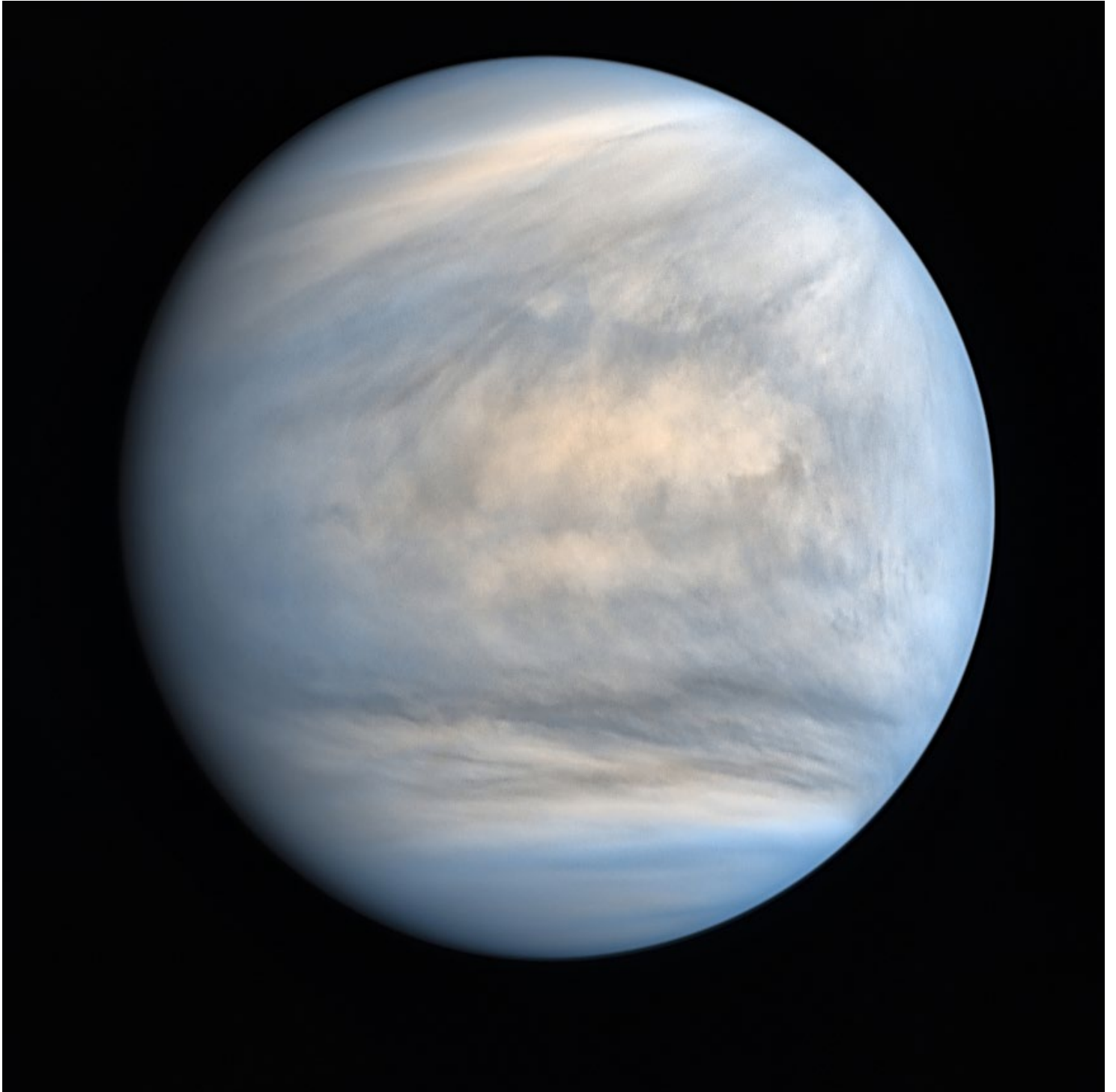


Picture taken from: https://www.nasa.gov/mission_pages/messenger/multimedia/messenger_orbit_image20111130_1.html





VENUS



Picture taken from: <http://www.astronomy.com/news/2019/05/venus-reimagined-a-new-image-of-an-active-world>



EARTH

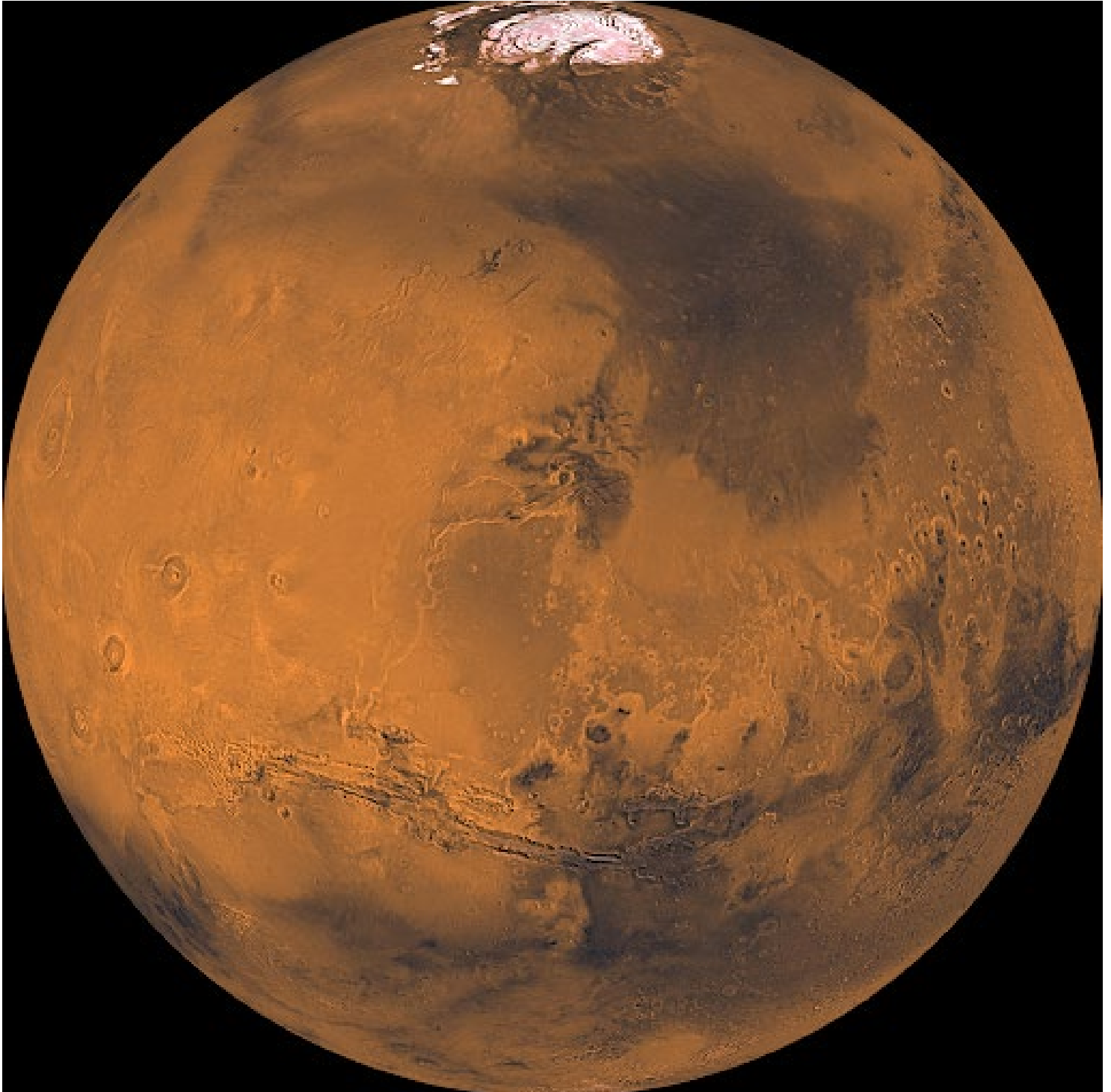


Picture taken from: <https://www.nasa.gov/image-feature/nasa-captures-epic-earth-image>





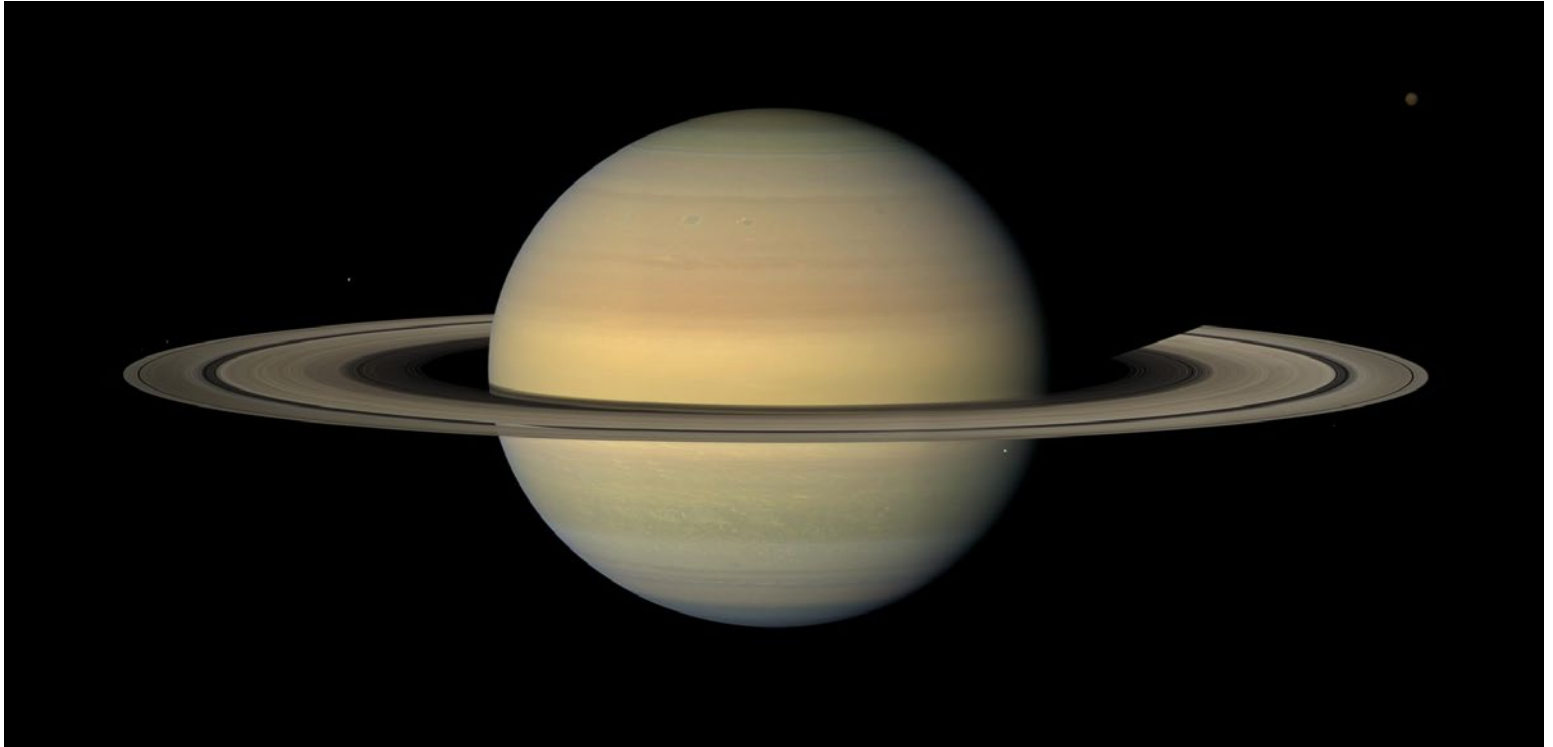
MARS



Picture taken from: <https://mars.nasa.gov/resources/7808/global-color-views-of-mars/>



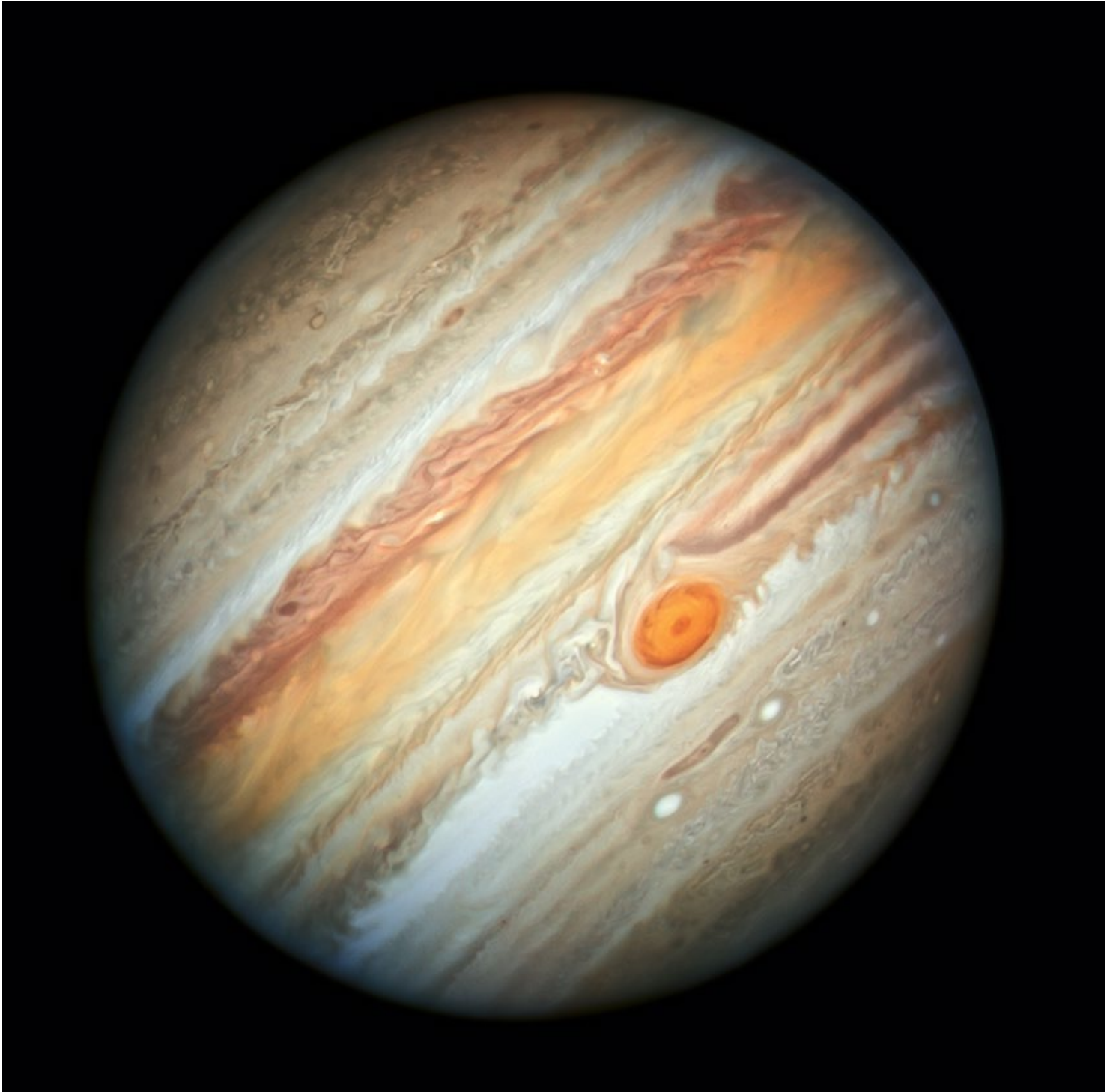
SATURN



Picture taken from: <https://solarsystem.nasa.gov/resources/14379/saturn-four-years-on/>



JUPITER

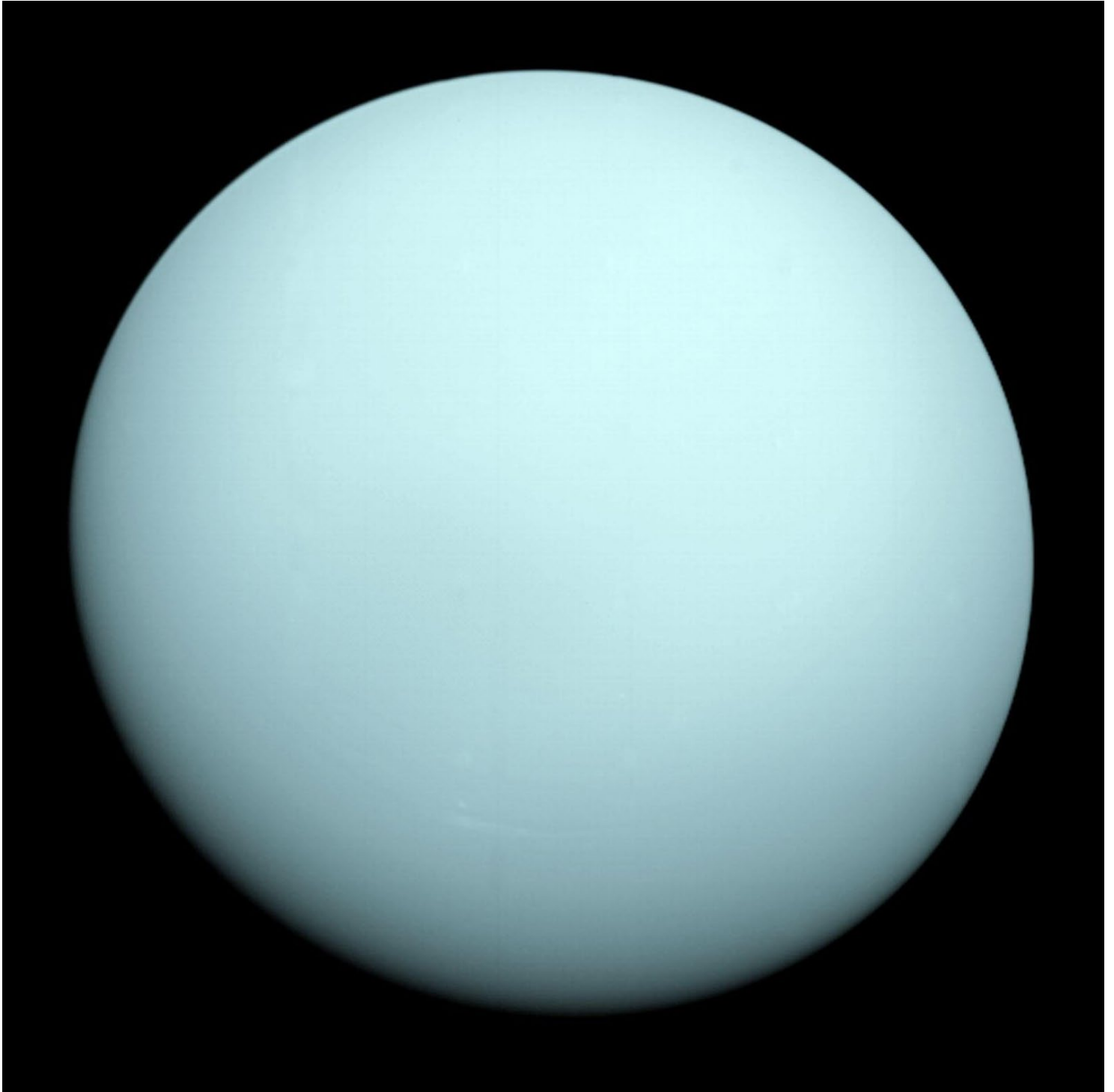


Picture taken from: <https://www.nasa.gov/feature/goddard/2019/hubble-new-portrait-of-jupiter>



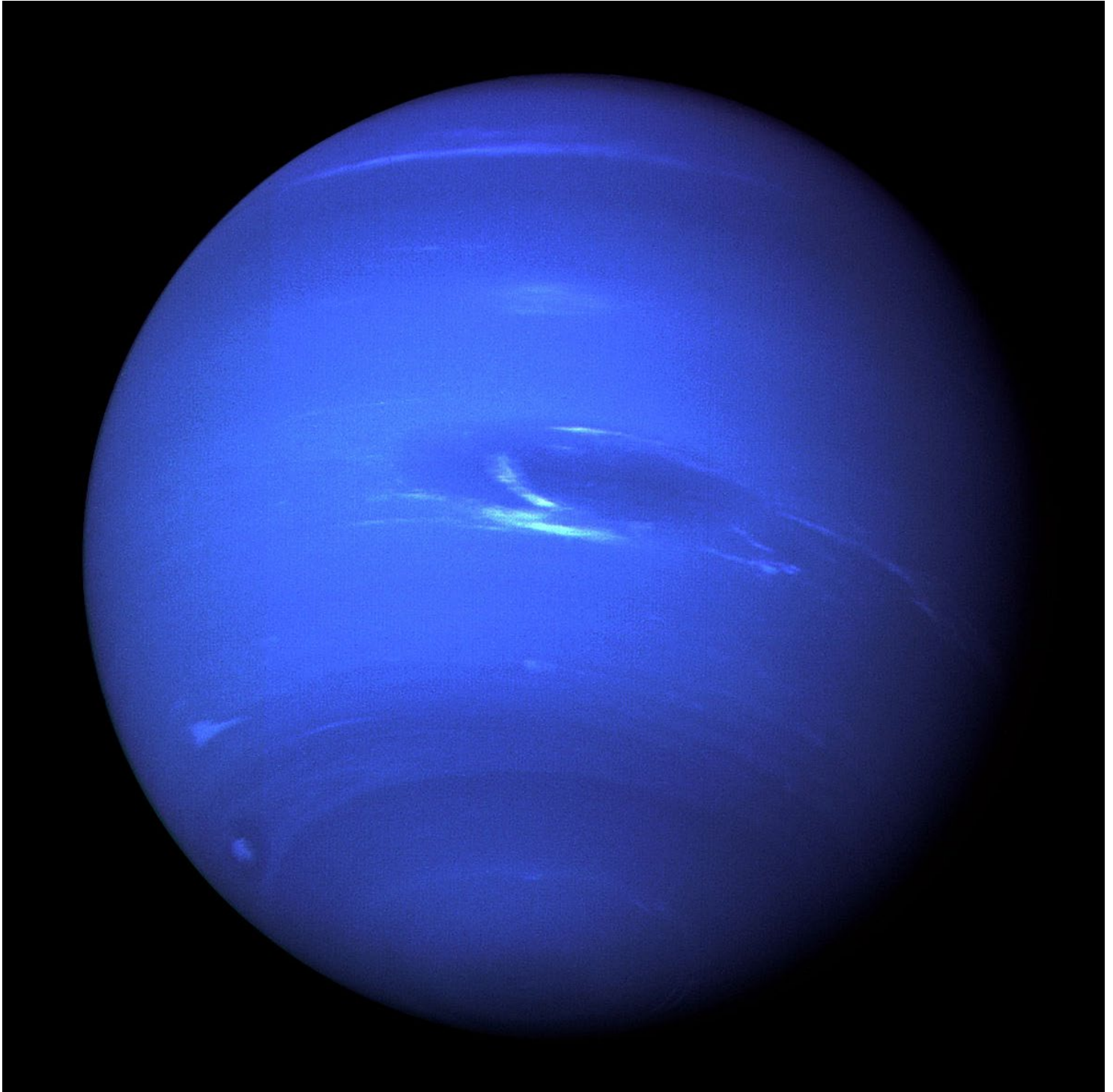


URANUS



Picture taken from: <https://solarsystem.nasa.gov/resources/599/uranus-as-seen-by-nasas-voyager-2/>

NEPTUNE



Picture taken from: <https://www.nasa.gov/feature/jpl/30-years-ago-voyager-2s-historic-neptune-flyby>





INTERNATIONAL SPACE STATION



Picture taken from: <https://www.nasa.gov/feature/jpl/high-tech-methods-study-bacteria-on-the-international-space-station>





HUBBLE TELESCOPE



Picture taken from: https://www.nasa.gov/mission_pages/hubble/multimedia/index.html



NEBULA

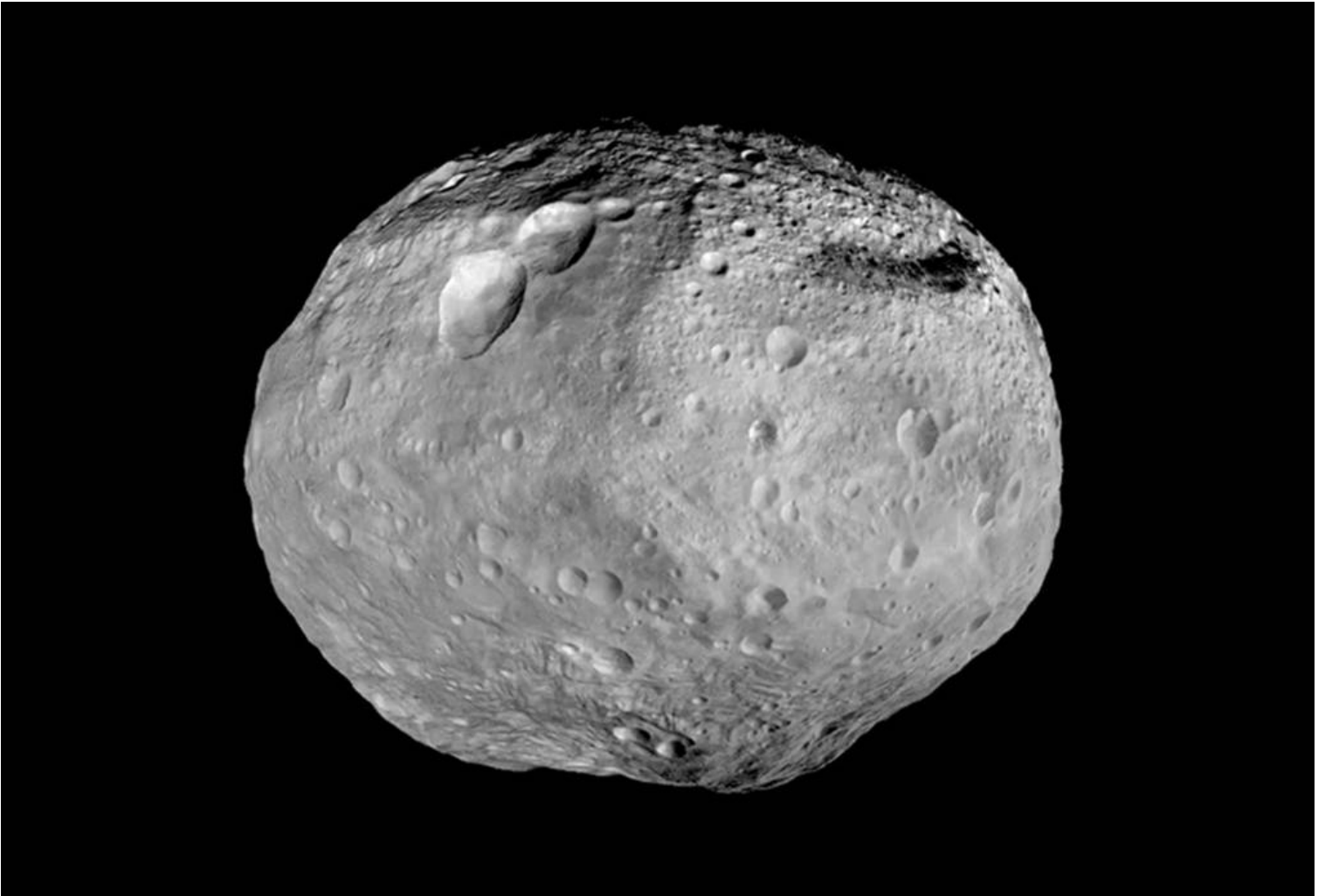


Picture taken from: <https://apod.nasa.gov/apod/ap170702.html>





ASTEROID



Picture taken from: https://www.nasa.gov/mission_pages/dawn/multimedia/pia15678.html





COMET



Picture taken from: <https://apod.nasa.gov/apod/ap150117.html>



GALAXY



Picture taken from: https://www.nasa.gov/multimedia/imagegallery/image_feature_2132.html





MILKY WAY



Picture taken from: <https://apod.nasa.gov/apod/ap051004.html>





The More Light at Night, the Less We Can See



Supplies

- An assortment of small battery-operated lights of different colors and intensities, OR a constellation projector
- Provide, or have each club member bring a flashlight
- Printed copies of light pollution maps and light pollution's effect handouts
- Printed copies of "What Is Light Pollution?" graphic

INTRODUCTION

In this club meeting, we will explore light pollution and its effects on our ability to view the stars. We will also discuss how light pollution affects other animals and make a plan to reduce light pollution.

PRIOR TO MEETING

- Gather materials.
- Identify a location to facilitate the activity.

BACKGROUND

What is Light Pollution?

Most of us are familiar with air, water, and land pollution, but did you know that light can also pollute? Using too many, too bright or misdirected lights are all causes of light pollution. Light pollution can have serious consequences for humans, wildlife, and plants. Different types of light pollution include:

- Glare - excessive brightness that causes visual discomfort
- Light trespass - light falling where it is not intended or needed
- Clutter - bright, confusing and excessive groupings of light source
- Skyglow - brightening of the night sky over inhabited areas

Light pollution is a side effect of industrial civilization. Its sources include exterior and interior lighting, advertising, offices, factories, streetlights, and illuminated sporting venues. Many outdoor lights used at night are inefficient, overly bright, poorly targeted, improperly shielded, and, in many cases, completely unnecessary. There is no need to point lights upward at the night sky. Lights should be directed downward at the space or object that requires illumination and used only where and when they are needed.





How Light Pollution Affects Our Quality of Life

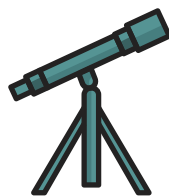
Misdirected lights and other forms of light pollution have resulted in 80% of the world's population not being able to see the Milky Way from where they live! Our artificial lights are literally washing out our view of the heavens! Humans also need darkness to rest and revitalize. Absence of light sends a critical signal to the body that it is time to rest. Having lights, televisions or phone or computer screens on at the wrong times alters the body's internal "sleep clock"—the biological mechanism that regulates sleep-wake cycles—in ways that interfere with both the quantity and quality of sleep.

The Effects of Light Pollution on Animals - Two Examples

Night-migrating birds use the moon and the stars as navigational tools along their migration routes. This behavior naturally draws night-migrating birds to the bright lights in cities along their journey. In these unfamiliar, urban environments, night-migrating birds often fatally collide with tall, brightly lit buildings. Artificial light is especially confusing to birds on foggy or rainy nights, or when cloudcover is low and the birds fly at lower altitudes. (<http://www.flap.org/toronto-lights-out.php>)

Sea turtle hatchlings have an innate instinct that leads them in the brightest direction, which is normally moonlight reflecting off of the ocean. Shore-side lighting can cause turtle hatchlings to become disoriented and wander inland (instead of out to sea), where they often die of dehydration or predation. (<https://conserveturtles.org/information-sea-turtles-threats-artificial-lighting/>)

Activity #1



EXPERIENCE LIGHT POLLUTION

TIME: 30 MINUTES

1. Set up a series of small, battery-operated lights of different colors and intensities on a table or floor in a room. Space the lights unevenly. Alternatively, you can use a constellation projector.
2. Explain to the group that these lights simulate stars, planets, and other celestial objects.
3. Provide a flashlight for each member in the club. Ask them to keep the flashlights turned off until you provide further direction.
4. Turn off the lights, and have the participants stand in the back of the room and note how well they can see the clarity of the light cluster.
5. Ask one member to turn on their flashlight and shine it toward the light cluster.
6. Ask the participants how adding a light changed or didn't change the clarity of the light cluster. Discuss the changes.
7. Add an additional flashlight and repeat the 2 steps above.
8. Repeat until all the flashlights are on.
9. Turn on the room lights.
10. Discuss how this activity relates to human-created light outdoors at night (for example, you can't see the stars as well, nor can you see your surroundings).





LIGHT POLLUTION AND OUR PLANET

TIME: 30 MINUTES

1. Look at the graphic describing the different types of light pollution. Discuss the following questions with the group:
 - a. What are the different types of light pollution?
 - b. How many of these types of light pollution do you have around your house? Your school? Your town/city?
2. Look at "Maps of Light Pollution Around the World" and "How Light Pollution Has Increased in the United States over Time." These maps measure sky glow. Discuss the following questions with the group.
 - a. What do the maps tell you about how the quality of darkness has changed over time?
 - b. What inferences can you make about your state based on the map?
 - c. Why has light pollution increased?
 - d. When you look at the light pollution maps, why are some places red? Why are some yellow? Why are some places black?
 - e. What are the positive aspects to these changes? What are the negative aspects?
 - f. Based on these maps, where are the best locations to see the stars?
3. Look at the graphic describing why animals need dark. Discuss the following questions with the group:
 - a. How does light pollution affect wildlife?
 - b. Are there things we can do to reduce the effect of light pollution on wildlife?





Reflect

- How does seeing the stars make you feel?
- Do you think there are health effects when we cannot see the stars? What might happen?
- Do humans and animals need darkness to function properly? Why or why not?

Apply

- Are there actions you would like to take in your own home/neighborhood to reduce light pollution? Make a list of what you could do.

4-H MISSION MANDATES

Citizenship

Youth are encouraged to identify sources of light pollution on local and broad scales and how it negatively affects our greater community and ecosystem health. This can motivate youth to advocate for change at home and in their communities.

Healthy Living

Members will explore how light pollution affects their lives including the negative effects on circadian rhythm and sleep.

Science

Members will understand sources and mechanisms of light pollution and its negative effects on humans and wildlife.

ESSENTIAL ELEMENTS

Belonging

Members each contribute to demonstrating light pollution and sharing their observations.

Independence

Members are asked to think about actions they can personally take to reduce light pollution.

Generosity

Youth will learn to think about beings other than themselves when it comes to environmental issues and the importance of making positive changes for everyone.

Mastery

Members will gain a mastery of looking at various kinds of maps, identifying sources of light pollution, and making inferences based on their observations.





Explore More on Your Own!

NASA's 'Black Marble' shows Earth's nighttime sky glow: New global map of Earth at night shows the growing impact of sky glow light pollution across the globe:

<https://www.mnn.com/earth-matters/space/blogs/nasas-black-marble-shows-earth-glowing-brighter>

Light Pollution Is Confusing Baby Sea Turtles:

<https://www.australiangeographic.com.au/news/2016/05/light-pollution-is-confusing-baby-sea-turtles/>

The Danger of Light at Night to Migrating Birds:

<https://www.flap.org/toronto-lights-out.php>

Light Pollution in Utah:

<https://utah.maps.arcgis.com/apps/Cascade/index.html?appid=3f60caabf8ef49d2b1ebddaebfecee79>





Light pollution?

Excessive use of artificial light.



Light trespass – light falling where it is not intended, wanted or needed.



Glare – visual discomfort from excessive brightness.



Clutter – Bright, confusing and excessive groupings of lights



Urban sky glow – the brightening of the night sky from artificial light over inhabited areas.

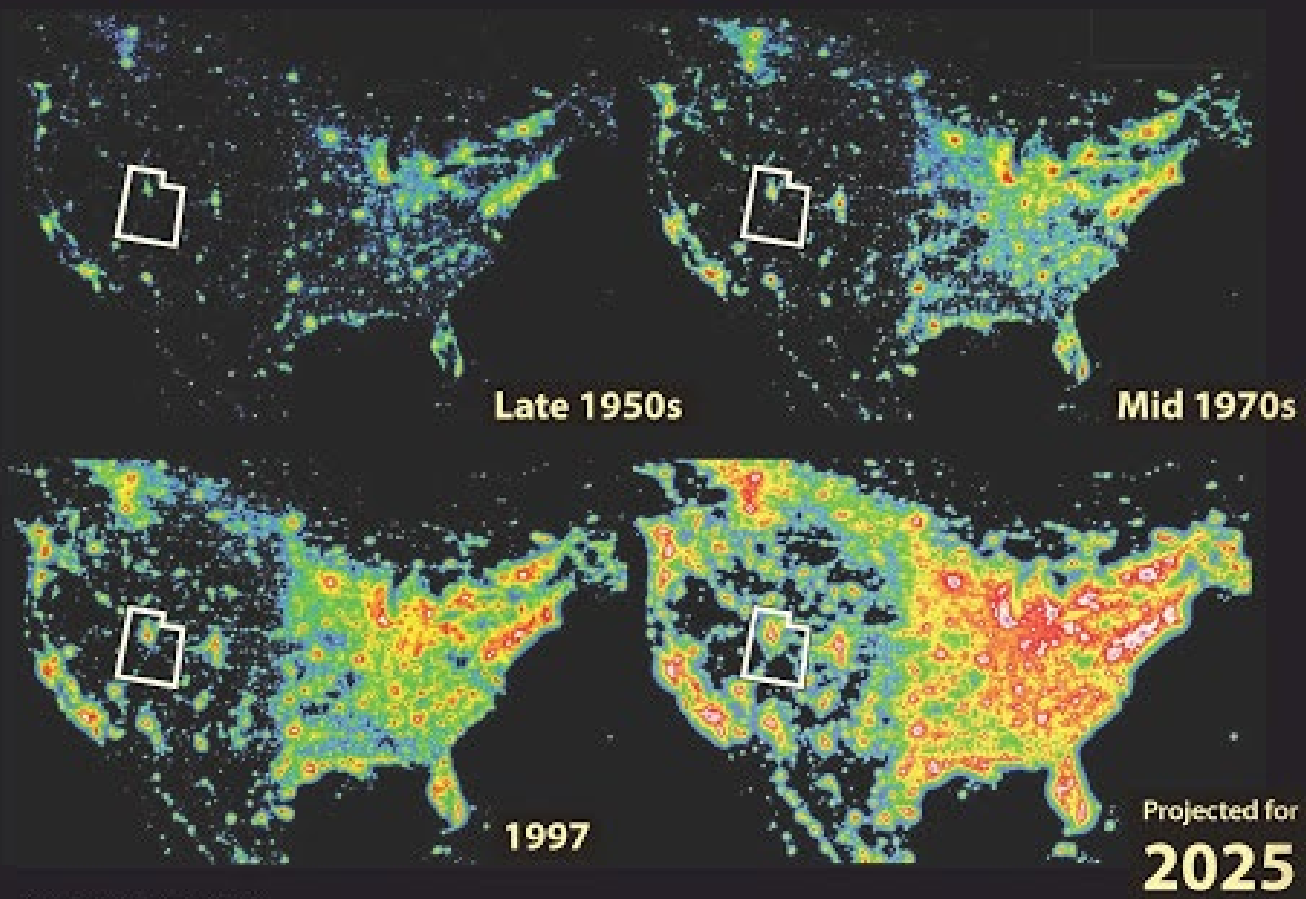
Graphics by Monica Stamm for Utah Division of Parks and Recreation Dark Sky Initiative





U.S. Light Pollution Growth

The measure of artificial night sky brightness due to light pollution.



© Cimano, F. Patil, C. D. Bridges, K. E. Jaeger, 2011.

Graphics by Monica Stamm for Utah Division of Parks and Recreation Dark Sky Initiative



World map of artificial sky brightness

Light Pollution Visual Impacts

- ☐ Pristine natural dark sky.
- ☐ Extent of urban sky glow into rural areas.
- Degraded near horizon.
- Degraded to the zenith.
- Milky Way is lost in winter.
- Constant artificial twilight.
- Night adaptation is no longer possible for human eyes.

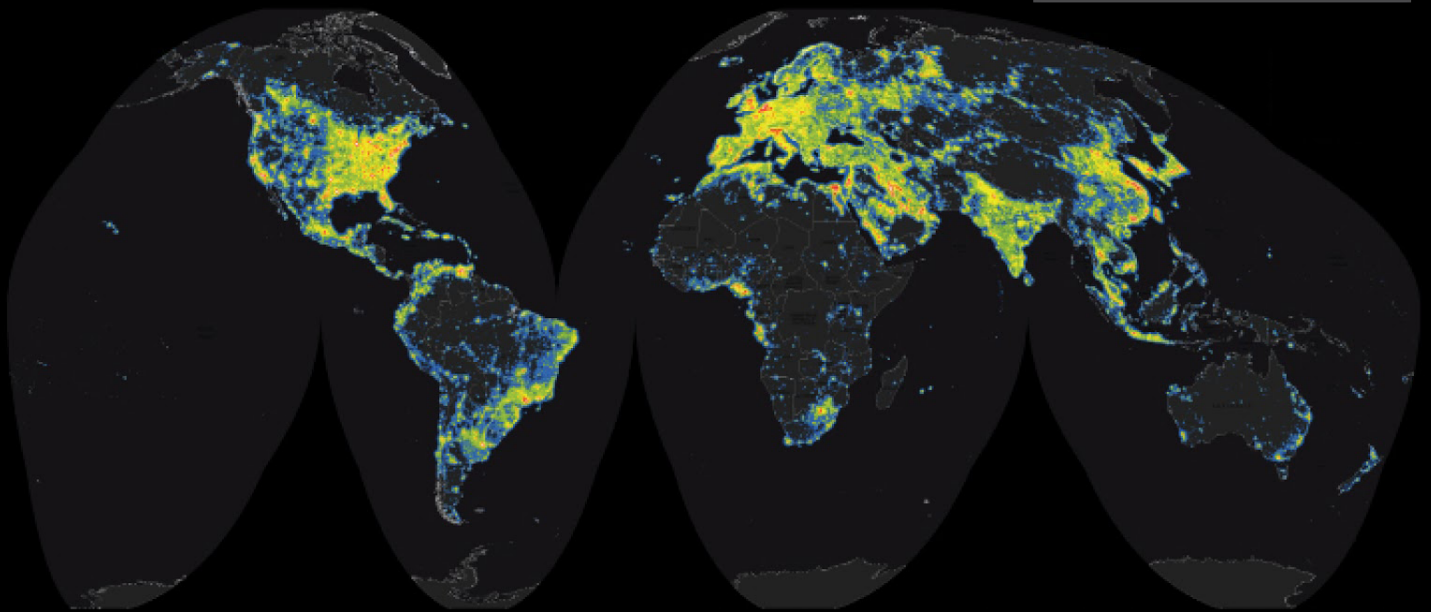


Image from the new "World Atlas of Artificial Night Sky Brightness." Two fold increasing steps, as a ratio to the natural sky brightness. P. Cinzano, F. Falchi, C. D. Elvidge, K. E. Baugh, 2016.

Graphics by Monica Stamm for Utah Division of Parks and Recreation Dark Sky Initiative



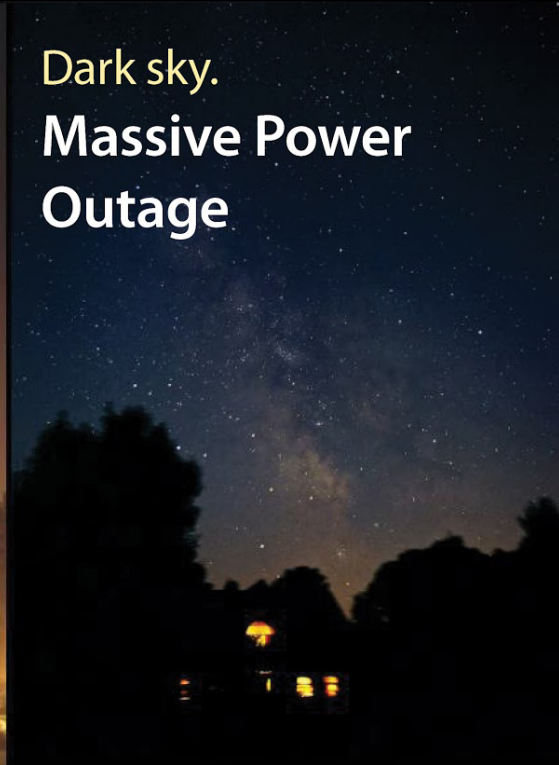


Bright sky vs. dark sky

Bright sky.
Urban sky glow



Dark sky.
Massive Power
Outage



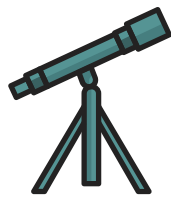
In 2003 there was a massive power outage that caused a blackout for 55 million people over large areas of the North American northeast. This dramatic before and after image was taken from the same vantage point in Goodwood, Ontario, Canada, looking towards Toronto.

Image credit: Todd Carlson

Light pollution is reversible.

Graphics by Monica Stamm for Utah Division of Parks and Recreation Dark Sky Initiative





Animals need the dark

Urban sky glow extends far beyond the borders of cities.
Night-friendly lighting helps wild areas stay dark.

Hunting and foraging:

Lack of natural darkness decreases nocturnal activity, causing hunger, weight loss, mating decline, and decreased population.

Declining insect populations:

The disappearance of bugs negatively impacts all species that rely on insects for food or pollination.



Shelter: Natural darkness provides safe places for animals to hide, live, and raise young.

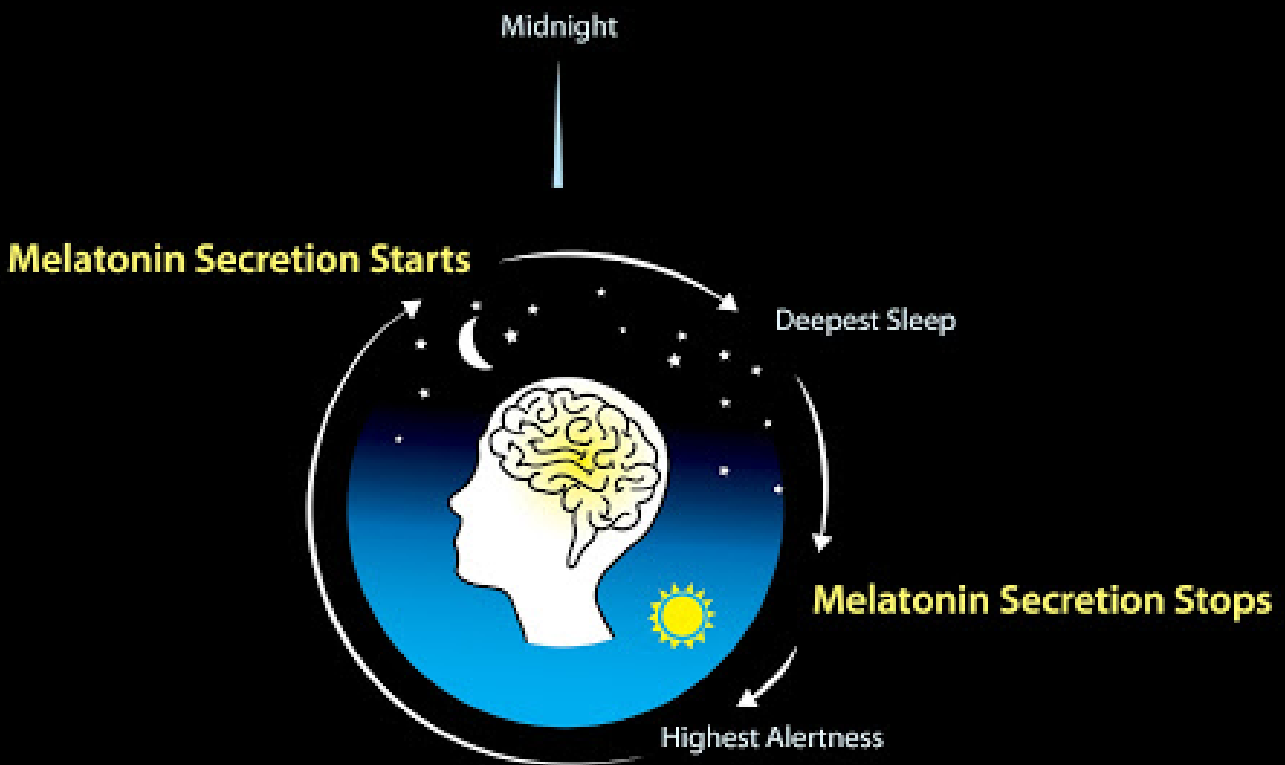
Migration: Artificial lights can cause migrating animals to wander off course and never reach their natural destinations.

Graphics by Monica Stamm for Utah Division of Parks and Recreation Dark Sky Initiative





Day-night cycle and human health.

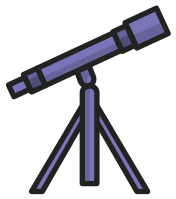


Our sleep-wake cycle, metabolism and immune system depend on the healthy levels of melatonin.

Melatonin: Exposure to light at night can suppress the body's natural production of melatonin.

Graphics by Monica Stamm for Utah Division of Parks and Recreation Dark Sky Initiative





Supplies

- Lights Out Salt Lake graphic
- Kelvin Lumen Wattage graphics:
http://www.darksky.org/wp-content/uploads/bsk-pdf-manager/2019/01/Dark-Sky-Assessment-Guide-Update-12_20_18.pdf
- Light shielding graphics
- Printed copies of the Lighting Inventory worksheet:
https://docs.google.com/spreadsheets/d/1bIbM-2VQ4pjay5VQwuLw5CfzfKyGKTBRfy_D7_OHU8GY/edit?usp=sharing
- Pencil
- Clipboard

INTRODUCTION

In this club meeting, we will learn about Dark Sky-friendly lighting and successful Dark Sky restoration projects. One important thing to remember is that light pollution IS reversible. Everyone can help lessen light pollution through very simple actions. Most light pollution solutions are not about getting rid of lights, but using better lighting, directed only where it needs to be.

PRIOR TO MEETING

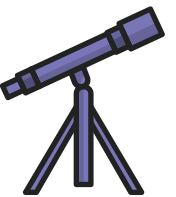
- Gather materials.
- Select a location for Activity #1.
- Print off copies of the Dark Sky Assessment form (Activity #2).

BACKGROUND

Read this short guide to dark sky-friendly residential lighting:
<https://dixiewong.com/pdfs/PG3-residential-lighting.pdf>

Read this short guide: "Residential Lighting Tips–It's Not Rocket Science."
<http://www.flagstaffdarks skies.org/dark-sky-solutions/dark-sky-solutions-2/residential-lighting-tips-2/>

Activity #1



LITTLE CHANGES CAN MAKE A BIG DIFFERENCE

TIME:30 MINUTES

1. Have the club members get into pairs. Ask them to look at handouts. Explain to each other the differences between kelvin, watts, and lumens are.





2. Discuss the following questions as a group:
 - a. What is the most Dark Sky-friendly kelvin color?
 - b. What is the least Dark Sky-friendly kelvin color?
 - c. Which is more Dark Sky-friendly—a higher or lower lumens number?
 - d. How do you find out how many watts a lightbulb is?

Activity #2

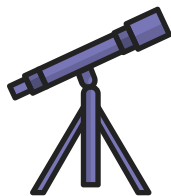


TAKING INVENTORY

TIME: 30 MINUTES

1. Look at the “Light Shielding” graphics and discuss as a group. What are the advantages of shielded light? What kind of light fixture is better for safety in the dark. Why?
2. Go outside. Use the provided Lighting Inventory Worksheet, along with the “Language of Lighting” handout to take lighting inventory of your club meeting place. Fill out each row for each outdoor lightsource you find.

Activity #3

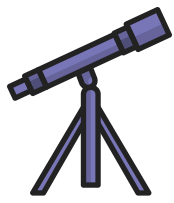


LOSING THE DARK

TIME: 7 MINUTES

1. Watch “Losing the Dark:”
<https://www.darksky.org/our-work/grassroots-advocacy/resources/losing-the-dark/>





Reflect

- How did the video make you feel about dark skies and light pollution?
- What have you learned that you would you like to share with your friends and family about dark skies and light pollution?

Apply

- What can you do to help protect dark skies? Are there simple steps you can do? What are they?

4-H MISSION MANDATES

Citizenship and Healthy Living

Club members will explore how light pollution affects their lives, specifically concerning safety, and what they can do to reduce light pollution on a personal level and advocate for positive changes in their own community.

Science

Members will learn about how different parameters of light are measured and apply them to better understand light pollution. STEM concepts are introduced that can be used to help control light pollution.

ESSENTIAL ELEMENTS

Independence

Members are asked to think about actions they can personally take to reduce light pollution.

Generosity

Youth will learn to think about beings other than themselves when it comes to environmental issues and the importance of making positive changes for everyone with their knowledge.

Mastery

This lesson combined with the information learned previously should instill a sense of motivation and subject mastery in the club members.





Explore More on Your Own!

New Lighting Gives Sea Turtle Hatchlings a New Lease on Life:

<https://www.nfwf.org/seaturtles/Pages/Gulf-sea-turtle-lighting-project.aspx>

Light Pollution Mitigation:

<https://utah.maps.arcgis.com/apps/Cascade/index.html?appid=184805c9454f43ba926189e5be66aca5>

The Value of Darkness:

<https://utah.maps.arcgis.com/apps/Cascade/index.html?appid=bf43db5671f54d2188253c4323e09278>

Planning for Dark Skies:

<https://utah.maps.arcgis.com/apps/Cascade/index.html?appid=80eb596792584845b4cab3f4b0d214b5>

Protecting Dark Skies in Utah:

<https://www.arcgis.com/apps/Cascade/index.html?appid=793c60e116fc4f358bf57cfe165c74b1>

Find Dark Sky Friendly Lighting:

<https://www.darksky.org/our-work/lighting/lighting-for-industry/fsa/fsa-products/>

Outdoor Lighting:

<https://www.darksky.org/our-work/lighting/>

How to Evaluate Light Pollution Where You Live and Conduct a Lighting Survey:

<https://www.darksky.org/our-work/lighting/lighting-for-citizens/lighting-basics/>

Dark Sky Assessment Guide:

http://www.darksky.org/wp-content/uploads/bsk-pdf-manager/2019/01/Dark-Sky-Assessment-Guide-Update-12_20_18.pdf





Why Fight the Light?



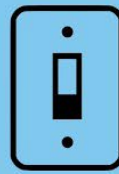
2/3 of songbirds migrate at night.



Join the initiative. Take the Lights Out Pledge at

www.tracyaviary.org/LightsOutSaltLake

Light pollution from cities can disorient these birds.

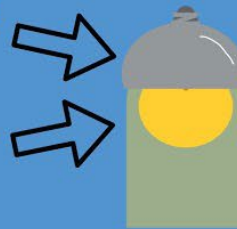


Turn off lights from **11 PM until 6 AM** during migration seasons (March-May and August-October).

These confused birds can then collide with buildings.



Shield your bulbs to direct light down. Choose warm white or yellow bulbs.



The collisions happen in Salt Lake City and all over North America, killing millions of birds per year.



Reduce energy costs. By participating, you'll save money every season!



The problem is complex, but the solution is simple.



What's more: when birds can see the stars, we can too!



Shielded lights help bring out the stars.

Exposed Light **Exposed Light** **Partial Shield** **Full Shield**

Simple steps preserve dark skies:

- ☐ Light only **where** you need it.
- ☐ Light only **when** you need it.
- ☐ **Shield** light fixtures to **direct** light downward.
- ☐ Use the **minimum** amount of light necessary.
- ☐ Use light bulbs with an **amber color temperature** of 3000-Kelvin or lower.
- ☐ Keep indoor light **inside**. Close blinds and curtains when lights are on at night.

LED is not always dark sky friendly.
LED lights can be overly bright and blue white. Dark sky friendly lights have lower lumens (less bright) and lower Kelvins (warm in color).

Lumens = brightness of the light.

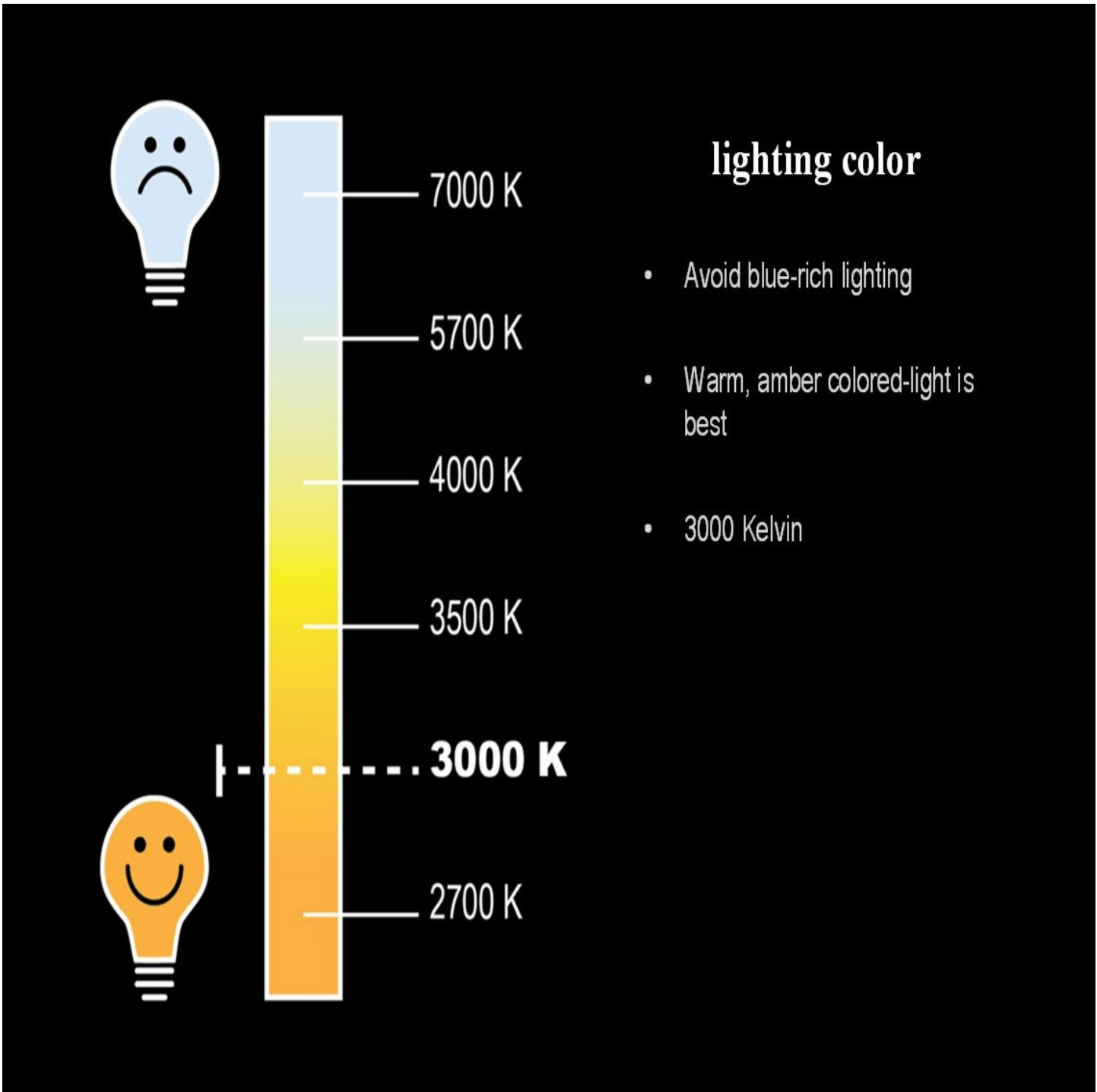
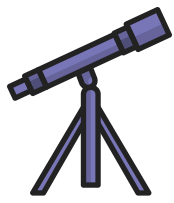
Low	450 L	600 L	800 L	1100 L	1600 L	2000 L	2800 L	Bright
	←							→
	Lower outdoor light is dark sky friendly.							

Kelvin = color spectrum of the light.

Warm white	1000 K	2000 K	3000 K	4000 K	5000 K	6000 K	7000 K	Cool white
	←							→
	Warm light is dark sky friendly.							

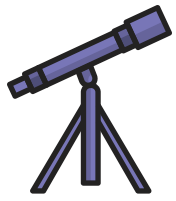
Light courtesy in the park.





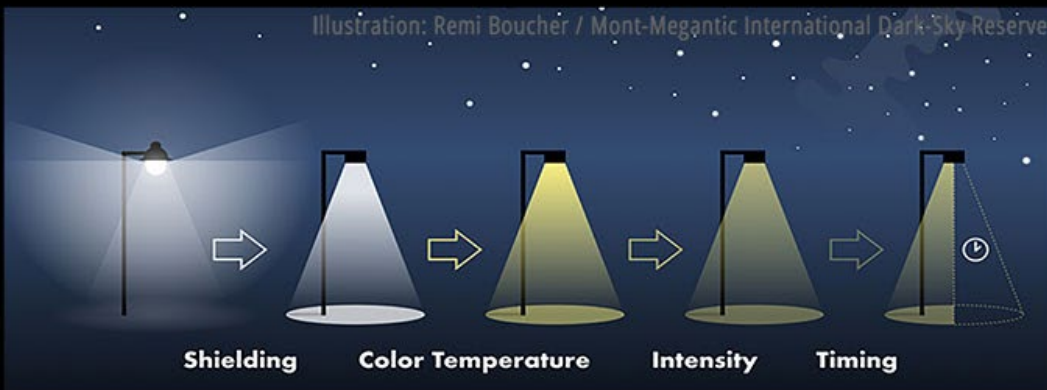
Graphics by Monica Stamm for Utah Division of Parks and Recreation Dark Sky Initiative





Light Pollution Solutions

Illustration: Remi Boucher / Mont-Mégantic International Dark-Sky Reserve





“Brighter” does NOT mean “Safer”



Knock. Knock.



Who's there?



Night Vision: Your pupils constrict in bright light. This diminishes your eyes' ability to adapt to low-light conditions.

Visibility Photo by George Fleener

Graphics by Monica Stamm for Utah Division of Parks and Recreation Dark Sky Initiative





Lighting Inventory for _____							
Type of Light	Drawing of fixture and where the light shines	Is the light shielded appropriately?	LUMENS: Is it too bright, just right, or not bright enough?	KELVIN: What do you think light's color temperature is? (1500k-8000k)	How many of this fixture do you see?	What is the purpose of this light?	Do you think this light is causing unnecessary light pollution?
Streetlamp (in parking lot)		No	Too bright	4500k	4	Lights the parking lot so people are safe and can find their cars.	YES
Streetlamp (on street)		Yes	Just right	2700k	6	Lights the street so drivers can see the road.	NO





Supplies

- Binoculars
- Telescope
- Red lights or red balloons or red cellophane to put over flashlights (Red light does not impair your night vision like other colors of light on the spectrum do.)

INTRODUCTION

This meeting will be a culmination of the Dark Sky studies we have done over the past five meetings. Club members will learn to use telescopes, observe the night sky, share our constellation stories, and celebrate the night sky.

PRIOR TO MEETING

- Decide which activity option below is most suitable for your club and plan accordingly.
- Remind club members to bring their original constellations from Club Meeting 2.

Activity #1



ATTEND A STAR PARTY IN YOUR AREA

TIME: 1-2 HOURS

Luckily for us, nowadays many state and national parks, museums, observatories, astronomical societies, and universities throw star parties. Check websites and Facebook pages of these institutions in your area to find one near you. If you are having a hard time locating a star party near you, check out these links and don't feel shy about contacting the people on the websites below. Please note that these resources are Utah based. If you do not live in Utah, google star parties near your area.

Once you find a location and are waiting for the sky to get darker and darker, this is the time to sit in a circle and try to find each club member's constellation from Club Meeting 2. Go around in a circle and let each member guide you to their constellation and tell their constellation's story.

- Salt Lake Astronomical Society:
<http://slas.us/>
<https://www.facebook.com/UtahStarParty/>
- Clark Planetarium Community Events:
<https://slco.org/clark-planetarium/events/>





- Ogden Astronomical Society:
<http://www.ogdenastronomy.com/>
- Utah Valley Astronomical Association:
<http://www.uvaa.org/>
- University of Utah South Physics Observatory:
<https://observatory.astro.utah.edu/>
- Southern Utah Space Foundation:
https://www.facebook.com/pg/SouthernUtahSpaceFoundation/events/?ref=page_internal
- Utah Astronomy Club:
<https://www.facebook.com/groups/638816972950322/>
- Utah Valley Astronomy Club:
<https://www.facebook.com/groups/utahvalleyastronomyclub/>
- Northern Utah Astronomy Club:
<https://www.facebook.com/Northern-Utah-Astronomy-Club-246393658730671/>
- Utah County Astronomy Club:
<https://www.facebook.com/utahcountyastro/>
- Utah State Parks Dark Sky Initiative:
<https://stateparks.utah.gov/resources/utah-state-parks-dark-sky-initiative/>
- Find a Certified Dark Sky Viewing Area in Utah:
<https://www.visitutah.com/places-to-go/dark-sky-parks/>

Activity #2



PLAN YOUR OWN STAR PARTY

TIME: 1-2 HOURS

You don't have to wait for a major Star Party in your area to view the wonders of the night sky. Throw your own Star Party! Here are some resources to help you plan:

<https://www.skyandtelescope.com/observing/recipe-for-a-happy-public-star-party/>

<https://www.space.com/33031-how-to-throw-a-star-party.html>

<https://www.astrosociety.org/education/k12-educators/project-astro-how-to-manual-star-party-ideas/>

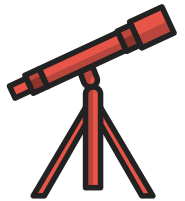
1. Plan to hold your star party at a place that gets very dark and has a wide view of the sky. Even if you live in an urban area, try to find a location that offers as wide a view of the sky as possible, free from obstructions such as tall buildings and is as dark as possible.





2. Plan to hold the event on an evening with clear skies (a few passing clouds are fine) at a time during the month when the moon is in its new (not visible) phase up to its quarter phase for best star viewing. It is really fun to look at the moon too.
3. Go to <https://eclipse.gsfc.nasa.gov/SKYCAL/SKYCAL.html> and use the search tools on the page to find out which lunar phases are happening on what days and when celestial events like meteor showers and lunar eclipses will be happening.
4. You could also plan your star party for a night that the International Space Station is passing over your area. The Space Station can be seen by eye or through binoculars. It will appear as a steady white pinpoint of light moving across the sky. Visit NASA's Spot the Station website for a schedule: <https://spotthestation.nasa.gov/sightings/index.cfm>
5. Keep monitoring weather sites to make sure you will still have mostly clear skies the night of your star party. Hold your star party at a facility with shelter in case and plan enough activities to entertain the kids if the weather turns bad. You can always go back outside when the weather clears. You may also want to check weather-related web sites for forecasts of your area.
6. Make sure everyone has red coverings over their flashlights. The longer our eyes are in the dark, the better we can see celestial objects. If people shine flashlights and other white light, our eyes have to adjust all over again every time. Red lights do not interfere with our night vision as much. So, if you have to shine a light, make sure it is red!
7. As you are waiting for the sky to get darker and darker, this is the time to sit in a circle and try to find each club member's constellation. Go around in a circle and let each member guide you to their constellation and tell their constellation's story.

Activity #3



VISIT AN OBSERVATORY OR A PLANETARIUM

TIME: 1-2 HOURS

1. Use the following resource to find an observatory or planetarium near you. If you live outside of Utah, you can google other observatories for your state.
<http://www.go-astronomy.com/observatories-state.php?State=UT>
2. At some point in your visit, be sure to make the time to sit in a circle and let each member tell their constellation story.





Reflect

- How did you feel when you were able to see farther into space than you ever had before?
- What were the most interesting celestial objects you observed? Why?
- Could you find your personal constellation?
- Which constellation stories did you find most interesting? Why?
- What was your favorite thing you studied about Dark Skies?
- How dark was the night sky when your grandparents were your age?
- How dark will the night sky be for your own children?

Apply

- Your dark sky journey has just begun! What are you going to do next with what you have learned?
- Make a goal list such as:
 - Share your knowledge by volunteering to help a state or national park with their Dark Sky programs and Star Parties.
 - Do a lighting inventory for the outside of your house/apartment building/yard/farm. Can you make dark sky-friendly lighting changes such as shielding light fixtures and changing bulbs to warm spectrum (yellow to red toned) Kelvin and low lumens?
 - Remember to turn off lights if you are not using them.
 - Remember to draw shades or curtains at night so your inside house lights don't escape outside.





4-H MISSION MANDATES

Science

Members will understand light pollution, its effects on humans and animals and how they can use STEM concepts to control light pollution.

Healthy Living

Club members will explore how light pollution affects their lives, specifically concerning safety, and what they can do to reduce light pollution on a personal level and advocate for positive changes in their own community. Youth are also encouraged to spend more time outdoors observing the night sky improving their well-being.

ESSENTIAL ELEMENTS

Belonging

By sharing their creative constellation stories as a group, youth can communicate their ideas in an inclusive environment.

Independence

Members will apply the new information they have learned to their personal lives and discuss actions they can take to reduce light pollution.

Generosity

Members learn by the example of their adult volunteers that volunteering is valuable to our communities. They will learn to think about entities other than themselves when it comes to environmental issues.

Mastery

The accumulation and reflection of their knowledge gained over the club meetings provides a sense of mastery and empowers youth to further investigate the night sky individually and lead family activities.





More to *Discover*

Congratulations on completing your Discover 4-H club meetings! Continue with additional curriculum in your current project area, or discover other 4-H project areas. Check out the following links for additional 4-H curriculum:

1. www.discover4h.org
2. <http://www.4-h.org/resource-library/curriculum/>
3. <http://utah4h.org/curriculum/>

Become a 4-H Member or Volunteer

To **register** your Utah club or individuals in your club, visit and contact your county Extension office:

<http://utah4h.org/about/>

<http://utah4h.org/join/index>

For help registering in 4-H online, visit:

<http://utah4h.org/staffresources/4honlinehelp>

Non-Utah residents, please contact your local 4-H office:

<http://www.4-h.org/get-involved/find-4-h-clubs-camps-programs/>



Stay *Connected*

Visit Your County Extension Office

Stay connected with 4-H activities and news through your county Extension office. Ask about volunteer opportunities, and don't forget to register for your county newsletter. You can find contact information for counties in Utah here:

<https://extension.usu.edu/locations>

Enjoy the Fair!

Enter your project or create a new project for the county fair. Learn about your county fair and fair judging here:

<http://utah4h.org/events/index>



Participate in Local or State 4-H Activities, Programs, Contests, or Camps

For Utah state events and programs, visit:

<http://utah4h.org/events/index>

<http://utah4h.org/projects/>

For local Utah 4-H events and programs, visit your county Extension office:

<https://extension.usu.edu/locations>

Non-Utah residents, please contact your local 4-H office:

<http://www.4-h.org/get-involved/find-4-h-clubs-camps-programs/>



Discover *Service*

Become a 4-H Volunteer!

 <http://www.youtube.com/watch?v=UBemO5VSyK0>

 <http://www.youtube.com/watch?v=U8n4o9gHvAA>

To become a 4-H volunteer in Utah, visit us at:

<http://utah4h.org/join/becomevolunteer>

Serve Together as a 4-H Club or as an Individual 4-H Member

Use your skills, passions, and 4-H to better your community and world. You are needed! Look for opportunities to help in your area or participate in service programs that reach places throughout the world (religious groups, Red Cross, etc.).

Hold a Club Service Project

USU Collegiate 4-H Club hosted "The Gift of Giving" as a club activity. Club members assembled Christmas stockings filled with needed items for CAPSA (Community Abuse Prevention Services Agency).

<http://tinyurl.com/lu5n2nc>



Donate 4-H Projects

Look for hospitals, nursing homes, or other nonprofit organizations that will benefit from 4-H projects. Such projects include making quilts for CAPSA or Primary Children's Hospital, or making beanies for newborns. During Utah 4-H State Contests, 40 "smile bags" were sewn and donated to Operation Smile.

Partner with Local Businesses

92,000 pounds of processed lamb, beef, and pork were donated to the Utah Food Bank in 2013 by multiple companies.

<http://tinyurl.com/pu7lxyw>

Donate Money

Clubs or individuals can donate money gained from a 4-H project to a worthy cause. A nine-year-old 4-H member from Davis County donated her project money to help a three-year-old battle cancer.

<http://tinyurl.com/mqtfwxo>



Give Us Your *Feedback*

Help us improve Discover 4-H curriculum. We would love feedback or suggestions on this guide.

Please go to the following link to take a short survey: [Click here to give your feedback](#)

or go to: <https://goo.gl/iTfiJV>