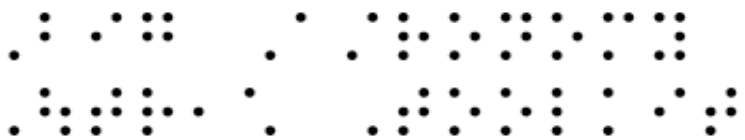
Outreach Toolkit

For Blind and Low Vision Audiences



big astronomy
people+places+discoveries

More activities: bigastronomy.org/education

ASP
ASTRONOMICAL SOCIETY of the PACIFIC

Welcome to the Big Astronomy Outreach Toolkit for Blind and Low Vision (BLV) audiences. This collection of activities and demonstrations support the Big Astronomy planetarium show. This Toolkit has four themes and three activities designed for use by museum professionals working with BLV and sighted visitors:

- Multi-wavelength astronomy gives a more complete picture of the cosmos.
- Astronomers need clear, dark skies for observing - all found in Chile.
- Astronomy is open to everyone, and there are many ways to become involved.
- The study of astronomy is deeply rooted in cultures around the world.

Each activity has a **Public Page** to engage audiences with open-ended questions and a **Facilitators Page** to give additional support, background, and extensions. This stimulates conversation with visitors and adds to their authentic understanding of the concepts. Also included is a **Best Practices** guide for working with BLV audiences in museums.

Find all Toolkit materials, along with supporting activities and extensions on the Big Astronomy Education page: bigastronomy.org/education and Night Sky Network website: bit.ly/bigastro

The **Big Astronomy planetarium show** debuted in 2020, and includes supporting live conversations with astronomers, educators, observatory staff, and more. At the time of this printing, there is also visual description version being created. All of these resources, as well as an Educator Guide with activities for classroom instruction, are available on the Big Astronomy website: bigastronomy.org

The Toolkit activities were designed and tested by the **Astronomical Society of the Pacific** (ASP astrosociety.org) in collaboration with many experts in BLV education. This set of activities owes its creation to our colleagues in the accessible education community, including Ken Quinn, Tactile Graphics Evaluator; David Hurd, Pennsylvania Western University; Cassandra Runyon, College of Charleston; Noreen Grice, You Can Do Astronomy; Cherilynn Morrow, Southwest Research Institute; Dan Gardner & Leanne Curtin at ViewPlus; special thanks to Nicole Johnson & Tom Yeh & John Keller at University of Colorado Boulder.

Big Astronomy is a collaboration between Abrams Planetarium at MSU, Associated Universities Inc. (AUI), Association of Universities for Research in Astronomy (AURA), Astronomical Society of the Pacific (ASP), California Academy of Sciences, Peoria Riverfront Museum, Ward Beecher Planetarium at YSU, Atacama Large Millimeter-submillimeter Array (ALMA), Vera C. Rubin Observatory construction project, NSF's NOIRLab facilities Cerro Tololo Inter-American Observatory (CTIO), and the international Gemini Observatory. Big Astronomy is supported by the U.S. National Science Foundation (Award #: 1811436)

SHOW SUMMARY

This 2-page summary comes from the Big Astronomy Educational Guide for teachers. The full guide is found on the main website: bigastronomy.org

Big Astronomy: People, Places, Discoveries explores three observatories located in Chile, at extreme and remote places. It gives examples of the multitude of STEM careers needed to keep the great observatories working. The show is narrated by **Barbara Rojas-Ayala**, a Chilean astronomer.

A great deal of astronomy is done in the nation of Chile, due to its special climate and location, which creates stable, dry air. With its high, dry, and dark sites, Chile is one of the best places in the world for observational astronomy. The show takes you to three of the many telescopes along Chile's mountains.

The first site we visit is the Cerro Tololo Inter-American Observatory (CTIO), which is home to many telescopes. The largest is the Victor M. Blanco Telescope, which has a 4-meter primary mirror. The Blanco Telescope's mirror focuses light onto a large lens, which is part of an instrument called the Dark Energy Camera. Here we meet **Marco Bonati**, who is an Electronics Detector Engineer. He is responsible for what happens inside the instrument. Marco tells us about this job, and needing to keep the instrument very clean. We also meet **Jacoline Seron**, who is a Night Assistant at CTIO. Her job is to take care of the instrument, calibrate the telescope, and operate the telescope at night. Finally, we meet **Kathy Vivas**, who is part of the support team for the Dark Energy Camera. She makes sure the camera is producing science-quality data.

The Dark Energy Camera was designed to peer into the farthest reaches of the Universe. But it has also been used to find thousands of small icy bodies far out in the Solar System, beyond Neptune, in the Kuiper Belt. These small icy worlds help us understand the history of our Solar System.

On Cerro Pachón, we visit another telescope called the Gemini South Observatory, which has an eight meter primary mirror. We meet **Vanessa Montes**, an Electronics Engineer who describes how well the teams work together at the telescopes. We also meet **Alysha Shugart**, Science Operations Specialist, who operates the telescope at night. An instrument on Gemini South called the Gemini Planet Imager helps us see planetary systems as they are just forming.

We now travel farther north in Chile to the Atacama Desert, one of the driest places on Earth, to the Atacama Large Millimeter/submillimeter Array, or ALMA. People have observed the stars here for millennia. Here we meet **David Barrera**, president of the indigenous community of San Pedro de Atacama, which is near ALMA. He feels the cosmos walks with him. It is part of the community, part of their life. People and the cosmos make up a single unit. ALMA looks to unite scientific knowledge to indigenous knowledge.

ALMA is made of 66 radio antennas that work together, observing the sky in unprecedented detail, both night and day. The antenna array is located in an area known as the Chajnantor Plateau at an altitude of over 5000 meters. The extremely thin, dry air at Chajnantor is essential to successful observations at millimeter and submillimeter wavelengths. Each antenna dish weighs about 100 tons, and they needs to move from place to place to make different kinds of observations and receive maintenance. **Alfredo Elgueta** is one of only four people trusted to operate the transporter that moves the antennas. The antennas collect a huge amount of data. Because they work as a network, data from each antenna is compared to data from every other one. **Cella Verdugo**, an astronomer and data analyst, collects and studies these observations for astronomers around the world. ALMA has given us close up images of young planetary systems.

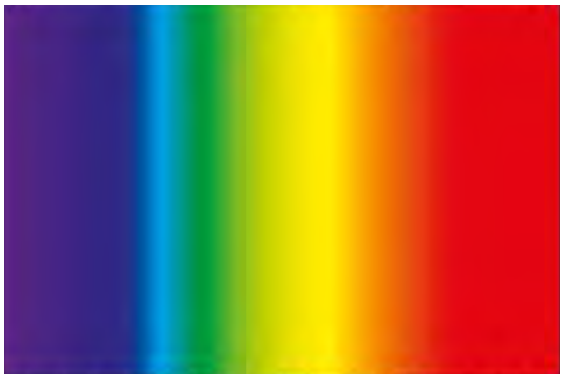
The show closes by previewing a new observatory that is being built in Chile, which will generate 20 terabytes of data every night. The data will be freely available to the world, enabling anybody to make the next great discovery.

All of the people we meet in the show come from different backgrounds, with many different talents and skills to contribute to Big Astronomy.

In a Different Light

It takes many types of light to learn about the Universe

Have you heard of the types of light beyond visible?



Which light do we use to see our bones?

Another type of light can cause sunburn!

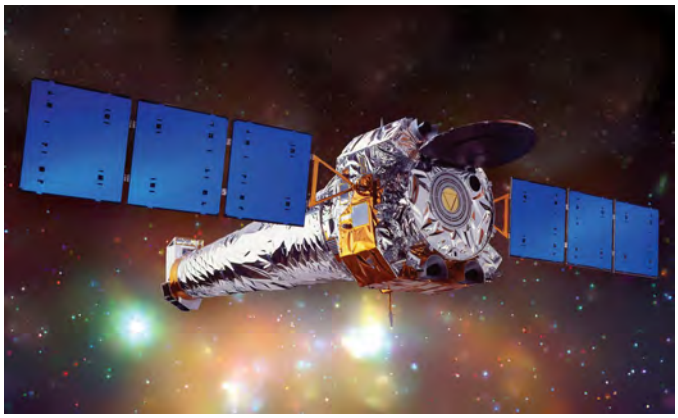
Astronomers study many types of light to get a more complete understanding.

big astronomy
people+places+discoveries

More activities: bigastronomy.org/education

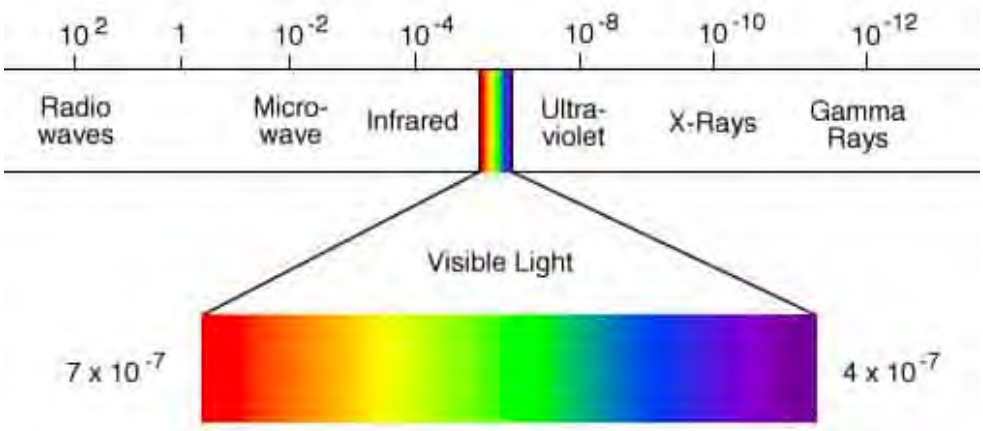
ASP
ASTRONOMICAL SOCIETY of the PACIFIC

The Chandra space telescope detects x-rays.



By NASA/CXC/NGST

X-ray light allows astronomers to see high-energy objects like black holes!



https://commons.wikimedia.org/wiki/File:Electromagnetic_spectrum_2.jpg

Looking at the full spectrum of light allows us to better understand our Universe.

big astronomy
people+places+discoveries

ASP
ASTRONOMICAL SOCIETY of the PACIFIC

Notes for the Presenter

In a Different Light

Time: 5-10 minutes
Visitors: General audience, ages 10+
Venue: inside, tabletop.

Learning Goals

- There are many types of light and the visible spectrum is just a small part.
- Different telescopes detect light beyond the visible spectrum to gain a more complete picture of our universe. (One telescope in the planetarium show detects radio waves.)

Materials

- Supernova 1987 A thermoforms (Key and Combined image)
- Picture of Supernova https://hubblesite.org/contents/media/images/2017/08/3988-Image.html?news=true

Leading questions

1. **"What have you heard about the different types of light beyond visible light?"** (Listen to responses, give hints if needed, e.g., "our bodies detect heat which is a type of light." (infrared light) "We listen to this in our car" (radio) "Sunscreen protects you from this type of light" (UV) "What type of light lets you see your bones?" (x-Ray)

2. Astronomers use different telescopes that detect these different types of light. Why do you think they need to do that? (To give them different information about the Universe to get a complete picture.) For example, a supernova is a very violent explosion that happens at the end of a massive star's life. A supernova produces many different types of light and observing each type gives astronomers as much info about the explosion as they can get.

3. Pass out the thermoforms, being sure to tell participants which direction it is being passed - the tactile will be coming on your left. Explore how each of the telescopes provided different flavors of light that make up our understanding of Supernova 1987A.

Describe what they will touch

In front of you are two thermoform pages with three textures on one and one bigger picture composed of those different textures. In the texture key, we have 3 images from different telescopes that detect different types of light:

a. Left – ALMA - planetarium show - radio waves. ALMA captures details about the very first stars and galaxies, the center of our Milky Way Galaxy, and directly images the formation of planets.
b. Center – Hubble - visible light. Shows where stars are.
c. Right – Chandra - x-ray. Shows high energy objects and events like supernovae, quasars, and black holes.

Each type of light is represented by a different texture. The top image has all three types of light and all three textures together.

4. **Activity wrap-up**

Say: "There are even more types of light and detectors than we've shown here. If you want to learn more about how astronomers use different types of light, and even gravity to learn about the universe, go here: https://science.nasa.gov/ems/"

Additional Resources

- An overview of light (topics such as wavelengths, frequency, and what different types of light tell us.) https://hubblesite.org/contents/articles/the-electromagnetic-spectrum
- A fun site to be an astronomer and color sky objects https://public.nrao.edu/color/
- See the ALMA live webcam: public.nrao.edu/alma-webcam/

Big Astronomy is supported by the U.S. National Science Foundation (Award #: 1811436)

Legends in the Sky

Making Meaning of the Stars

Since before recorded history, humans have looked up at the sky in awe and wonder.

Why do you think cultures around the world have different sky legends?

big astronomy
people+places+discoveries

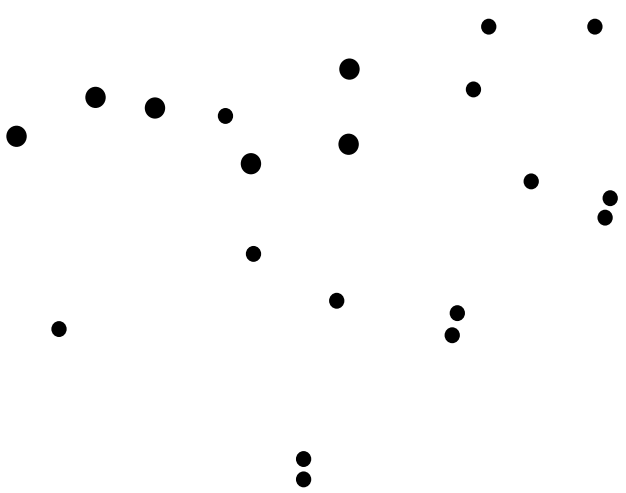
More activities: bigastronomy.org/education

ASP
ASTRONOMICAL SOCIETY of the PACIFIC

Compare the star field below, left with the Sami people's interpretation on the right.

They tell of the bow and arrow of a great hunter.

Star Field



Constellation

Do you know any sky legends?

Who would you honor with a place in the sky?

big astronomy
people+places+discoveries

More activities: bigastronomy.org/education

ASP
ASTRONOMICAL SOCIETY of the PACIFIC

Notes for the Presenter

Legends in the Sky (Tactile)

Learning Goals

1. Cultures throughout time have found meaning in the stars.
2. Constellations are made up of stars together forming a pattern.

Time: 10-15 minutes
Visitors: General audience, ages 10+
Venue: inside, tabletop.

Materials

- 4 Dubhe tactile pages

Advance preparation: Be sure to read the list of best practices for working with Blind and Low Vision visitors.

Introduction: Humans create patterns and mental maps to make sense of our world, including the stars in the sky. Many cultures have seen the bright stars around the North Star, and they crafted legends relevant to them.

Describe what they will touch: In front of you, there is a page with two star fields, where raised dots represent stars. On the bottom left hand side, you'll feel the stars as they are arranged in the sky. In feeling these stars, you may start to have a mental picture of where the stars are. On the right, you can find one culture's interpretation of these stars as a constellation.

Say: Explore these four other interpretations of the same stars from different cultures. Ask yourself "**Why might a culture imagine this in the sky?"** (Pass them around one at a time; be sure to say if you are starting on the left or right, so visitors know where to find them.)

Summing up: Cultures around the globe have made Legends in the Sky. They often honor things important to their culture – values, people, or animals – or indicate a time of year, such as a time for migration or planting. These legends are passed down through generations and share what each culture values.

Ask: "Do you know any sky legends?" and/or
"Who would you honor from your life with a place in the sky?"

Respecting the legends of other cultures:

It is important to understand that, far more than merely stories, the figures seen in the sky often represent ancestors, important Indigenous knowledge, and even stories not told outside a culture, or only told by certain revered members of the culture. By giving only the name of the figure, not the entire story, we are recognizing that the sky is important to cultures around the world and that the Greek constellations used by the astronomical community are just one way to interpret the sky. We use the word “legends” not “stories” because for some cultures, these are more than stories – sometimes ancestors are memorialized in the sky or it is a part of a larger belief system.

Constellation notes:

The International Astronomical Union divides the entire sky into 88 constellations - regions often surrounding the Greek version of the constellations. Amateur and professional astronomers use these to indicate where an object is in the sky in the same way one might use states to tell the location of a park. So, Zion National Park is in Utah while the Sombrero Galaxy is in the constellation Virgo. The boundaries of Utah and Virgo are both invented and useful.
The Northern and Southern Hemispheres see the constellations flipped upside down from each other. So, the foot of a dancing man in Australia may be the shoulder of Orion to people in the Northern Hemisphere.

To learn more:

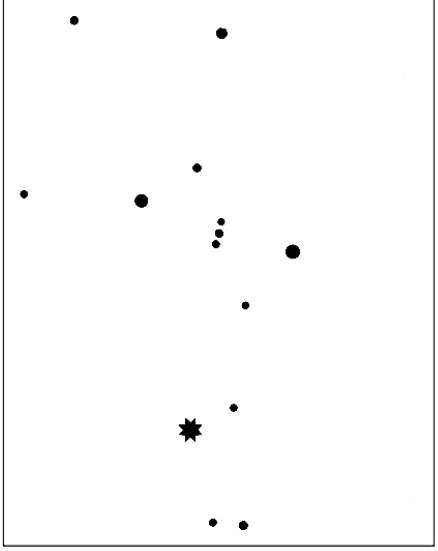
- Figures in the Sky: www.datasketch.es/may/code/nadieh/
- Native Skywatchers: www.nativeskywatchers.com/
- Astronomy of Many Cultures Resource Guide: astrosociety.org/file_download/inline/eb3601be-8e70-4f11-8e12-3c8c5b52e66a
- The Royal Astronomical of Canada is collecting and tending the World Asterism Project: www.rasc.ca/world-asterism-project

Big Astronomy is supported by the U.S. National Science Foundation (Award #: 1811436)

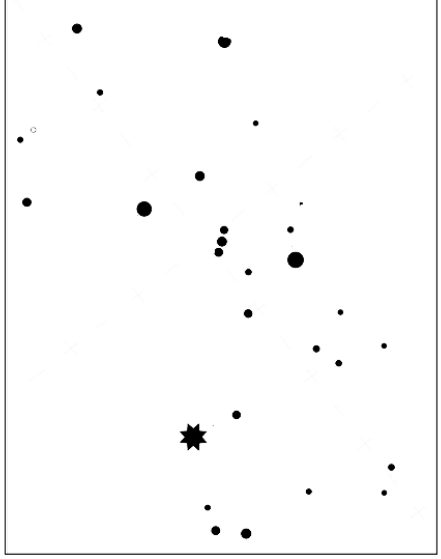
Losing the Night

What do you notice about Orion as seen from these different locations?

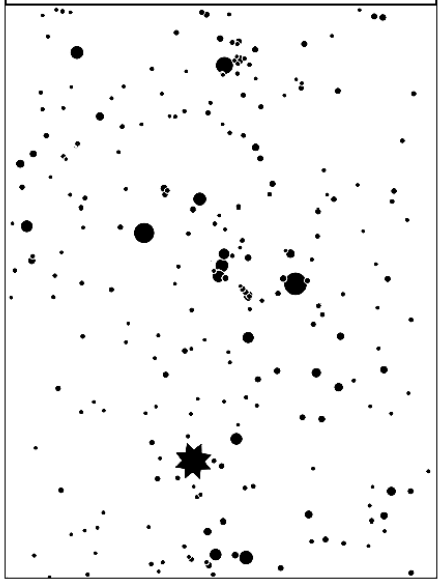
City Sky



Suburban Sky



Rural Sky



What could be causing the difference?

big astronomy
people+places+discoveries

More activities: bigastronomy.org/education

ASP
ASTRONOMICAL SOCIETY of the PACIFIC

Astronomers need **clear, dark skies.** Most of Earth's large telescopes are located in the high deserts of Chile, in some of the darkest skies in the world because these sites:

Image above of the telescopes on Cerro Tololo.
Image Credit: NOIRLab/NSF/AURA

- Are above much of the atmosphere
- Have still, dry air that does not distort the light
- Are in local communities that share a commitment to dark skies
- Have the infrastructure and workforce to support big science

big astronomy
people+places+discoveries

More activities: bigastronomy.org/education

ASP
ASTRONOMICAL SOCIETY of the PACIFIC

Notes for the Presenter
Losing the Night (Tactile)

Time: 5-10 minutes
Visitors: General audience, ages 10+
Venue: inside, tabletop.
Orion is visible winter and spring
Cygnus in the summer and fall

Learning Goals

1. Understand the impact of lighting on our ability to see the night sky.
2. Understand that stars do not all have the same brightness.
3. Understand how light pollution affects the visibility of stars.

Materials

- Light Pollution: A tactile View of Urban vs Rural Skies –sservi.nasa.gov/books

Facilitation Notes

What have you heard about light pollution? Just like water and soil pollution, light pollution diminishes our connection to our environment. Can you think of any other types of pollution? Humans throughout history have spent long hours looking at the night sky. It's our cultural heritage and it is being altered.

To encourage exploration of the tactile book, ask visitors the following questions:
1. How many stars can you count in this image? Note, not ALL the stars on this tactile are labeled.
2. What do you notice about the sizes of the stars?
3. How many different sizes can you find? (hint: there are fewer than 8 sizes)

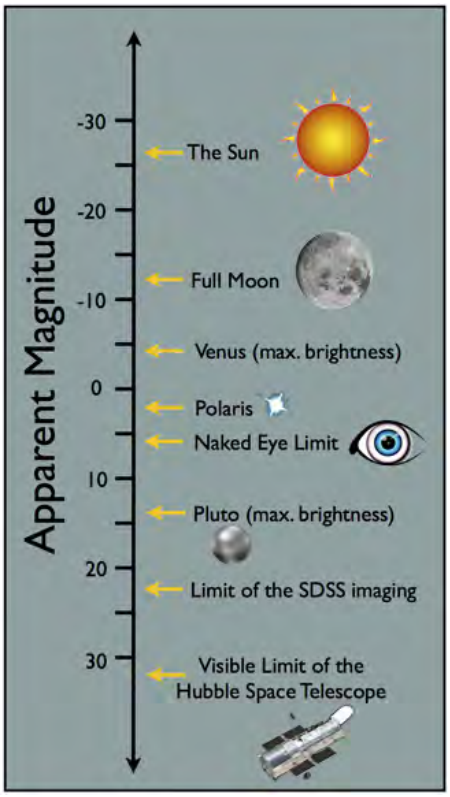
So what? Who cares if it's bright out? Light pollution affects our sleep cycles, and the migration of many animals, including young turtles and many birds. While many think that more lights mean better safety, that is not always the case. More lighting can cause glare and other distractions that make us less safe.

Be a scientist! Record your observations at globeatnight.org and add to a global database of sky brightness.

Background Information

Why do you think some stars are brighter than others? It could be their distance or how big and bright they are. Some stars are also different colors!

Magnitudes listed here are **apparent magnitudes**, or the brightness of an object *as seen from here on Earth* (as opposed to the absolute magnitude of an object, a measurement of the light it emits). It is an inverse log scale, with higher numbers indicating dimmer stars.



Scale of magnitudes from SDSS Voyages for teachers. Find more information and many exciting activities. voyages.sdss.org

Virtual and Hands-on Presentation Extensions

- This activity complements the light shielding activity **Good Light, Good Night** provided in the Big Astronomy kit or at bit.ly/bigastro
- Tell constellation legends and have visitors create their own with the **Legends of the Night Sky** activity, also in this Toolkit.
- Explore the effects of light pollution on the night sky with Light Pollution Interactive globeatnight.org/light-pollution.php

Additional Resources and Credits

The Light Pollution Tactile book (sservi.nasa.gov/books) and accompanying challenge questions were created by David Hurd of Pennsylvania Western University, Cass Runyon at the College of Charleston, Joseph Minafra at SSERVI, and Ken Quinn.

Support provided by SSERVI, and the NASA Science Mission Directorate, and NASA grant #NNA141Bo1A

Big Astronomy is supported by the U.S. National Science Foundation (Award #: 1811436)

big astronomy
people+places+discoveries

More activities: bigastronomy.org/education

ASP
ASTRONOMICAL SOCIETY of the PACIFIC

Best Practices for Welcoming Visitors

With Blindness / Low Vision

Created to accompany the Big Astronomy Outreach Toolkit for Blind and Low Vision Audiences bigastronomy.org/education

Many of us would like to welcome more visitors with blindness or low vision (B/LV) to our museums and events. Here you will find a list of best practices compiled from several sources (included with the additional resources) to help museums become more inclusive in our public engagement.

In Advance

1. Have information on your "plan your visit" webpage regarding available accommodations, especially if any part needs to be reserved in advance. If your site offers field trips, ask for any accommodations needed on the request form.
2. Have a written description of your layout rather than (or in addition to) a picture. Example: "The planetarium is on the right, down a wide hallway about 30 ft from the front entrance."
3. It's easy to make your website friendly for text readers. A text reader is a software program or app that reads text aloud. Some sites that can help you find out if your site is accessible:
    - https://www.w3.org
    - https://webaim.org/techniques/screenreader
4. Low vision visitors may have needs such as getting closer to the exhibit, size of print needed, orientation and mobility needs (how the visitor gets around), and implications of other disabilities. Be sure to list what is available.
5. Organize the workspace with B/LV visitors in mind. For example, keep items from rolling away from the work area by using a tray with sides. Orient the visitor to the tray by describing the items on the tray (or table) from left to right or referring to a clock face. Example: "The beads are at the top right side," or, "the clay is at 6 o'clock."

6. Use tactile or “real” objects with low vision or totally blind visitors. Unless the low vision visitor is a “visual learner” as indicated in their information, paper-and-pencil or crayons or paints may not be useful.
7. Review Universal Design Principles. These seven guidelines are about accessibility for everyone, not only B/LV populations.
8. Proper lighting is a must for all visual tasks. Ask what type of lighting is preferred by those with limited vision - each person may have different needs.
9. Using high contrast colors can help you distinguish one object from another. (Example: Dark tablecloth with white plates.) It’s even better if you use different textures as well.
10. Provide a schedule for the visitor, either in large print, braille or with symbols to help them anticipate the day’s activities.

During the Visit

1. Introduce yourself every time you arrive. “Hello, I’m Joanna with Guest Services.”
2. Describe in simple terms where you will go with the visitor. “We’ll be going to the planetarium. We’ll walk down this hall on the right. Then, at the end, we’ll turn right. It’s the door on the left.”
3. If the visitor needs assistance getting around, offer them your arm and have them hold on just above your elbow. **Always ask if any assistance is desired first.**
4. Be sure to let the visitor know when you are leaving the area. Example: “I’ll be right back. I’m just going down to the office to get more materials.” or “I’m leaving now. Nice meeting you.” And when you are back, let them know you are back.

General Do’s & Don’ts

When speaking with a person who has Blindness or Low Vision:

- DO identify yourself, especially when entering a room. Don't say, "Do you know who this is?"
- DO speak directly to the individual. Do not speak through a companion. Unless they are hard of hearing, they can speak for themselves.
- DO give specific directions like, "The desk is five feet to your right," as opposed to saying, "The desk is over there."
- DO give a clear word picture when describing things to an individual with vision loss. Include details such as color, texture, shape, and landmarks. (You used a comma elsewhere with lists of nouns, so I inserted a comma here.)
- DO touch them on the arm or use their name when addressing them. This lets them know you are speaking to them, and not someone else in the room.
- DON'T shout when you speak. They can't see but often have fine hearing.
- DON'T be afraid to use words like "blind" or "see." Their eyes may not work, but it is still, "Nice to see you."

If you see a Blind person who seems to be in need of assistance:

- DO introduce yourself and ask the person if they need assistance.
- DO provide assistance if it is requested.
- DO respect the wishes of the person who is blind.
- DON'T insist upon trying to help if your offer of assistance is declined.

If a Blind person asks you for directions:

- DO use words such as "straight ahead," "turn left," "on your right."
- DON'T point and say, "Go that way," or, "It's over there."

If you are asked to guide a Blind person:

- DO allow the person you are guiding to hold your arm and follow as you walk.
- DO move your guiding arm behind your back when approaching a narrow space so the person you are guiding can step behind you and follow single-file. This may be counter-intuitive, as we often want a guest to go first. In this case, leading the way is more helpful.
- DO allow the person you are guiding to find the handrail and locate the edge of the first step before proceeding.
- DON'T grab the person you are guiding by the hand, arm, or shoulder and try to steer him.
- DON'T EVER grab the person's cane or the handle of a guide's harness.
- DO refer to Sighted Guide Techniques for more information.

Steps / Signage:

- DO hesitate briefly at a curb or at the beginning of a flight of stairs.
- DO tell the person you are guiding whether the steps go up or down. And provide an approximation of the number of steps.
- If possible, adding colored grippy tape to each step is a benefit to those with low vision.
- DO follow the ADA code. Signs should be 5 feet up and on the opposite side of the hinges. This will prevent people from getting hit with the door.

General guidelines:

- DON'T pet, feed, or distract a guide dog. They are not pets; they are working companions on whom a Blind person depends.
- DO treat Blind people as individuals. People with visual disabilities come in all shapes, sizes, and colors. They each have their own strengths and weaknesses, just like everyone else.

To Learn More

Visit the National Federation of the Blind or your local chapter.

Explore the Perkins School for the Blind website.

Select Sources:

https://dhs.wisconsin.gov/obvi/adjustment/dos-donts.htm

https://www.abvimichigan.org/education/best-practices/

https://www.perkins.org/resource/10-tips-working-individuals-visual-impairments-additional-disabilities/

Additional Resources:
https://www.museumnext.com/article/making-museums-accessible-to-visually-impaired-visitors/