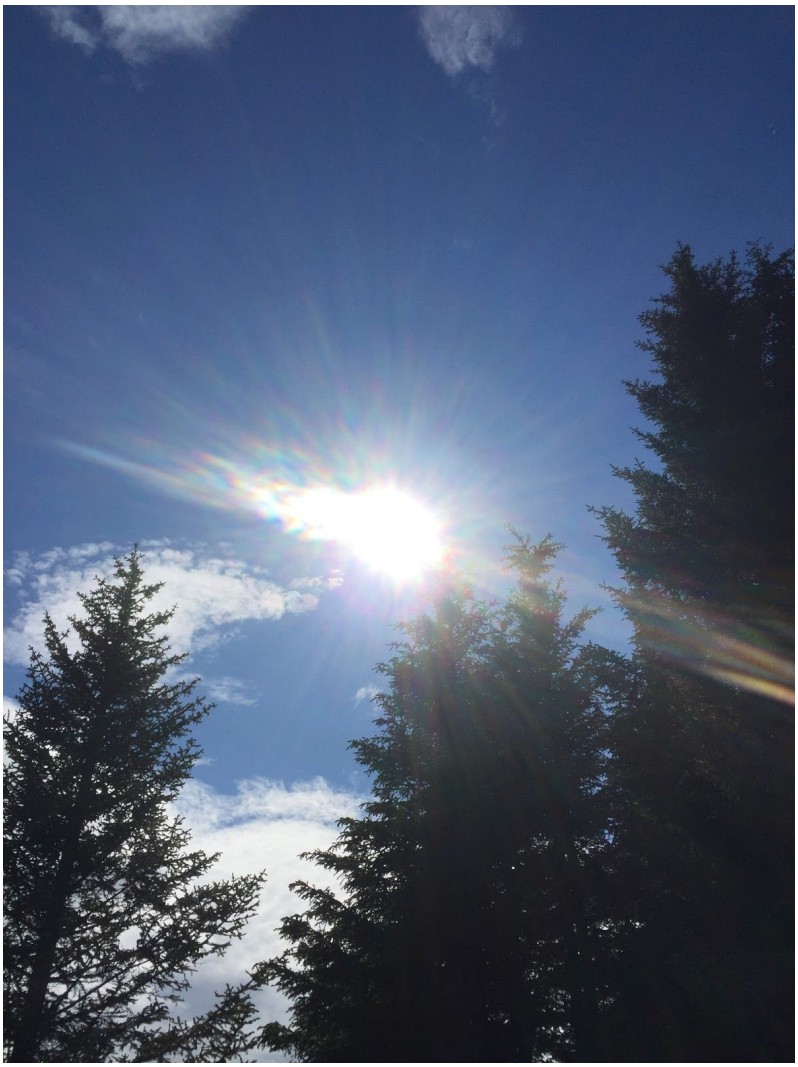
Arctic Connection

Linking Your Place to the MOSAiC Expedition

June Solstice Edition

Introduction



As I write this, it is the June Solstice. The exact moment of solstice occurred a few hours ago, at 21:44 Universal Daylight Time. This was at 1:44 pm today here in Homer, Alaska. This moment marked when Earth's north pole leaned most toward the sun, and the Earth's south pole was tilted most away from the sun.

On this day, the sun appears directly overhead at local noon for those living at 23.5 degrees north (the Tropic of Cancer), as far north as the sun ever gets. And during the December solstice, the sun appears directly overhead for those living at 23.5 degrees south (the Tropic of Capricorn).

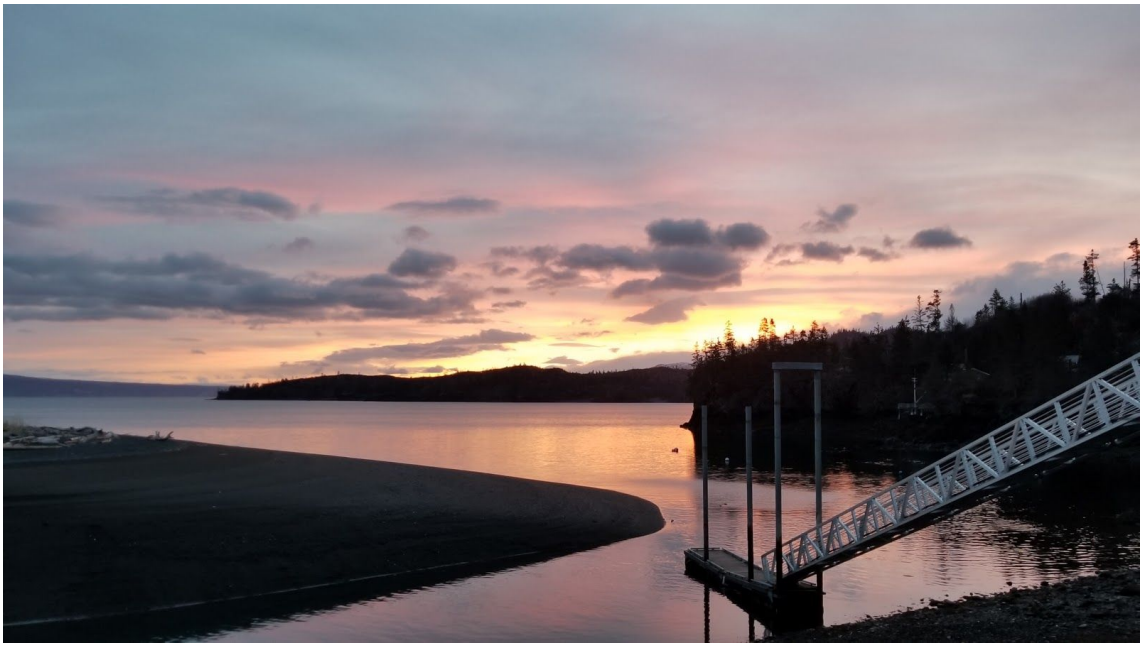
(In case you need a refresher, here's the basic science from Earth & Sky.)

In the northern hemisphere, the June Solstice is called the summer solstice and represents the day(s) with the most amount of daylight. I say days because in some parts of the northern hemisphere, the sun has stayed above the horizon for multiple days now and won't rise again until the next month. This is often called the Midnight Sun, and the ice camp at the Polarstern has been bathed in light for many days. This is good news for the scientists of Leg 4, who are just now arriving to the floe. The extended daylight will help make all of the research tasks a little bit easier than those Leg 1 and Leg 2 researchers who had to work through the Polar Night.

In Utquiagvik, Alaska (also known as Barrow) the sun rose early in the morning on Sunday, May 10 and hasn't set since. The next time the sun will dip below the horizon will be August 1, nearly two months later!

For others at mid latitudes in the northern hemisphere, the summer solstice marks a specific date and usually a time for celebration. It is the 24 hour period when there is the greatest amount of daylight, the shortest night of the year. Here in Homer, Alaska, at 59 degrees North, the sun rose at 4:50 am today and will set at 11:29 pm today. That's 18 hours and 39 minutes of daylight.

However, it doesn't really get dark here these nights, when the sun has technically set. I can't really see the stars, and I can make out lots of shapes in the twilight. This is called civil twilight. The sun isn't above the horizon, but some light from the sun is being scattered and reflected by the Earth's upper atmosphere into the lower atmosphere. We see this visible light. Today in Homer we will have a total of 21 hours and 47 minutes of visible light, from the dawn civil twilight (3:16 am) to the dusk civil twilight (1:03 am). In years past, we would play soccer from midnight to 1 or 2 am. It wasn't broad daylight, but it was possible.



But even outside of civil twilight, the darkness may not be so dark. However, nautical twilight is when most brighter stars become visible -- which is where the names come from. Mariners navigating using stars and most other celestial bodies couldn't do so outside of nautical twilight (or astronomical twilight, or night). Before astronomical dawn, the sky is absolutely dark. After astronomical dusk, the sky is also absolutely dark. This is truly night, and no sunlight is being reflected to the lower atmosphere from the upper atmosphere. (Of course, if there is moonlight, that is a different sort of reflected sunlight!) Here in Homer, we won't see this true night again until August 20, 2020.

The pattern in the southern atmosphere is the opposite. June Solstice marks the longest night(s) and shortest day(s) of the year for our neighbors on the southern side of the equator. This is when the

southern hemisphere is most tilted away from the sun for the year, and they begin the seasonal cycle of gaining daylight after this point. Their "summer solstice" happens in December.

Whether you teach in a classroom, nature center, museum, outdoor classroom, at home, or an infinite number of other places, the June Solstice marks a great time to learn more about summer ecology and adaptations as well as astronomy and seasonal cycles.

In Alaska, the summer solstice tends to be a frenetic time, as people pack in lots of activity. This year, the solstice seems to be an especially appropriate time to use some of those 'extra hours in the day' to learn about and take action to shine light on the needs and injustices in our own communities, countries, and around the world.

Art

Make some sun prints! I remember spending many sunny summer days as a child collecting interesting objects, leaves, and flowers to make sun prints with. The fastest and most detailed sun prints are made with chemically-treated paper, but you can also do simple sun prints with construction paper. Put a piece of colorful construction paper into a flat area that gets lots of sun (this could be inside on a windowsill if you are worried about rain or wind). Place objects of various shapes and opaqueness on top of the construction paper, but make sure to leave some construction paper uncovered. If the objects are light and could blow away, weigh them down with small rocks or other weights. Depending on the intensity of the light, the sun print may take more or less time. The learner can check from time to time by carefully peeking underneath one of the more opaque objects to see if the area around the object has become significantly lighter than the area obscured by the object. Once they are happy with the contrast, remove the objects and enjoy the art.

Observation

As a family or small group, decide where you want to go for a walk to look for evidence of the current season. Use your 5 senses during the walk to make about the season. Talk about these observations together, and record them and any questions that come up. This activity idea, and a great template, come from the Learning In Places project. After your walk, or while you are still outside, brainstorm and discuss reasons that this particular season is important to your family or community. Check out more of the Learning In Places project, which aims to "cultivate equitable, culturally based, socio-ecological systems learning and sustainable decision-making utilizing 'field based' science education in outdoor places." Para Familias (Spanish) or 对于家庭 (Simplified Chinese).

In the northern hemisphere, an extra boost of sunlight around the summer solstice can really fuel rapid growth of plants. This is a great opportunity to track some of this growth. Choose one or two or a few plants in your backyard or garden, a nearby field or forest, or at a sunny window inside where you live. Use a piece of yarn or ribbon or flagging to carefully mark the plant. Measure the height of the plant, or the length and width of a key leaf. Return to the plant on a regular interval (every day, every 3 days, every week) to measure it again. Use graphs or other visual means to track how much the plant grows in

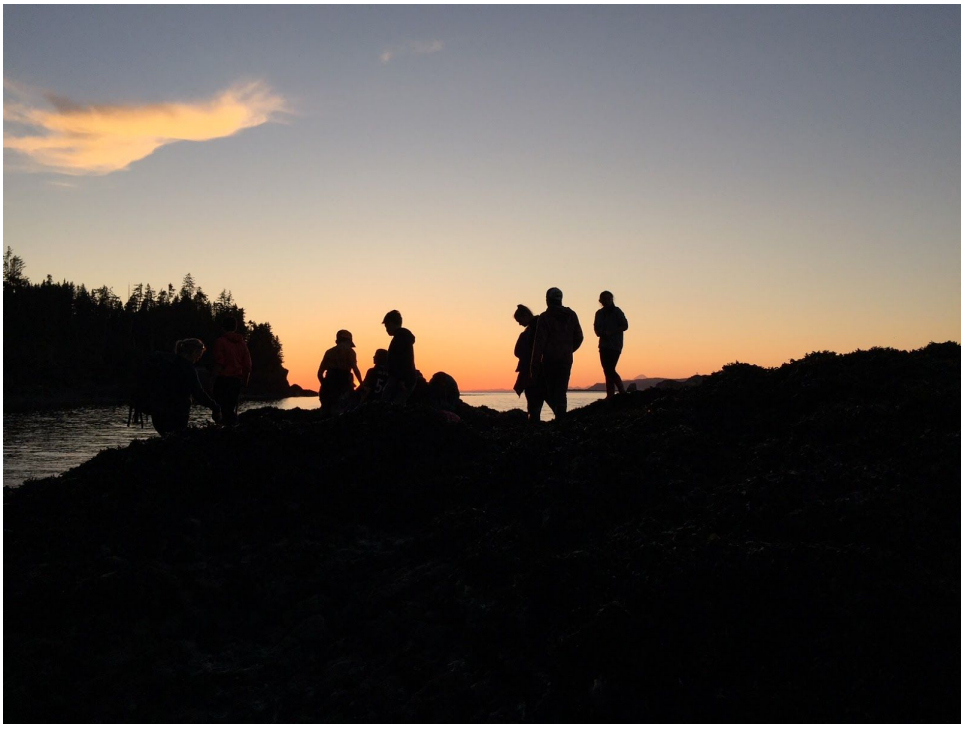
each interval. When is it growing the fastest? When is the growth slower? In addition to the amount of sunlight, consider tracking precipitation, air temperature, and/or soil temperature.

Outdoor Engineering

June Solstice is a great time to make a sundial! Here's a template for a paper sundial from NASA, or you can encourage your learner to create their own sundial outside. Start with found objects like a stick, tall rock, or tree in the middle of a fairly flat, open area. Draw in the sand/soil or use smaller rocks to mark where the shadow of the object falls at specific times today and tomorrow morning. This sundial will be fairly accurate throughout the summer months, but will need to be adjusted as the seasons shift. Here are some other directions for how to make a simple sundial.

Kinesthetic, Observation & Adventurous

If your schedule, timing, and location allows, try to spend some time outside during civil or nautical twilight. If it is safe and you are able, go out for a night/twilight hike. It is an amazing way to experience a place in a way we usually avoid. You can find out when twilight occurs where you live using this tool from timeanddate.com If learners are a little bit nervous about being outside at night, sound mapping is a wonderful, observation-based activity that can also help to build comfort in this new situation.



A favorite, simple activity for exploring light and sight requires just crayons or markers and something to write on. You can do this outside, but it also works inside if you can turn lights off when the sun begins to set. Have the learner pull a marker/crayon out of the bag. Ask the learner to look at the color of the crayon (or tip of the marker) and write the name of that color on the piece of paper. If you want, you can also ask the learner to write the time down with each notation. Do this from time to time as it gets darker. Eventually, at low enough levels of light, our eyes stop being able to differentiate color but can still perceive light and dark, shadows and movement. When you are

ready, look at the color of the writing with a flashlight, under a street light, or back inside. Which colors did they get right? When did it become hard to tell colors apart.

If you live at low latitudes, pay attention to when you notice the first star in the sky. Record the time. Did this occur during civil twilight, nautical twilight, or astronomical twilight? If you live at higher latitudes, pay attention throughout the season and record the day, not time, that you see the first star as summer wanes into fall. Or, if you live far south in the southern hemisphere, record the last date you are able to see stars as winter shifts to spring.

Following are some seasonal activities I've mentioned before, but if you haven't tried them, the June Solstice is a great time to start!

Art & Engineering

The June Solstice is a perfect time to make some observations of the sun and explore some of the properties of how light works. Creating a pin-hole camera is a great and really engaging way to observe the sun safely. For this activity, students will need access to an outdoor space where they can see the sun or a south-facing window with clear views of the sun. These instructions from NASA Jet Propulsion Lab are great, and use fairly common materials. (And, next time there is a solar eclipse, you'll have a great way to view it!)

Students can also use their pinhole camera to document the arc of the sun across the sky. To do this, they'll need to be able to leave the pinhole camera set up (or have a very detailed way of re-installing it in the same place each week). They will also need to have paper or another surface they can draw on where the pinhole image is projected. Once a week, students should mark the location of the sun's image at sunrise, solar noon, and sunset and then connect these with a curved line. If possible, it is best to do this more frequently during the day to get a more accurate path of the sun's arc each week. Continue the observations for as many weeks as possible -- ideally until the September equinox or December Solstice! But even a few weeks will be enough to see how the sun's path changes with the seasons. If you have access to supplies for photography, you can actually do an amazing solargraphy project. There was even a global citizen science project to collect images of the sun's path over 6 months in different places around the globe. Check out the project to see some amazing images and compare different spots on the globe.

Observation 1

If you don't want to set up a pinhole camera to trace the changing path of the sun, there are other simple ways to observe this seasonal change. If learners have access to a south-facing window or outdoor space, have them use tape, chalk, flagging, or pencil to mark each morning the first place the sun hits (floor,

window, yard). If possible, also have them mark the last place the sun hits in the afternoon, and where the sun shines around noon each day. Do this once per week for a number of weeks, or ideally until the September equinox or December solstice. Here is a version of this activity, using a removable sticker that learners can place on a south-facing window.

If you can't get outside and don't have access to a south-facing window, learners can investigate the same pattern using the length and direction of shadows cast by tall objects in the neighborhood. Depending on what floor you live on, these objects might be other buildings, light posts, telephone poles, trees, shrubs, or any other stationary object that casts a shadow. Help the learner to find a spot in the morning to observe these shadows from, and then document them using a camera or sketching. Return to document them from the same spot around noon and in the evening. How do the shadows change throughout the day? To extend the activity, decide on one time of day to make continued observations. Each week, the learner should observe from the same spot, documenting the shadows with the same camera or sketching approach. Continue this for as many weeks as possible.

Kinesthetic Observation

Another simple activity for understanding changing seasons requires only a yard stick/tape measure and a kid. It is best done over the course of a year (once close to each solstice and equinox), but could also be done once each week for a month or two. On a sunny day, stand outside or near a south-facing window close to noon. Have the kid stand still, and measure from their toe to their shadow's top. You can also have them measure your shadow. Gather data over the course of the year, or over the course of 1-2 months. If age appropriate, graph the data. What patterns does the data reveal? Thanks to Green Child Magazine for the idea.

June Solstice -- In the classroom

For upper elementary and middle school, I would recommend beginning with a good video that explains the astronomy behind equinoxes, solstices, and seasons. This one from National Geographic is pretty good for older students: https://youtu.be/kaG6PTVrFP4 and this could be a good one for younger kids: https://youtu.be/b25g4nZTHvM

Next, you could jump more deeply into the science. Here is a great, comprehensive set of lessons from PBS!
https://www.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.lp_seasons/seasons-on-earth