

Animated Star Chart Grade 9 – Earth and Space

<h2>Lesson Plan</h2>	Coding Tool	Scratch
	Cross Curricular	Math

<p>Big Ideas Different types of celestial objects in the solar system and universe have distinct properties that can be investigated and quantified.</p> <p>People use observational evidence of the properties of the solar system and the universe to develop theories to explain their formation and evolution.</p>	<p>Specific Expectations D2.2 use direct observation, computer simulation, or star charts to determine the location, appearance, and motion of well-known stars and other celestial objects that are visible in the night sky.</p>
--	---

Description
 Students create their own digital animated star chart showing the motions of the stars in the night sky for any day of the year and time of day. Examples are given to complete the task with Scratch.

<p>Materials</p> <ul style="list-style-type: none"> Star chart graphics Access to internet Scratch (scratch.mit.edu) account. 	<p>Computational Thinking Skills</p> <ul style="list-style-type: none"> Algorithm Design Conditional Loops
---	---

Introduction
Review the motions of the Earth – Daily rotation.
 You may want to use a ball and light to illustrate.

- Every day the Earth spins around on its axis.
- The Sun is in on direction of the sky. When you face that way it's daytime. When you are on the other side from the Sun it is your night time.
- The stars we see on that day are the stars on the night time side. (Illustrate with sketch – start with arrangement below then add arrow showing Earth rotating counter clockwise.)

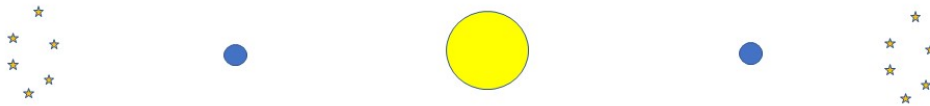


- You can see that as the Earth spins the stars in the sky change. The stars appear to move from East to West (just like the Sun does during the daytime).
- Note that there is a point above the Earth – where its axis points to – that does not move. That is the location of the North star. It's like we had a big sphere around the Earth that appears to us to spin around once every 24 hours.

Review the motions of the Earth – Annual orbit

In addition to daily rotation the Earth also moves around the Sun once a year.

- You can see that six months later (add Earth on the other side from the Sun to your sketch) the stars we see in the night sky are totally different. The stars that were nighttime stars are now up during the day (and not visible).



- We know this well as the signs of the zodiac. As we move around the Sun it appears to us that the Sun moves past different stars as the year passes.
- Again, the star right above the Earth – the North Star – doesn't move.

It gets a bit complicated to imagine so the best thing we could do is create a simulation of this so we can understand it better. Let's do it!

Action

The Supplied Materials

- We need a map of the stars that are visible from where we live throughout the year. This is like a half-sphere above us (we can't see the stars on the other side of the Earth ever – the ones visible down in Australia).
- We can show the half-sphere as a circle in 2-D. This is the supplied **star map**.
- Then we need to show which part of this half-sphere is actually above the horizon at any particular time. This is the supplied **horizon**.
 - NOTE: This horizon and star map is correct for a latitude of 45°N on Earth. It would look different at latitudes far away from this (e.g. in Australia!).
- Now we can overlay the horizon onto the star map. We can rotate the star map to show the visible stars at any time. You can see which stars will be in every cardinal direction. The stars in the middle of the visible window would be right above us.

Creating the Simulation (Similar instructions on handout below)

1. Start by overlaying the horizon on the star map. Arrange the locations and sizes of the graphics until you have a perfect alignment of the circular edge of the horizon graphic

with the edge of the star map graphic. The date and time tick marks need to be visible just beyond the edge of the horizon graphic (illustration 1 below).

2. Create controls to rotate the star map. Increasing level of difficulty:
 - i. Just add the ability to set the map to any angle between 0 and 360
 - ii. Create an animation that rotates the map through 360 degrees automatically.
 - iii. Pick any starting point. Add the ability to rotate by a selected number of hours since this starting position time to show daily motion. The amount it rotates by is $360 \text{ degrees} / 24 \text{ hours} = 15 \text{ degrees per hour}$.
 - iv. Using the same starting point, add the ability to rotate by a selected number of days since the starting position date to show annual motion. The motion per day is $360 \text{ degrees} / 365 \text{ days per year} = 0.97 \text{ degrees per day}$.
 - v. Finally, add ability to set any actual date AND time and it automatically rotates the right amount.
 - NOTE: Due to limitations of programming language this may still be in number of days since start day and number of hours since starting time, BUT it should be an easy place to start from – for example the initial map could be set for January 1st at midnight. Then you have to enter the number of days from January 1st (or month number followed by day of the month number) and the number of hours past midnight (could be a negative number)
-

Consolidation/Extension

Discussion

- How come the night sky looks the same on different dates but at different times? (Explore this on board by looking at where some fixed stars appear in the night sky for a few spots along the Earth's orbit around the Sun. You'll see how they are near one horizon first, then in the middle of the sky and finally at the other horizon.)
 - What could this program be useful for? (Helping us find constellations in the sky, determining the time from the stars if we know the date, ...)
 - Can you think of further refinements to the program? (E.g. you could imagine a program that can also be set for different locations on Earth).
-

Assessment

1	2	3	4
Uploaded the images as sprites and aligned the them. Attempted to complete the code for rotating the star map.	Succeeded in getting sky map to rotate and attempted to rotate map by taking input from user for number of hours and number of days passed.	Succeeded in showing daily and annual rotation based on user input. Successful completion of last task, though it may not be as user friendly as it could be.	Successful completion of all assigned tasks. Clear understanding of how the sky seems to rotate demonstrated. The last task is completed with a view to user friendliness.

Additional Resources

Day number for any date: <https://miniwebtool.com/day-of-the-year-calculator/>

A similar, but much more elaborate, example (and in Spanish):

<https://scratch.mit.edu/projects/285662081/>
