ASTRO EDU

Peer-reviewed Astronomy Education Activities

Evening Sky Watching for Students

Let's observe the evening sky with the naked eye

Akihiko Tomita, Wakayama University

AGE

4 - 8

LEVEL

Pre-school, Primary

TIME

30min

GROUP

Group

SUPERVISED

Yes

COST PER STUDENT

Low Cost

LOCATION

Outdoors

CONTENT AREA FOCUS

Astronomy

ASTRONOMY CATEGORIES

The Sun, Planetary systems, Stars

EARTH SCIENCE KEYWORDS

Atmospheric Sciences

CORE SKILLS

Asking questions, Communicating information

TYPE(S) OF LEARNING ACTIVITY

Structured-inquiry learning, Discussion Groups, Observation based

KEYWORDS

Sky watching, First star, Colour of star, Colour of sky, Twinkle of star, Motion of star, Observation, Art

GOALS

- Students get interested in watching the sky, especially the evening sky. Admiring the evening sky is a gateway to lifelong astronomy education.
- Students admire the beauty of the evening sky, even in an urban area. Students foster positive attitudes to their own daily life environment.
- Students improve their skills of observation and expression of their findings. The skills are a basis for lifelong science education.
- Nursery teachers gain guidance skills for the evening sky. Astronomy interests not only children but also adults.

LEARNING OBJECTIVES

- Students will be able to recognise the evening sky and that the stars have various colours. (Activity 1)
- Students will be able to spot the first visible star/planet and other stars/planets in the evening sky. (Activity 2)
- Students will be able to recognise that stars twinkle and the star’s colour twinkles. (Activity 3.1)
- Students will be able to recognise that stars and planets rise and set. (Activity 3.2)
- Students will be able to explain clearly what they see. (All activities)

EVALUATION

- Students are asked to describe the colours of the evening sky and stars, note the colours in the evening sky, and distinguish subtle colours in stars. Note whether they use real colours and the variety of colours when they draw the sky, clouds, and other things. (Activity 1)
- Students are asked to spot the first visible star/planet and other stars/planets in the evening sky and explain their positions. (Activity 2)
- Students are asked to describe how the light and colour of stars twinkle. (Activity 3.1)
- Students are asked whether stars and planets move, and to provide a reason for their answer (e.g. I saw the stars set). (Activity 3.2)
- Students are asked to explain clearly what they see. How clearly students explain what they see reflects their careful observations and speaking ability. (All activities)

MATERIALS

- Good weather
- Classroom with a big window or garden/playground with a good view of the sky
- Ability to switch off bright outside lights (advantage)

BACKGROUND INFORMATION

Colours of stars and planets [Related science fields: Solar system, Galaxy, Stellar spectral type]

Stars are ‘fixed’(i.e., their patterns of relative positions appear fixed from Earth) pinpoints of light and are distant Suns. They are so distant that we see them as pinpoints even through big telescopes, while they really are big balls of gas like the Sun. They form constellations, and some of the brightest stars have their own names, e.g., Vega, Antares, and Sirius. Some stars have distinct colours, but most of them have only a hint of colours.

A star’s colour is related to its stellar spectral type, from bluer to redder, O, B, A, F, G, K, and M. The sequence is physically the sequence of stellar surface temperature, from hotter to cooler. The Sun is a type G star, white-yellow in colour. A pure white star is called type A. Planets are ‘wandering’(they wander through the background of stars) pinpoints of light and are siblings of Earth. While planets are much smaller than stars, they are close enough to observe as disk images through our telescopes. Some bright planets have distinct colours. The colour of the planet comes from its reflection of sunlight.

Twinkling [Related science field: Astronomical scintillation, Composition of atmosphere]

One reason for the twinkling of stars and planets is the Earth’s atmosphere. Many layers of air of slightly different refraction indices flow through the Earth’s atmosphere. As the starlight passes through the atmosphere, it bends, thus causing the twinkling. Since planets are small disk images in our sky, the bent light from each point combines, minimising the twinkling. Since stars are pinpoints, they twinkle more than planets. Not only does the position of the pinpoint dance around but the colour of the pinpoint also seems to change a little, especially for white stars. The degree of a star’s twinkling varies daily with the weather conditions.

Diurnal motion [Related science fields: Earth rotation, Sun-Earth system]

All the stars, planets, and the Sun and the Moon move once a day across the sky. This apparent motion of diurnal motion is due to Earth’s rotation on its axis once a day. All the heavenly bodies rise from the eastern horizon, soar high, and set to the western horizon, except objects close to Polaris, the North Star, which circle

around the celestial north pole. The diurnal motion is slow, so when the body is about to set it is a good chance to observe the continuous motion that is common to all bodies.

Colour of the evening sky [Related science fields: Sun-Earth system, Composition of atmosphere, Scattering of light]

The sunlight that strikes Earth's atmosphere scatters, creating a bright blue sky in the day time, and various colours in the evening sky. The colours of the evening sky change by the day depending on the weather conditions. The colour is also affected by small particles in the air.

First star [Related science fields: Solar system, Season, Latitude and longitude, Time of the day]

The first star is not a specific star or planet. It could sometimes be a planet like Venus or Jupiter or a star like Vega or Sirius. Planetarium software like Stellarium or almanacs are of use to learn the names and positions of planets and stars. The time when night falls and the first star is visible depends on the season, latitude, and longitude of the observing site.

CAUTION: Staring at the Sun, even the setting Sun, is very dangerous for our eyes. Post-sunset is safe for evening sky observations. The sky is still bright just after the sunset.

FULL ACTIVITY DESCRIPTION

Situation

1. In the evening, in the room of a nursery, kindergarten, or preschool.
2. Some students stay during extra-hour care with their teachers, waiting for their parents.
3. The weather is fine, and the students can see the evening sky out of a big window.

4. In the playground or in the roof play area, the students can see the open sky.

5. The teachers may read books to the students, they may sing with the students, or they may show the students videos before the parents come back to pick up their students. It is a comfortable space and time, and there is a wonderful natural treasure for the students and teachers: the evening sky. Take advantage of this; there is no cost, extra time to prepare, or special equipment needed, and it is available for all people in all places even in the centre of light-polluted cities. This activity is a children-educator, conversation-based activity.

— Choose one or several of the activities described below. —

Activity 1: Evening Sky Painting after Sunset

Activity 1.1 Colour of the evening sky

Observation: Evening sky

- Question: What colour is the sky?
- Expected answer: Red or orange
- Question: Is that the only colour you see? What else?
- Expected answer: Golden yellow, blue, dark blue, grey…

Question-and-answer stimulates further observation. Teachers also may notice a wide variety of colours. Finding many colours leads to a richer drawing activity. Be careful as intense sunlight can cause severe damage to the eyes. Even the gentle light of the setting Sun can be very dangerous to stare at. After sunset is a good time for observations.

Activity 1.2 Colours of the evening sky in different directions

Observation: Evening sky

- Question: Is the colour the same across the sky all day?
- Expected answer: It is red and orange and yellow in the evening.
- Question: Look above your head.
- Expected answer: Ah, it is dark blue!
- Question: Look in the direction opposite to sunset.
- Expected answer: Ah, it is a little bright, too.
- Question: What colour is it?
- Expected answer: There is an area that is somewhat pink.

Question-and-answer stimulates further observation. Different from the daytime sky, the colour of the evening sky differs a lot from horizon to zenith, from east to west. Lie on the playground and you will notice the variation. You may notice a strange pink horizontal belt parallel to the eastern horizon. The dark area below the pink belt just above the eastern horizon is the shadow the Earth casts on Earth’s atmosphere. The pink belt is the edge of the Earth’s shadow and it is the projection of the evening glow. The pink belt is called the Venus belt.

Activity 1.3 Colour change of the evening sky

Observation: Evening sky

- Question: Is the colour of the sky changing?
- Expected answer: Yes.
- Question: In what way?
- Expected answer: The sky is getting dark, from blue to dark blue to black. The yellow and orange part is getting smaller.
- Question: How about the whole sky?
- Expected answer: The bright area is sinking down and down.

Question-and-answer stimulates further observations.

Activity 1.4 The shape and colour of the evening clouds

Observation: Evening sky

- Question: Pick out your favourite cloud shapes. What are they?
- Expected answer: A dog! A cat! A dinosaur! A dragon! A ghost!

Some may be real animals or buildings and others may be imaginary ones. Finding many strange features will lead to a richer drawing activity.

- Question: Are the clouds moving?
- Expected answer: The clouds are floating.
- Question: Look at the clouds for a while.

- Expected answer: The clouds are moving! The cloud shapes are changing!

Question-and-answer stimulates further observations. Some students do not care about clouds moving or their changing shapes, so they often draw stereotypical clouds as pretty cotton on the upper part of the sheet. Do not just tell the students that clouds are not still, encourage the students to notice they are not.

Students may say that some clouds are black. This is not due to their true colour, but the bottom of the clouds are in the shade. Teachers can explain it like this: if the outside is bright, switch off the room light and look at the white window frame. It looks black compared to the bright outside landscape, though the true colour is white (or another colour).

Activity 1.5 The changes in temperature, wind, sound and atmosphere

Observation: Temperature, wind, sound

- Question: Do you feel something different in the evening?
- Expected answer: It is getting dark.
- Question: Is that all you feel? Is it cold? Is it dark? How about sound? How about wind?
- Expected answer: The temperature is getting cold suddenly. Many people are going home so traffic noise is increasing. The wind is getting stronger and the direction may change.

Question-and-answer stimulates further observations. Let students feel that astronomical phenomenon like the Sun setting has a great impact on our daily life.

In the evening sky there are pinpoints of light other than stars. Some clouds and buildings look black due to shade, hiding their true colours.

Activity 2: First Star

Activity 2.1 Picking out the first star

Observation: First star

- Question: It is getting dark. Look for and find the first star.
- Expected answer: There it is!

Student eyesight is better than that of adults, especially in the evening. Even though an astronomy educator knows where the first star will pop up, the students can win.

- Question: (Though a girl or a boy may find the first star quickly, many others may not.) She (or he) found it! (To another student) Not yet? Please explain the position.
- Expected answer: Above that tree. To the left of the lamp. – No! – Two fists above the tree, a little left of the lamp, just on the edge of the dog-shaped cloud. – Yes, there!

Encourage students to explain the position of the first star by indicating other objects and the distances from them. Some students would ask about star names. However, you do not have to remember all the names. Observing stars popping up and colours and explaining them clearly are more important for students to improve their scientific skills than just knowing the names. Therefore, encourage students to notice the star’s position and colour and other characteristics carefully. On the other hand, learning a star’s name in advance is good for the educator’s confidence. Software such as Stellarium is very useful for

learning the sunset time, twilight duration, and names of bright stars depending on the location, latitude, longitude, and date. The software also simulates how the first and several other stars will pop up.

Activity 2.2 Picking out the second and third stars

Observation: A few bright stars

- Question: Have you all already found the first star?
- Expected answer: Yes!
- Question: Where is it?
- Expected answer: There! (Pointing with a finger)
- Question: Mm? Some are pointing there and others are pointing there… Are there “many” first stars?
- Expected answer: That is the first star! – No, that is the first star! – Yes, I think so! – No, that is true!

When students find the first star, it is already very dark. As the second, third and many more stars pop up, they will notice how many stars there are in the evening sky even in an urban area. One cannot expect to see a sky full of stars with the Milky Way in an urban area, but several bright pinpoints of light are enough for students to feel that there is a real starry sky in their daily life.

- Question: OK, can you count the number of stars?
- Expected answer: Yes! One, two…

For very young students, counting over ten may be a little difficult, but if there is a need to count, we need big numbers. There is no intention to make them learn math too early. We have to count, so we need big numbers, and students enjoy using big numbers.

- Question: Now, how do you tell stars apart from airplanes or helicopters?
- Expected answer: Stars shine steadily. Airplanes shine on and off. Artificial satellites grow brighter or fainter. / Stars don’t move. Airplanes do. Artificial satellites move fast. / The colour is different. (Stars are not so colourful.) / Stars do not make a sound.

Based on what they see in their daily lives, students can successfully distinguish stars from other objects. Here, it is important to let them explain the reason. Students will try to explain using words or gestures.

This is an example of the first star, planet Venus with some small eerie clouds.

Activity 3: Stars

Activity 3.1 The colours of stars

Observation: A few bright stars

- Question: Do you notice the colours of the stars?
- Expected answer: …No. / Colours?
- Question: You may feel many stars look white. But there is a hint of colour, a little red, a little blue. Can you see the hint?
- Expected answer: Yes, I see some red… / A little blue!

Question-and-answer stimulates further observation. A star’s colour is subtle. There are no colourful pure red or pure blue stars. Basically they are white with a hint of red, orange, yellow, or blue. Human eyesight is poor at distinguishing the colours of less bright objects. If we use binoculars or telescopes and get a lot of light, we can enjoy a variety of star colours, but with simply the naked eye, only

some of the brightest stars show any colour. Science books introduce the colours of stars, and some planetariums project exaggerated colours. But the reality is that a star's colour is subtle and not easy to see.

- Question: Is that star orange? Is that true? Is that star white with no colour? Is that true? Look at it again carefully.
- Expected answer: Wow, the colour changes! Yellow? No! Now, it is blue… No! I can't figure out the colour!

Question-and-answer stimulates further observations. Due to the Earth's atmosphere, stars twinkle. That also causes a flickering change of the colours. The best examples are Vega in summer and Sirius in winter. Both are spectral A type stars, and the expected colour is pure white. However, through the twinkling, the colour seems to change from red, yellow, and blue to white. Enjoy the flickering colour as well as the flickering light. Flickering colour cannot be simulated in a planetarium dome. It is a sign of true natural star light.

Activity 3.2 A star's motion (recommended age range: C)

Observation: A few stars, especially a setting bright star or planet

- Question: Do stars set?
- Expected answer: No! Stars float.
- Question: Does the Sun set?
- Expected answer: Yes.
- Question: Why do you think so?
- Expected answer: I saw it.
- Question: Good. Then, does the Moon set?
- Expected answer: Yes. I saw it.
- Question: Good. Then, why do you think stars don't set?
- Expected answer: I didn't see it. Stars pop up and float in the night.

This is a typical question-and-answer of a 4 or 5-year-old child. They answer yes or no based on what they see in their daily life. It is a scientific attitude. Most students have not seen stars setting or rising. The situation is the same for most adults.

- Question: Do you know there is a bright star in the evening twilight? (If you can see Venus or Jupiter, take advantage of the lucky situation.)
- Expected answer: I know. Every day I go home with dad from the nursery, and I see the star!
- Question: Good. Does the star stand still? Does it move?
- Expected answer: … / Sometime, it changes position.
- Question: After going home, with adults, look at the star from a window for a while. Today will be clear. Try it!

The motion of stars, which soar high above, is difficult to notice, but for stars that are about to set it is a lot easier to discern their motion. With solid experience, he or she will surely say: Stars set, stars move. Because I saw it. When stars are close to layers of clouds, and the clouds flow fast, the stars appear to move fast. If so, ask them 'Which one is moving, cloud or star?' Students would answer 'star, moving fast'. 'Compare the star's position with respect to the trees and building. So fast?' Students will learn that it is important to have multiple reference points.

CURRICULUM

Country | Level | Subject | Exam Board | Section
— | — | — | —
UK | KS1 | Science | - | Working scientifically: using their observations and ideas to suggest answers to questions.
UK | Early Years Foundation Scheme | Communication and language | - | Listening and attention: children listen attentively in a range of situations. They listen to stories, accurately anticipating key events and respond to what they hear with relevant comments, questions or actions. They give their attention to what others say and respond appropriately, while engaged in another activity.
UK | Early Years Foundation Scheme | Understanding the world | - | The world: children know about similarities and differences in relation to places, objects, materials and living things. They talk about the features of their own immediate environment and how environments might vary from one another. They make observations of animals and plants and explain why some things occur, and talk about changes.
Japan | Nursery | Environment | Nursery School Childcare Guideline, Ministry of Health, Labour and Welfare | Content No.3: Leading a life close to nature, being aware of its grandeur, beauty and wonder. Content No.6: Developing and incorporating an interest in things surrounding them, such as nature.
Japan | Nursery | Language | Nursery School Childcare Guideline, Ministry of Health, Labour and Welfare | Content No.4: Expressing in their own words what they did, saw, heard, tasted, felt, and thought. Content No.6: Paying attention to what people are saying, ensuring that they make themselves understood to their conversation partner.
Japan | Kindergarten | Environment | Kindergarten Education Guideline, Ministry of Education, Culture, Sports, Science and Technology | Content No.1: Leading a life close to nature, being aware of its grandeur, beauty and wonder. Content No. 4: Developing and incorporating an interest in things surrounding them, such as nature.
Japan | Kindergarten | Environment | Kindergarten Education Guideline, Ministry of Education, Culture, Sports, Science and Technology | Content No.2: Expressing in their own words what they are doing, seeing, hearing, feeling, thinking, etc. Content No.4: Paying attention to what people are saying, ensuring that they make themselves understood to their conversation partner.
Japan | Elementary School, Grades 1 and 2 | Living Environment Studies | Guide of the Course of Study for Elementary School, Ministry of Education, Culture, Sports, Science and Technology | Content No.5: To enable pupils to sense that conditions of life change according to the four seasons, through such activities as observing nature in the immediate environment and performing activities related to seasonal and local events, and to lead their own lives and make them more enjoyable.

ADDITIONAL INFORMATION

Akihiko Tomita’s web site: http://www.wakayama-u.ac.jp/~atomita/

This activity summary is based on Akihiko Tomita's visiting research at nurseries, kindergartens, preschools, and after school cares in Japan for about nine years; among them, especially Hikari Nursery and Osaka City Liaison Association of After School Care for practice, many educators and researchers including at Osaka Ohtani University for discussion, Dr. Kouji Ohnishi for valuable comments. Part of the research has been supported by Japan Society for the Promotion of Science, Grants-in-Aid for Scientific Research, grant numbers 20500778 and 25350251.

Japanese version of the activity is available at http://astroedu.iau.org/media/activities/attach/fb5749c1-8953-4336-86c5-551cf9518275/astroedu1616-evening-sky-watching_oXbN2Vz.pdf

CONCLUSION

1. There are many features in the evening sky that students can observe with the naked eye.
2. Question-and-answer stimulates further observations.
3. Through careful observations, students learn:
4. a wide variety of colours in the evening sky, clouds and stars,
5. subtle colours of stars with twinkling,
6. motion of the stars, and
7. that there is a starry sky even in an urban area.

ATTACHMENTS

- Japanese version PDF

CITATION

Tomita, A., 2016, *Evening Sky Watching for Students*, astroEDU, , doi:10.14586/astroedu/1616