New young astronomers

The sky above us (Before Visiting the Observatory)

The online observatory collaboration consists of the following partners:
Baldone Observatory, Brorfelde Observatory, Cardiff University, Harestua Solar Observatory, Helsinki Observatory

Quick Overview	Outline
Age Range: 7 – 10 years old, (Optional extended tasks are aimed for older pupils) **Teacher Preparation Time:** 1 hour **Total lesson time:** About 1-2 hours + a few separate moments for observing the direction of the Sun in the course of a day (+ Optional extended task Analemma: several observations in the course of a year). **Cost per activity:** Low (less than 10 euros) **Includes the use of:** Pen, paper (size A3), toy figure (e.g. a favorite toy from home, max about 3 cm), ruler, compass (e.g. smartphone), sunny day, Stellarium (https://stellarium.org/fi/)	Take the first steps into the universe with your class! The rotation of the Earth is investigated by observing the length of a toy figure's shadow in the course of a day. As an introduction, the pupils can spin around themselves like the planet Earth to reveal the daily motion of our planet, and they can try to create different kinds of shadows with a torch. As an extended task, you can use the free Stellarium software to investigate how the Sun seems to move across the sky in the course of a day and how this movement changes in the course of a year. Alternatively, with the other extended task the students can investigate the analemma pattern in the sky. In addition, with the aid of this material you can learn about the stories of constellations of different cultures. THE STORIES ARE UNDER CONSTRUCTION IN ENGLISH

Pupils will learn:

The Sun seems to move in the sky during the day, but actually our planet Earth is rotating around itself. The constellations help us find our way around the night sky. Different cultures have used different myths and formed the constellations in different ways. Learn some of the most famous constellations!

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Lesson plan

Overview of the time required to complete the lesson.

Description	Time	Notes
Introduction to the subject	15 min	
Activity 1: Moving shadows and rotating Earth		
A) Spin like a planet	15 min	
B) Moving shadow	15 min	
C) Follow the Sun		See the example files. At least one observation in the morning, at noon and in the afternoon/evening.
D) Extended 1: Stellarium OR	30 min	https://stellarium.org/fi/
E) Extended 2: Analemma		Requires observations e.g. once a month in the course of one year.
Activity 2: The sky full of myths - Stories of constellations	30 min	Under construction in English

Introduction to the subject

The Earth rotates around itself like a spinning top causing the sequence of day and night.

Activate and find out the level of your pupils' prior knowledge by discussing with them the following questions:

- How can you see the daily rotation of the Earth by observing the Sun in the sky or by observing the night sky?
    - The Sun and the stars seem to move clockwise in the sky. This is caused by the Earth rotating counterclockwise on its axis.
- Have you noticed that the Sun casts shadows? Do shadows stay the same and point to the same direction at all times of the day?
    - An object lit by the Sun casts a shadow which falls opposite the direction of the Sun. Hence, as the Sun moves in the sky, also the shadow moves. The length of the shadow depends on the elevation of the Sun. In the winter time shadows are longer compared to the summer time, and similarly, in the morning and in the evening they are longer compared to the the noon.
- From which directions does the Sun shine during the day, for example from different windows in the school building or at home? In which direction does the Sun rise?
    - The Sun appears to rise in the east, it seems to travel to the south and finally set in the west.

Credit: Iztok Bončina/ESO

Activity 1: Moving shadows and rotating Earth

A spot with direct sunlight is required throughout the experiment (observations required throughout the day). Please note that, if needed the task can be divided to several days within a reasonable short period of time.

A) Spin like a planet

1. Take a lamp (floor or desk lamp, torch) and imagine it is the Sun. Stand so that you can see the lamp. You are the planet *[your name]*. Is it day or night on your nose mountain?
2. Now you can start spinning slowly around yourself (for example, it takes 24 hours for the Earth to spin once around itself)! Did you notice that the Sun disappears? The night has fallen on your nose.
3. When you continue spinning slowly you can notice that the Sun soon rises again and a new dawn breaks. This is the cycle of day and night.

B) Moving shadow

1. You will need a torch and a toy figure of your liking.
2. Place the toy figure on the table and illuminate it with the torch. What will happen to the toy figure's shadow if you illuminate the figure from different directions?
3. What if you place the torch at different heights? When is the shadow at its smallest?

C) Follow the Sun

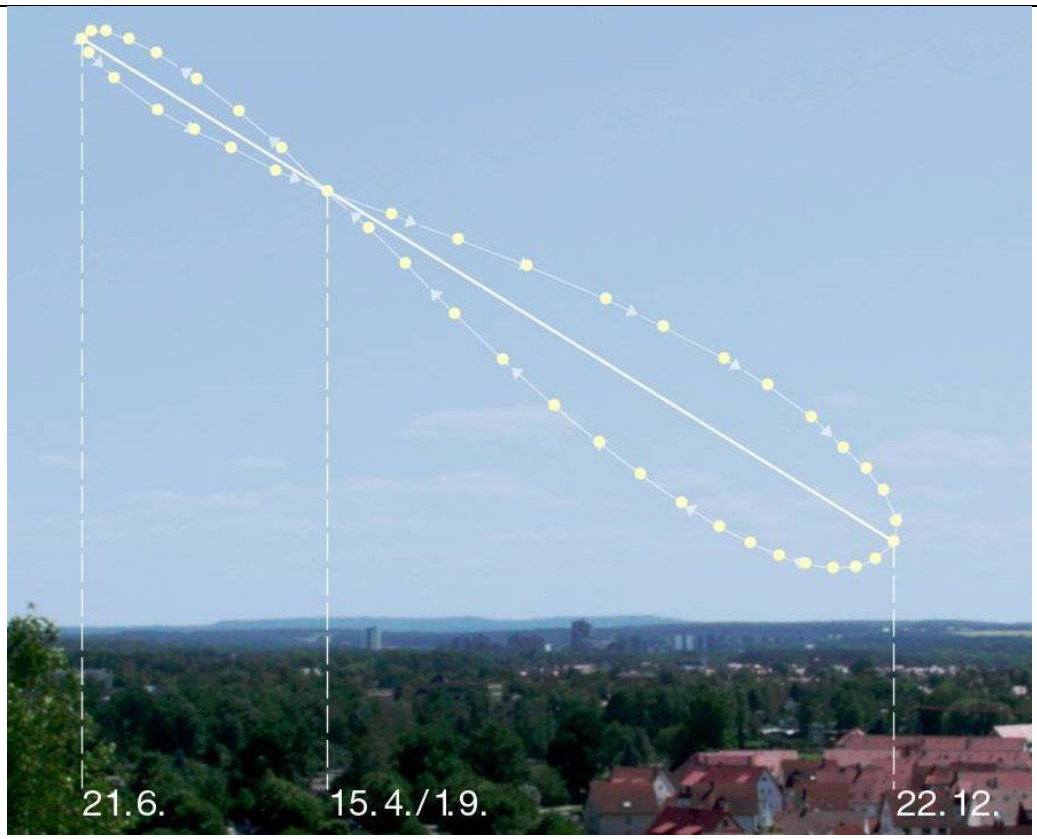
1. Choose a spot where the Sun shines throughout the day.
2. Find south (for example using a compass). Mark in the upper corner of the paper the direction of the south with an arrow. Point the arrow towards the south.
3. Draw in the paper the objects (houses, trees etc.) that you can see on the horizon. The model picture will help you (Moving shadows and rotating Earth Student Example.pptx).
4. Draw a circle in the middle of the same paper. Place the toy figure in the circle. The model picture will help you (Moving shadows and rotating Earth Student Example.pptx).
5. Draw in the paper the position of the Sun at least once in the morning, at noon and in the afternoon/evening. Write down the time of the observation.
6. In addition, draw a straight line starting from the circle all the way to the end of the toy figure's shadow. Again, write down the time of the observation next to the line.
7. Compare the pictures! Ask questions that make the pupils understand how the direction of the Sun affects the direction of the shadow. Furthermore, does the direction of the Sun have an impact on the length of the shadow? When is the shadow at its shortest and why? (Check the introduction and the model picture (Moving shadows and rotating Earth Teacher Example.pptx).)
8. Why does the Sun appear to move across the sky? Where does the Sun go at night?

D) (Optional extended task 1) Stellarium

1. Download the free Stellarium software and investigate how the Sun seems to move across the sky in the course of a day. Open the Date/Time window to change the time. How fast does the Sun seem to move across the sky (from dawn to dusk)?
2. Open the Date/Time window to change the month. Do you notice how the elevation of Sun (at noon) changes in the course of a year?
3. Can you figure out when the objects cast the shortest possible shadows (at noon)? (Answer: When the elevation of the Sun is at its largest, in other words in the summer time.)
4. What about the objects in the night sky? How do they move? In which direction do they rise and in which direction do they set?

E) (Optional extended task 2) Analemma

1. Find a spot where you can see the Sun at least once a day (for example at noon) throughout the year.
2. Use a smartphone or camera to take a photo of the Sun. Make sure that there is also some landscape visible in the photo so that it is easier to see to which direction the photo is taken.
3. Once a month, exactly at the same time of the day, go to the same spot and repeat taking the photo of the Sun.
4. After a year you can compare the photos (or even combine them in the Photosop) to see how the position of the Sun has changed in the course of a year. You should see the positions of the Sun forming an eight shaped pattern called the analemma. Can you think what causes the pattern? (The midday altitude of the Sun varies over the course of the year due to the tilt in the Earth's axis of rotation. The Sun's sideways movement in the analemma is caused by the Earth's varying orbital velocity.)



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Activity 2: The sky full of myths - Stories of constellations **UNDER CONSTRUCTION**

Assessment

QUESTIONS FOR LEARNING ASSESSMENT

- If the rotation of the Earth around its own axis stopped, what would happen to the Sun in the sky?
- Do you know of a type of clock that uses shadows to measure time?
- How does the sky move at night? Which objects do not follow the rotation of the Earth? (Hint: think about airplanes, shooting stars etc.)

Required background knowledge

Required background knowledge for the activity. Please take care in limiting the amount of text and use illustrations or free images (www.pixabay.com, https://commons.wikimedia.org/, www.esa.int, www.nasa.gov, www.eso.org or Online Observatory network images where appropriate).

- Cardinal directions (north, south, east, west)
- Knowledge of clock