Lesson Plan

SUNDIAL: TIME AND SHADOWS

Subjects: Science, Mathematics, Design and Technology
Grade: 4th
Lesson Duration: 120 min

Message: Long time ago, people told time by observing the Sun and shadows. You will also make your own sundial, observe shadows, and learn how the Sun helps us to tell time.

The Aim: Students make their own sundial, understand its working principle and the movement of shadows during the day, as well as measure angles and divide 360° into hourly marks.

Learning Outcomes: Students create a simple sundial from a paper plate and a skewer (or pencil), observe shadows during the day (make predictions and then check), carry out an experiment with a flashlight, and calculate the angles between hour marks.

Materials Needed: Paper plates, skewers (or pencils), ruler, protractor (for measuring angles), pencil, markers, compass or smartphone with compass app, flashlight.

Planned Activities:

- Research about time and shadows – in digital resources, textbooks, encyclopedias, and other visual materials;
- Explore the variety of sundials in Latvia – using digital resources, encyclopedias, periodicals;
- Experiment with a flashlight. Shine the flashlight (as the Sun) on the skewer/pencil and observe how the shadow length changes during the day;
- Create a sundial, measure angles, divide, and calculate hour marks.

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	Lesson Flow – Specific Activities and Tasks
Activation	Lesson about shadows and the path of light rays. The teacher asks open-ended questions: • Have you ever noticed how sunlight creates shadows on the ground? • How do these shadows change when the Sun moves? • Can we use the Sun and shadows to tell time, and how can we check it? • Why does the shadow length change? What does it depend on? • Why do clock hands move from left to right? Why not the other way around? To find answers, the teacher invites students to conduct an experiment with a flashlight. • In which parts of the day was the Sun's shadow long? • In which part of the day was the Sun's shadow short?
Review of Prior Knowledge	• Review the cardinal directions on a map and plan, using directional markers or a compass. Orient in the nearby area, determining directions and positions of objects according to the Sun. • Review dividing into equal parts using a clock. With a clock model, explain dividing into equal parts, and show fractions of a whole.
Understanding	The teacher explains how a sundial works and how the shadow changes as the Sun moves (video, visuals, presentation). Demonstrates (flashlight experiment) how a shadow changes direction and length during the day. At 12:00 noon the Sun is at its highest in the sky. At this moment, the shadow is the shortest and always points north. Therefore, for the sundial to work correctly, the "12:00" mark must be placed exactly to the north. When making a sundial, we use a compass or phone to find north. "12:00" is drawn in that direction. Only then will the other hour marks be placed correctly, and the shadow movement during the day will show the right time. The sundial combines knowledge about the Sun's movement and mathematics. By placing 12:00 to the north and dividing the circle into 12 parts (12h), we get an accurate, Sun-aligned time indicator.
Sundial Making	**Sundial Making** • Students use paper plates, make a hole in the center, and insert a skewer as the gnomon. • With teacher's help, they mark "12:00" north using a compass. • Mathematical Calculations • Students measure angles between hour lines (e.g., between 12:00 and 13:00, 13:00 and 14:00, etc.). • Discuss how the total 360° is divided among 12 hours (each hour – 30°). • Practice measuring and drawing precise angles on the plate. **Outdoor Experiment** • Students take their self-made sundials outside. • Place the sundial so that the gnomon is vertical and the "12:00" mark points north. • Every hour (e.g., from 12:00 to 14:00) students mark the shadow direction on their plate. • Record the time and compare with a real clock. • Create an observation table to record their notes. **Artistic Part** • Students decorate their sundials with sun rays, clouds, numbers, drawings.

Reflection	The teacher encourages reflection, asking students to share their experiences. At the end of the day, analyze the work done. Tell in your own words: How does the Sun move across the sky during the day and how do shadows change! **Angle Exercises:** • On the plate, use the protractor to mark every 30° angle (from 0° to 360°). • Find the hour marks – what is the angle between 9:00 and 12:00? • If the shadow appears at a 60° angle, what time could it be? **What I Learned About the Sun and Shadow:** • What did you learn today that you didn't know before?; • How did the shadow change as the Sun moved? (Did it get shorter, longer? Which direction did it point?); • What did you learn about angles and 360°? (How did you divide the circle? How did you measure 30°?); • How did you make your sundial? (How did you know where to place 12:00? What helped you draw the hour lines?).

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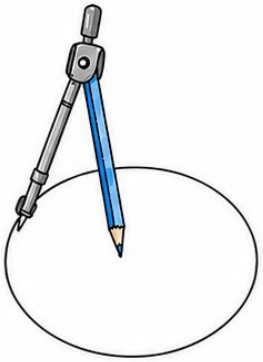
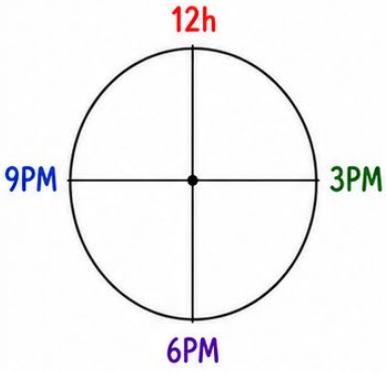
Instruction sheet for students "How to Make a Sundial"

HOW TO MAKE A SUNDIAL

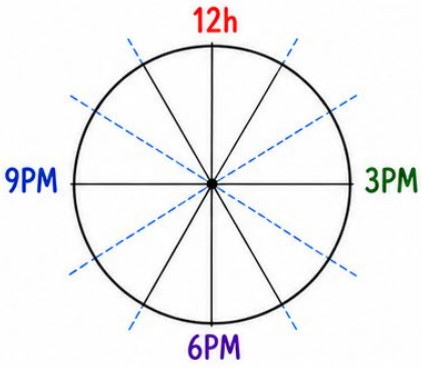
1 Draw a circle.
Use a compass to draw a circle.



2 Divide the circle into 4 parts (90°) and mark:



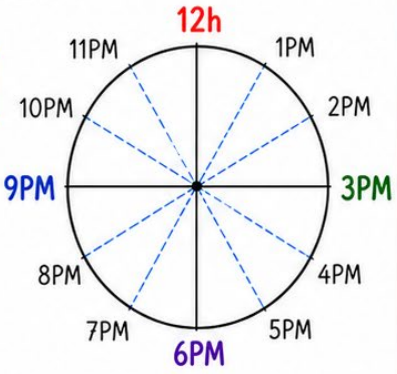
3 Remember, the whole circle is 360°.
Divide the circle into 12 equal parts.



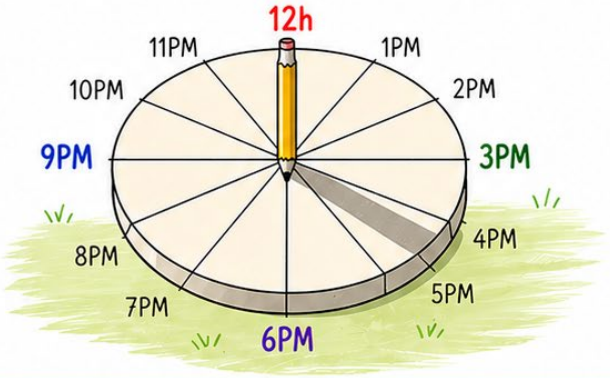
4 Mark how many hours each part will be.

360° : 12 = 30°

Each part is 30 degrees.



5 Your sundial is ready!
During the day, look at the shadow of the stick to find the time.



Remember: A full circle is 360°.
To divide it into 12 parts, each part is 30°.

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Instruction sheet for students "How to make a sundial outdoors"

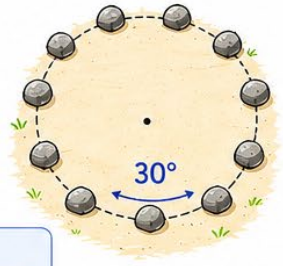
Make a Sundial clock - hands-on example:
https://www.youtube.com/watch?v=Q2MIT9ePAbU&t=2s

HOW TO MAKE A SUNDIAL OUTDOORS

YOU WILL NEED: compass; wooden stick (straight); 12 stones; a flat place outside

1 MAKE A CIRCLE

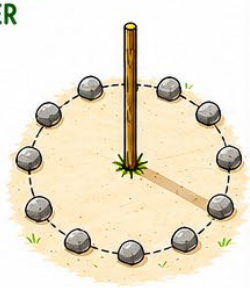
Find a flat place.
Draw a circle on the ground.
Place 12 stones evenly around the circle.



The distance between each stone is the same (30°).

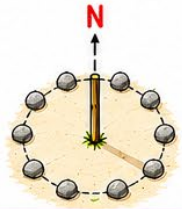
2 PLACE THE STICK IN THE CENTER

Place a straight wooden stick in the center of the circle.
Make sure it stands straight up.



3 FIND DIRECTIONS USING A COMPASS

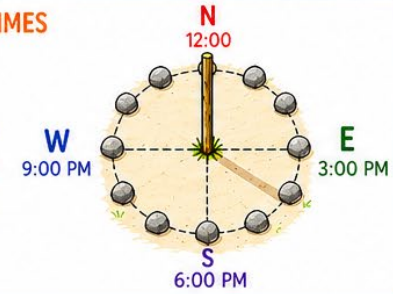
Place the compass on the ground.
Turn it until the needle points North (N).



This direction will be **12:00**

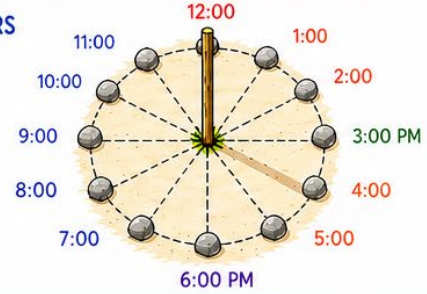
4 MARK THE MAIN TIMES

- North (N) → 12:00
- South (S) → 6:00 PM
- East (E) → 3:00 PM
- West (W) → 9:00 PM



5 MARK THE OTHER HOURS

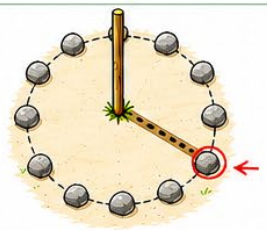
Each step between stones is 30 degrees = 1 hour.
So you can also mark:
1:00 PM, 2:00 PM, 4:00 PM, 5:00 PM, 7:00 PM, 8:00 PM, 10:00 PM, 11:00 PM



Each step between stones is 30 degrees = 1 hour.

6 TELL THE TIME

Look at the shadow made by the stick.
The stone the shadow points to shows the time.



Example:
If the shadow points to this stone, the time is 4:00 PM.
4:00 PM

7 CHECK YOUR TIME

Compare it with your:


watch

or

phone

REMEMBER:

- A full circle is 360°
- 360° ÷ 12 = 30° for each hour

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