

Measure the slope of a surface with a spirit level

Respective blueprint	Level
Description	<p>In this pedagogical sequence students will learn about angles and how to test if something is not in a straight position and how to find the slope</p>
Learning Objectives	<p>Students will:</p> <ul style="list-style-type: none"> - Understand different types of angles - Learn how to calculate different angles in degrees unit - Use the level to calculate the slope of various surfaces
Related curricular subject(s)	Geometry, History

<p>Prerequisites / preparatory actions for teachers</p>	<p>Teachers should gather the materials for the blueprint</p>
<p>Prerequisites / preparatory actions for students</p>	<p>Understand basic geometry (e.g. point, line and plane and measurements)</p>
<p>Age of students</p>	<p>9-13</p>
<p>Duration</p>	<p>1-2 hours</p>
<p>Level of difficulty</p>	<p>Medium</p>



Step by step description of the tasks

Step 1: What is an Angle?

An angle is formed by two rays connected by a point, or vertex.

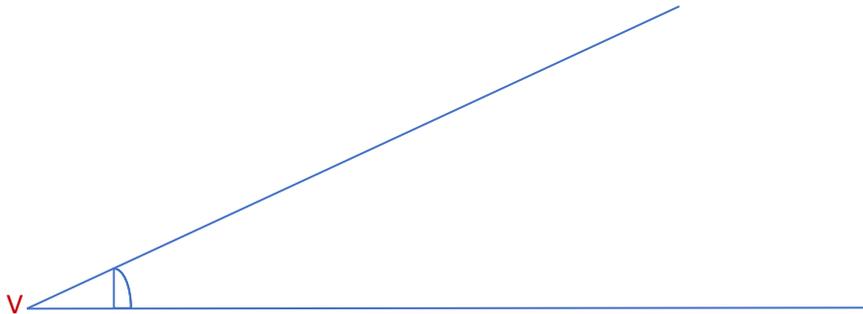


Fig. 1 Angle Showing the Vertex

When we want to calculate an angle, we take the distance between the two rays. This is expressed in degrees. To measure angles, we use a special tool known as a protractor.

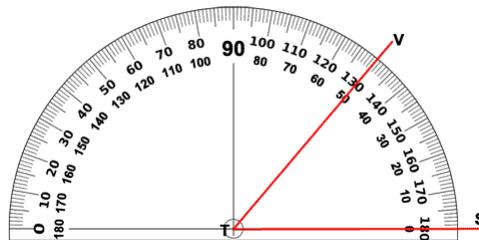


Fig. 2 A protractor is a tool used to measure angles.

Step 2: Types of angles

Right Angle: A right angle has a measurement of 90 degrees, which is written 90° . This means that one side is perfectly flat, or horizontal, and the other is going straight up and down, or vertical. You can see an example in the picture below. You see this type of angle all over the place, especially on things that are rectangular or square in shape. We compare all angles to a right angle to see if the space between the rays is bigger or smaller than 90° .

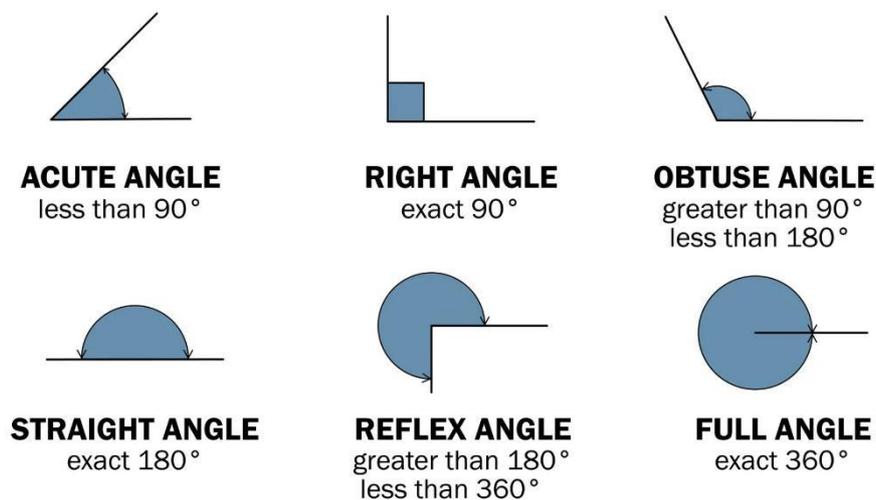


Fig. 3 Types of angles

Acute Angle: The space between the two sides of an acute angle is always less than the right angle. This means that an acute angle is less than 90° . It can measure anywhere from $0-89^\circ$. You can see an example in the picture. If you look at a triangle, at least two of the corners are always acute angles. A way to remember the name is to think of an acute angle as a 'cute' angle because it is small.

Obtuse Angle: The space between the two sides of an obtuse angle is always bigger than the right angle. So, an obtuse angle is larger than 90° . It can measure anywhere from $91-179^\circ$. The obtuse angle is thought to be a 'fat' angle.

Step 3: Introduce and/or build the Level

Figure 4 depicts the ancient Level, which was the forerunner of the modern level and had the shape of the letter "A," from which its Greek name was derived. It was used for the construction of the "Ziggurats" in Mesopotamia, the Pyramids in Egypt and the temples of the Greeks. It verifies the horizontality or the inclination of the surfaces.

If the teacher wants, they can use the blueprint to build a Level with the students.

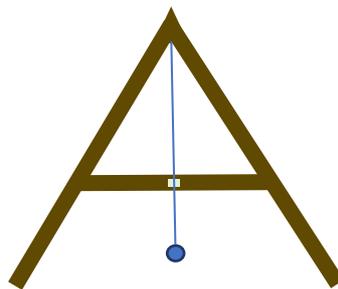


Fig. 4 Ancient Level tool



Step 4: Use a level to discover if there is a slope

If you put the Level on your school table, you can see if it is in a really horizontal position or not. If the weight is balanced, then there is no slope. In any other case it will tilt right or left.

Do the same to adjust the pictures in your school class as seen in Fig. 5.

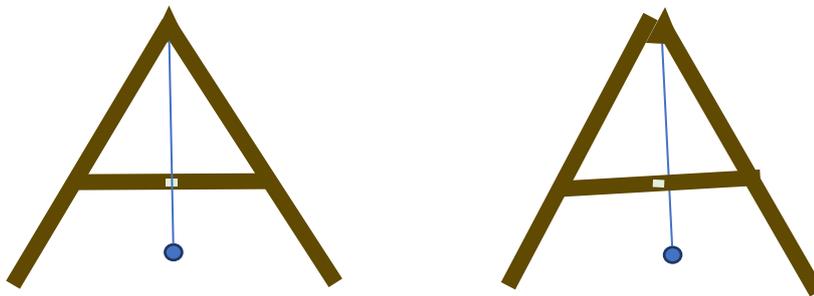


Fig. 5 Ancient Level tool

Step 5: Measure the angle with a Level, a ruler and some straight stick

Let's say that we want to measure the slope of a surface or the ground.

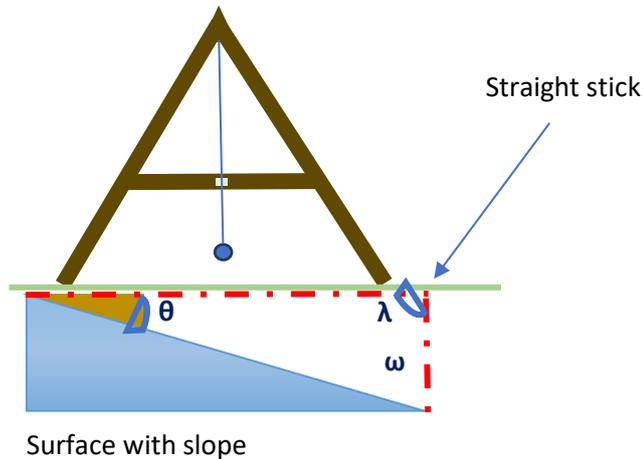


Fig. 6 Measure the angle of a sloping surface

We first use a straight wooden rod or something similar and we try to balance the Level on it. Then, with the aid of the ruler, we measure the length of the red dotted segments. We then calculate the tangent of the angle θ as:

$$\tan \theta = \frac{\text{Opposite}}{\text{Adjacent}}$$

For example, let's say that the opposite side is 2 cm and the adjacent is 5 cm. The tangent will equal 0.4cm, which will correspond to an angle of 22°. With the aid of Tangent Tables Chart like

<https://www.mymathtables.com/trigonometric/tangents-0to90->

[tables.html](#) we can find the degrees of each angle based on the value of the tangent.

To find the degrees of ω , students can follow the same process. But it is also known that the total of the degrees of the angles of a triangle is equal to 180° . So, the degrees of ω are calculated as follows:

$$\hat{\theta} + \hat{\omega} + \hat{\lambda} = 180^\circ \Rightarrow 22^\circ + \hat{\omega} + 90^\circ = 180^\circ \Rightarrow \hat{\omega} = 68^\circ$$

Conclusion

In this lesson the students learned what an angle is, the different types of angles and how to measure them. They learned how to use the Level to test if a surface is sloped. Then, they measured the angle of a sloped surface by using trigonometric formulas and charts.

Assessment activities

Activity 1. Find information about the use of ancient Level (or spirit Level).

Activity 2. Use the Level to place an image frame in your school.

Activity 3. Try to measure the slope of a ramp in your school to see if it is too steep.