Clinometer

General information			
Respective blueprint	Clinometer		
Description	In this lesson, pupils will build a clinometer. Students will discover how it works and the historical background of its invention.		
Learning objectives	At the end of this session, pupils will be able to : • Estimate the size of a tree using a clinometer • Put the invention and development of the clinometer into a historical context		
Related curricular subjects	Mathematics, Sciences,History		
Duration	**2h – 3h**		
Level of difficulty	Basic	Medium	Advanced
	☐	☑	☑
Inclusivity guidelines			
How to integrate students with SLD	• Formulate short, simple instructions that only require one action at a time. For example, cut a straw to the size of the side of the template. • When you give instructions (written), highlight the word of action, so pupils know what they are expected to do → In this example, **cut** a straw to the size of the side of the template. • When it's possible, you can show the expected result of the manipulation. • When creating groups, try to place students who are having difficulties with students who are generally more advanced so that they can help each other (a dyspraxic student will have a lot of difficulty with cutting tasks).		
How to integrate students who work faster	Ask the pupils who finished their tasks earlier to research the current uses of the clinometer and/or their use over time. They can present their findings to the class orally or with a poster.		

Step-by-step description of the lesson

Step 1: Introduction	**Estimated time: 1h**

- **General intro – 30 min**

Walk around the school (or in a park) to observe the vegetation.

Ask the pupils to find the tallest tree.

Ask them to estimate the size of the tree. Try to find "techniques" for measuring the tree.

For example, I'm 1.50 m tall and think the tree is three times taller than me.

Let the students formulate their hypotheses and make a note of them on the dedicated Clinometer measuring the height of a tree.

- **Introduction to the clinometer – 30 min**

The teacher explains that a more precise tool can be used to measure the height of a tree. The teacher shows a clinometer that has been built and asks the pupils if they know what it is and how it is used.

The pupils speculate on how the tool might be used.

History and use of the clinometer :

It was invented over 1,000 years ago and was an important equipment for early navigators.

A Clinometer is a useful piece of equipment for measuring angles and calculating approximate heights. It is used frequently in forestry, engineering and astronomy. It is also called an Astrolabe on account of being used in astronomy.

Step 2: Construction of a clinometer:	**Estimated time: 15 – 30 min**

The teacher suggests making a clinometer for two to measure the tree they chose during the introduction.

The teacher forms groups of 2 pupils and distributes the construction plan. For younger pupils, a template is provided (document Clinometer_template).

More advanced students can build the clinometer from scratch by following the steps below;

1. Draw two straight lines AB and CD where B and C meet. The two lines must be perpendicular to each other.
2. Using a compass, draw an arc of a circle between points A and D.
3. Name the straight line BC → X.
4. Measure 45° and mark the arc.

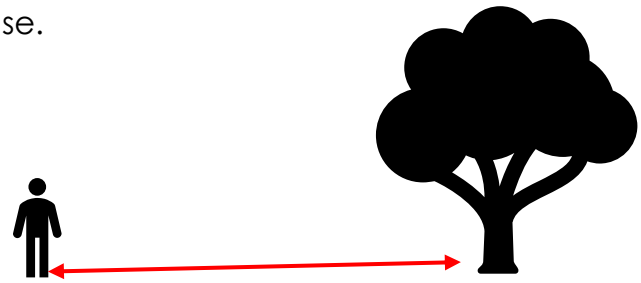
Using the compass and measuring angles can be a good exercise in straight lines, points, perpendicularity.
The steps to follow are then described in the construction plan.

Step 3: Testing of the clinometer	**Estimated time: 1 hour**

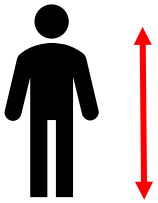
- **Explanation – 20 min**

The teacher begins by explaining how to use the clinometer to measure the height of a tree.

1. Find a tall tree in a place with plenty of space to move away from the object you are measuring.
2. Look through the straw and find the top of the tree.
3. Ask your friend to read the angle being recorded on the clinometer.
4. Keep moving back (or forward if you've gone too far) until the clinometer angle measures 45 degrees. With a 45-degree angle, your job will be much easier as the distance from you to the tree will equal the distance from the ground to the top of the tree.
5. Measure the distance between where you are standing and the tree's base.

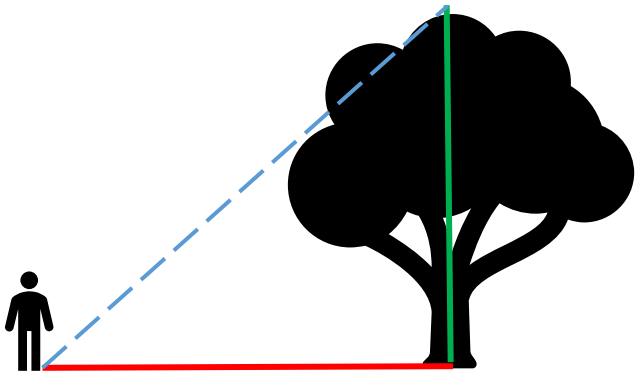


1. Measure the distance from your eyes to the ground (this is where your partner is indispensable!)



2. Add these two distances together - to be most accurate, the triangle must finish at your feet, not your eyes.
3. You now have a very close approximation of the height of the tree, building or other tall structure.

You, the base of the tree and the top of the tree form an isosceles triangle, meaning the distance from you to the base of the tree is equal to the tree's height (from the viewer's eyes to the top).



- **Measure – 30 min**

The class moves around near the trees chosen by the pupils, and, in groups of 2, the pupils estimate the height of the chosen tree.
The students record their measurements on the monitoring sheet available on the document Clinometer_Measuring the height of a tree.

Step 4: Back to class	**Estimated time: 20 min**

The students share the measurements they have found with the rest of the class and their feelings about the activity.

Assessment activities

Activity 1: Self-assessment activity

Ask the students to self-assess their performance during the group activity using the grid (Document Self-assessment grid).
Self-assessment encourages learning and improves performance. Self-evaluation is systematically formative. It aims to highlight areas for improvement.

Activity 2: Assessment of knowledge acquired

After a long sequence (of several sessions), it may be useful to carry out a formative (or summative) assessment of the knowledge acquired. Here are some examples of questions you could ask.

1. How many years ago was the clinometer invented?
2. What was the first use of the clinometer?
   In forestry – In astronomy – In boat
3. What is the name of the clinometer when used in astronomy?
4. Explain in a few words what a clinometer is used for.
5. Briefly explain the steps involved in estimating the height of a tree.

Attachments

- Template
- Self-assessment grid
- Measuring the height of a tree

References

- Esero. (s. d.). DESIGN AND MAKE A CLINOMETER AND MEASURE THE HEIGHT OF A TREE. https://www.sfi.ie/site-files/primary-science/media/pdfs/col/dpsm_clinometer_activity.pdf
- University of Cambridge. (s. d.). Making Maths : Clinometer. Consulté 22 août 2023, à l'adresse https://nrich.maths.org/make-a-clinometer

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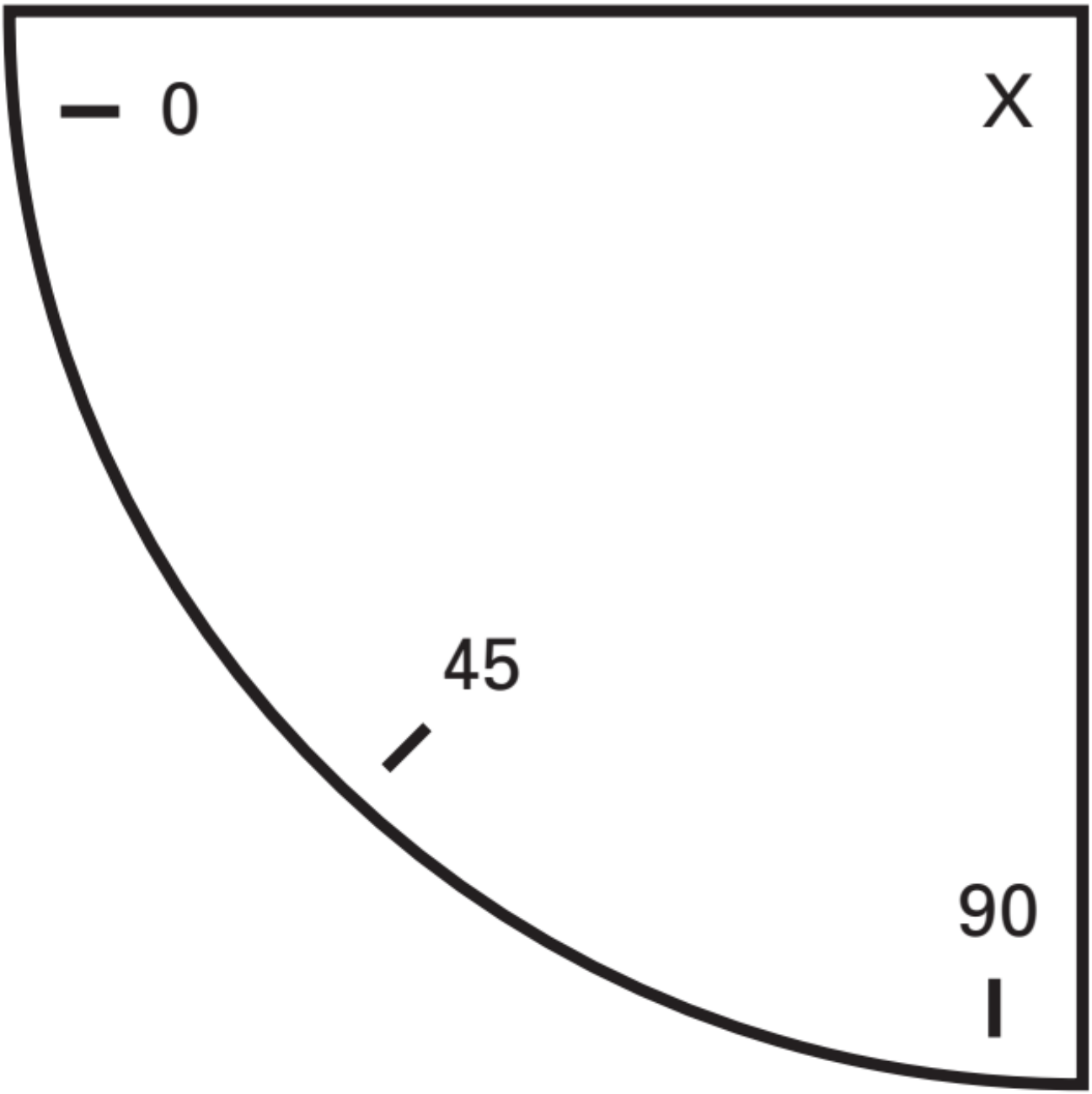
Clinometer template



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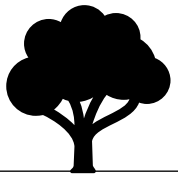

Measuring the height of a tree

Write down your hypotheses:

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Complete the sentences:

It was invented over ..... ago and was an important piece of equipment for early ..... .

A Clinometer is a useful piece of equipment for measuring ..... and calculating approximate ..... It is used frequently in forestry, engineering and ..... It is also called an Astrolabe because it is used in this field.

Now it's your turn!

Follow the instructions to estimate the height of the tree.

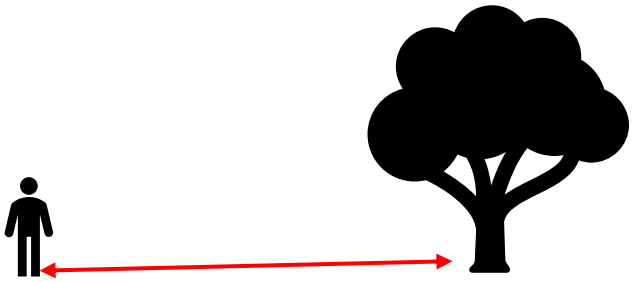
1. **Find a tall tree** in a place with plenty of space to move away from the object you are measuring.

2. **Look through the straw** and find the top of the tree.

3. Ask your friend to **read the angle** being recorded on the clinometer.

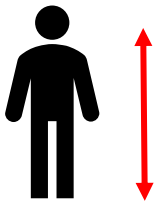
4. **Keep moving** back (or forward if you've gone too far) until the clinometer angle measures **45 degrees**. With a 45-degree angle your job will be much easier as the distance from you to the tree will be equal to the distance from the ground to the top of the tree.

5. **Measure** the distance between where you are standing and the tree's base.



The distance between my feet and the base of the tree is: .....

1. **Measure** the distance from your eyes to the ground (this is where your partner is indispensable!)



The distance between my eyes and the ground is : .....

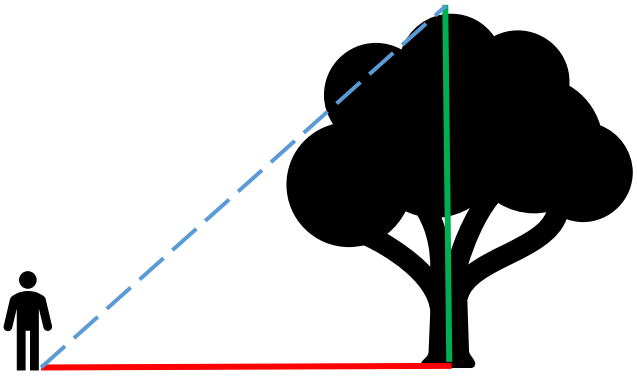
2. Add these two distances together.

..... + ... = ...

3. You now have a very close approximation of the height of the tree.

The tree is approximately ..... .

You, the base of the tree and the top of the tree form an isosceles triangle, meaning the distance from you to the base of the tree is equal to the height of the tree (from the viewer's eyes to the top).



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Self-assessment grid

Work in group

	☺	😐	☹
I took part in organising and carrying out the task.			
I cooperated actively within the group.			
I respected the other group members at all times.			
I was able to recognise and accept the skills and knowledge of the other members of the group.			
Everyone took part in our group discussions			
We asked the other members of our group for help when we needed it.			
I respected the deadlines			
I've finished my work.			
I've made an effort and I did my best			
I knew how to ask for help when I needed it			
The manipulation helped me understand the concepts			
I'm proud of my work and the result I've achieved			
I enjoyed taking part of this activity !			

☺ = Absolutely / 😐 = Partially / ☹ = Not at all

Teacher's comments :

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STEAM IN TIMES

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