Physics Oscillatory motion

Topic	Mechanical vibrations
Duration	2 lessons (90 minutes)
Class/Age	The series is primarily intended for final years of primary school (years 7-8) and for years 1 or 2 of secondary school during the implementation of the core curriculum for physics (basic course). It can also be used to implement the core curriculum in advanced physics to describe harmonic motion.
Objective	**Main objective:** To understand and describe oscillatory motion. **Specific objectives:** The student defines oscillatory motion and gives examples. The student describes the quantities characterising oscillatory motion: amplitude, period, frequency of oscillation, damping of oscillation. The student analyses oscillatory motion on the basis of graphs. The student conducts experiments related to oscillatory motion using the EMPE sensor. The student draws conclusions from the experiments conducted.
Description	Students investigate the oscillatory motion of a body (e.g. a board suspended on a string) using an EMPE sensor and software that displays in real time a graph of changes in position in of the function of time. During the lesson, students: • Set the body in vibrating motion and observe the graph of changes in its position over time on the screen. • They analyse the shape of the graph and identify the characteristics of oscillatory motion (periodicity, amplitude, equilibrium position). • They compare graphs for different initial conditions (different amplitude, mass, pendulum length) • They interpret andanalyse various graphs of and recognise errors and unusual cases
Teaching aids	- EMPE sensor with software - desktop computer or laptop with web browser - projector, projection screen or multimedia board

FIRST LESSON

I. Introduction (10 minutes)

1. A brief review of information from previous lessons on movement
(e.g. reference systems, relativity of motion, uniform motion, uniformly variable motion).

During the revision, the teacher should encourage (but not force!) students with aphasia to speak. They should be asked questions so that the teacher can ensure that they have mastered the content relevant to the rest of the lesson and can remind them of important points and/or correct any mistakes.

2. Introduction to the topic:

- Introductory question:
  Have you ever encountered a repetitive movement? Where? In what situations have you observed such a movement?

- Give examples of oscillatory motion from everyday life (e.g. swinging, heartbeat, vibration of a guitar string).
- Demonstration of oscillating motion: set in motion an object (e.g. a small board) suspended on a string attached to a hook in the ceiling or suspended on a tripod.

During the demonstration, students with aphasia should be seated in the classroom so that they can observe the demonstration without obstruction.

- Explain that in this lesson we will take a closer look at oscillatory motion and its description.

II. Theoretical introduction (10 minutes)

1. Explain the basic concepts used in the description of oscillatory motion in relation to the previous demonstration:

- Oscillatory motion: motion that repeats at regular intervals.

- Equilibrium position: the point at which a body remains at rest when no external forces act on it.

- Amplitude: the maximum deflection of a body from its equilibrium position.

For students with aphasia, explaining the above issues should not be based solely on verbal methods. It will be necessary to supplement the theory with a demonstration.

III. Motion sensor experiment (15 minutes)

We use a pendulum specially designed for this purpose, which has a flat wall, e.g. in the form of a board suspended on a string. We set the EMPE sensor so that it measures the amplitude of the board's deviation from its equilibrium position.

We can also use a long spring on which we hang a weight with a large base area, and we measure changes in its distance from the ground using the EMPE sensor.

During the demonstration, students with aphasia should be seated in the classroom so that they can observe the demonstration without obstruction.

2. Demonstration:

- The teacher demonstrates how the motion sensor works and how data is recorded.

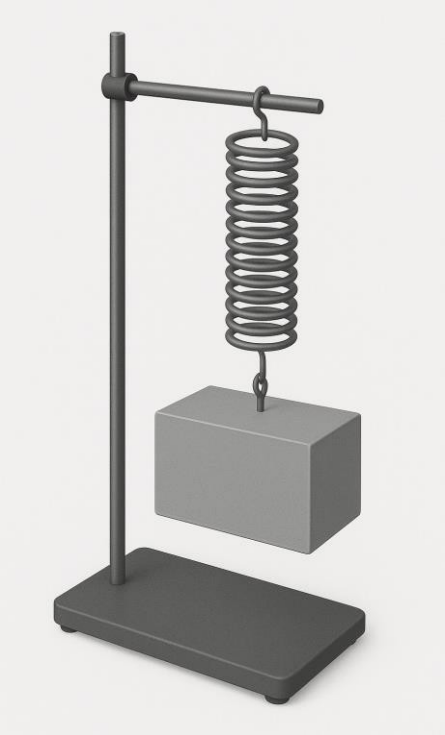
3. Conducting the experiment by students (group work):

If there is more than one pupil with aphasia in the class, they should not be placed in the same group. When working in groups, the teacher should pay attention to whether pupils with SEN are being excluded by other group members from actively participating in the experiment.

Knowing the needs and abilities of the pupils, the teacher can suggest a specific role for the pupil with SEN, e.g. setting the pendulum in motion.

- The pupils set the pendulum in oscillating motion.

1. Preparation of the station:
place the EMPE sensor
A) under the oscillating body suspended on a spring, remembering that the distance should be greater than 40 cm,



B) perpendicular to the surface of the board,
remembering that the distance should be greater than 30 cm due to the accuracy of the sensor measurement

- Setting up the pendulum (e.g. a board suspended on a string).

  Connect the motion sensor to the computer and launch the software.
  If there is no physical laboratory available, the EMPE kit can be used by adding extra weight to the case with heavy objects and repeating the experiment as shown in the photo. The case is suspended on a string with a variable length of 150-250 cm.

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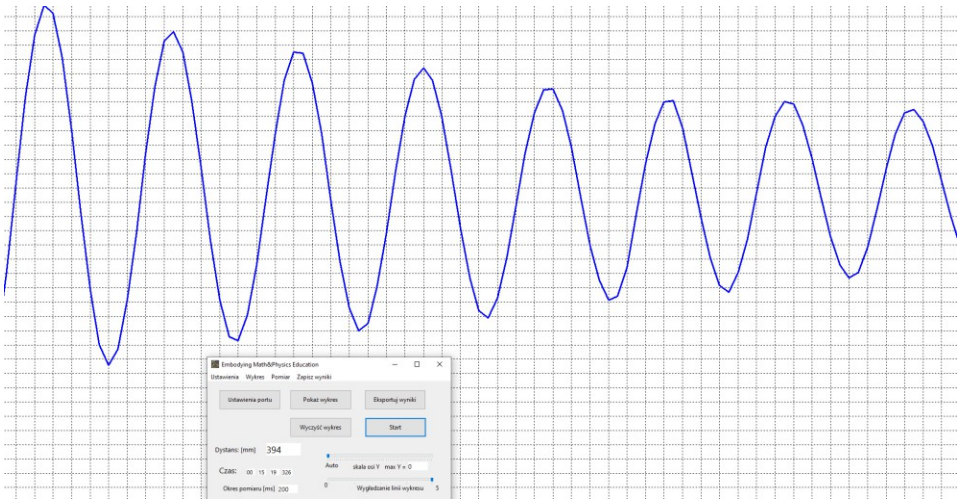
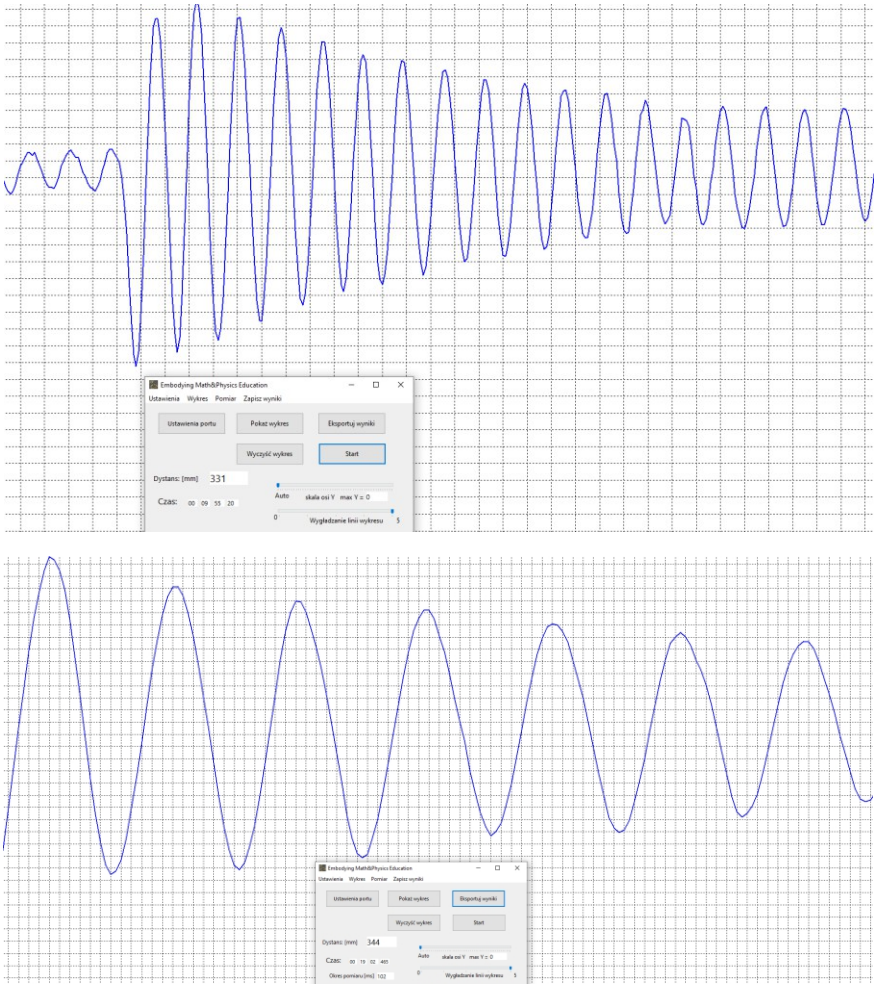
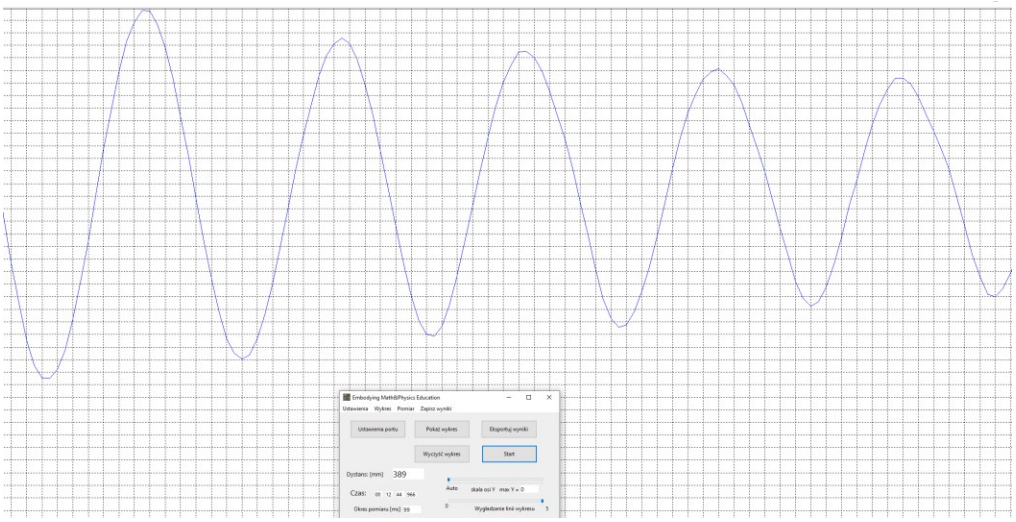


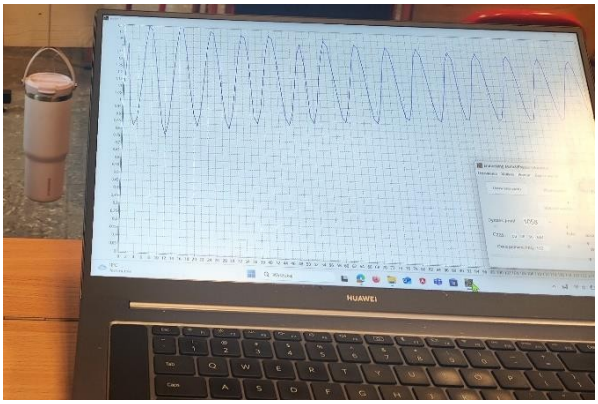
The recording frequency has a significant impact on the quality of the recorded data. We recommend setting the value to 100-150 [ms]. We recommend setting the sensor to measure distances of no less than 30 cm.

Sample records for a recording period of 200 ms and 100 ms (below).





- The motion sensor records changes in body position over time.



- Students observe the graph on the computer screen.

For students with aphasia, the computer screen must be adapted to their perceptual abilities: image legibility, font size.

IV. Discussion (15 minutes), sample questions.

1. *How does the position of the body change over time? Is this movement repeatable?*
2. *Is it possible to read the time of one swing from the graph, and if so, how?*
3. *At which point on the graph is the body's deviation from the equilibrium point greatest, and at which point is it smallest? What do we call these values?*
4. *How can the amplitude of the movement be read from the graph?*
5. *Where on the graph is the body's equilibrium position? How can you recognise it?*
6. *What can you say about the time intervals between successive maximum deflections?*
7. *Are these times equal?*
8. *What would the graph look like if the amplitude of the movement was greater/smaller?*
9. *How will the shape of the graph change if we change the mass of the oscillating body?*
10. *How will the shape of the graph change if we change the length of the pendulum?*
11. *Do you observe any irregularities? What could be the cause of them?*

During the discussion, the teacher should encourage (but not force!) students with aphasia to participate actively. Conditions should be created for students to speak and present their ideas. This will not only allow them to be actively involved in the lesson, but also enable the teacher to ensure that students understand the content being taught and to correct any mistakes.

V. Homework assignment (5 minutes)

Task:
Find examples of oscillatory motion in your surroundings and describe them,
giving approximate amplitude values.

Task for students with aphasia:

Find 3 examples of oscillatory motion in your environment. Describe these motions. Give approximate amplitude values for each of these motions.

Summary

During this lesson, students learned about one way of describing oscillatory motion using graphs. The use of the EMPE sensor allowed for practical implementation of the description in real time and greater understanding and analysis of this phenomenon.
Active participation in the experiment and discussion should reinforce the knowledge gained and develop the ability to analyse experimental data.

Ensure that students with aphasia have properly recorded notes from the lesson.