

Comparing approaches

Explore in pairs or threes the science tasks below. Discuss the following questions:

What decisions have been left to the students in any of the tasks?

When comparing structured/unstructured versions of the same task:

- a. Which version may be perceived as more challenging or motivating for the students?
- b. Which version best promotes students' autonomy and decision-making?

What are the learning goals for any of the tasks? Compare structured vs. unstructured versions



Make a list of any the things (skills, strategies of key ideas) that students can learn or develop when conducting any of the tasks. Compare structured tasks versus unstructured tasks.

What pedagogical issues will arise when you start to use unstructured problems like this?

Germination depends on temperature (structured version)

Background Information:

Germination in plants is the process by which a dormant seed begins to sprout and grow into a seedling under the right growing conditions. Just like many other life processes, germination is affected by temperature. In chemical reactions inside living things the speed of reactions increases with increasing temperatures. However, the temperature required for germination to begin can vary greatly depending on the species of plant. Every species has its own optimal temperature for germination to start.

Conduct the following experiments in order to confirm the influence of temperature on seed germination

Material:

2 Petri dishes, a thermometer, garden cress seeds, a large clear plastic container kept damp, a fridge.

TIME	Number of germinated seeds	
	Room temperature	4 °C
24 hours		
3 days		
1 week		
2 weeks		

Questions

What influence does raising the temperature have on germination?
Why do seeds germinate faster when it is warmer?

Inquiry about germinating seeds (unstructured version)

Imagine that you work as a scientist in a biological research lab. One day your boss comes to you with a problem he wants you to answer:

‘Global warming could be a big problem for farmers all around the world. The germination of some species of plants could be affected. Design an experiment to find out how global warming could affect seed germination in the spring, and if this will be a problem for farmers’.

You have to design and conduct an experiment to find out what effect global warming could have on seed germination. You should:

- Decide which experiments to conduct
- Decide which data to collect
- Do the experiment
- Make a poster showing your results and conclusions

Pendulum (structured version)

Background Information

A pendulum is generated when you suspend a body or mass from a fixed point and displace it sideways from its resting equilibrium position, making it swinging back and forth due to gravity.

The simple gravity pendulum is an idealized mathematical model of a pendulum, where a weight (or bob) is suspended on the end of a massless cord suspended from a pivot, without friction. When given an initial push, it will swing back and forth at constant amplitude. However, real pendulums are subject to friction and air drag, so the amplitude of their swings declines.

The time for one complete cycle, a left swing and a right swing, is called **the period** (T).

The length of the period (L) is the distance between the pivot and the centre of the bob

The amplitude is the maximum angle that the pendulum swings away from vertical

The period depends on the length of the pendulum and also on the amplitude of the oscillation. However, if the amplitude is small, the period is almost independent of the amplitude. It is also independent of the mass of the bob if the amplitude is limited to small swings.

For the simple gravity pendulum it can be demonstrated that:

$$T^2 = 2\pi L/g$$

T = period

L = Length

g = gravity

Materials

- stopwatch
- meterstick
- three metal washers, about 2 cm in diameter
- ring stand or other support for clamp for pendulum
- 1,5 m of good string
- spring clamp
- two small pieces of wood or two coins that may be closed in the jaws of the clamp protractor
- metal bobs with different masses

Procedure

1. Attach the clamp to the ring stand or other support so that it is free to hold the string for the pendulum. It is important that the pendulum suspension be friction-free so that the wood blocks or coins are used to provide a point suspension for the string. Put the blocks or coins together with the string in between, and sandwich the combination in the clamp.
2. Tie the washers to the other end of the string to make a pendulum. The pendulum should swing freely without hitting anything
3. Measure the length of the pendulum in centimeters from the place where the string leaves the blocks to the middle of the suspended washers. This value should be recorded on the data table as length (L) for trial 1.
4. Pull the pendulum away from the vertical at an angle of 15 degrees (use your protractor to

check the angle), and let it swing. With the stopwatch, time how long it takes to make 10 complete back-and-forth swings. Record this result on the data table

5. Release the clamp and change the length of the pendulum. Measure and record this new value for L on the data table. Again bring the pendulum out to 15 degrees, and measure and record the time for 10 complete swings
6. Repeat step 5 three more times for a total of five trials. Each trial should use a pendulum with a different length
7. Complete the data table. To find the period (T) of one swing, divide your time values for 10 swings by 10. Calculate T^2
8. Repeat the same procedure for any of any of the different masses.

Study of Pendulum for bob 1 (mass = g)				
Trial	Length (L) (sec)	Time for 10 swings (sec)	Period (T) (sec)	T^2 (sec ²)
1				
2				
3				

Questions:

How does the period of pendulum depend on the length of the period?

How does the period of pendulum depend on the mass of the bob?

Inquiry about pendulum (unstructured version)

It is said that Galileo began his study of pendulums after he watched a suspended lamp swinging back and forth in the cathedral of Pisa, when he was still a student there. He got deeply intrigued by the back and forth motion of a suspended weight and begun to raise some questions:

- Does the weight of the suspended mass have an effect on the time to complete an oscillation?
- What is the relationship between the length of the string and the time to complete an oscillation (the period)?

What we do

1. In small groups discuss what does the pendulum motion depends on and formulate some hypothesis about it
2. Design and conduct experiments to test your hypothesis.

Present and discuss your results to the whole class group