Fast and slow motion (Item No.: P6105200)

Curricular Relevance

Area of Expertise: Natural Sciences
Education Level: Age 11-14
Topic: Nature and technology
Subtopic: Mechanical devices in daily use
Experiment: Fast and slow motion

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Easy	10 Minutes	10 Minutes	2 Students

Additional Requirements:

Experiment Variations:

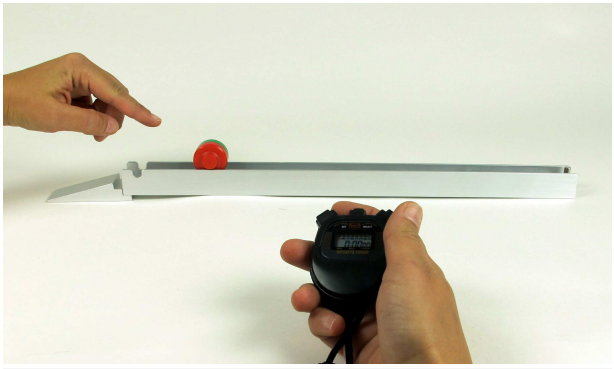
Keywords:

Acceleration, Inclined plane, Velocity

Information for the teacher

Educational objective and competences

During this experiment, the students observe the movement of a roller on an inclined plane. They notice that the motion becomes quicker when the angle of inclination is increased. They realise that this is in fact an accelerated motion which is caused by the weight of the roller and that the influence of the weight on the motion increases the steeper the plane becomes.



Experiment set-up

Competences

Process-related competences:

The students can...

K: Knowledge gain
C: Communication
A: Assessment

K02 – develop problem-related questions and formulate hypotheses.
K03 – describe relationships with sentences of the type "The more/less..., the more/less..." or "The greater/higher/smaller/lower..., the greater/higher/smaller/lower...".
K06 – execute simple experiments independently based on written instructions.
K08 – recognise technical concepts in examples from everyday life.
K09 – plan, execute and document simple experiments by themselves.
K10 - describe relationships with the aid of geometrical representations.
K12 – make assumptions about connections and causes.

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C02 – describe the technical connections and relationships in everyday language.
C03 – acquire measurement data and extract them from age-appropriate representations.
C05 – present their results with the aid of specified media.
C06 – express and accept criticism.
C07 – work in groups on their own initiative.
C09 – read age-appropriate, relevant texts and relay the content thereof.

A01 – appraise their own results based on a comparison with other groups.
A02 – recognise the role of scientific phenomena in their everyday life.
A03 – evaluate arguments, take up a position and substantiate their point of view.
A06 – explain the areas of application in which scientific knowledge is of importance.
A08 – distinguish between the desired and undesired characteristics for the application of scientific effects.

Content-related competences:

The students can... **S:** Specialised knowledge

S18 – identify forces as the cause of motion.

S20 – describe linear motion.

S21 – describe accelerated motion.

Material

Position No.	Material	Order No.	Quantity
1	Roadway for magnets	11066-00	1
2	Stairs for roadway	11066-01	1
3	Magnetic roller, spare	11065-01	1
4	Digital stop watch, 24 h, 1/100 s and 1 s	24025-00	1

Saefty information

For this experiment, the general notes and instructions concerning safe experimentation in science classes apply.

Didactic notes

Procedure

At the beginning, the time measurements will probably be rather imprecise, since your students need to familiarise themselves with the measurement procedure. Let them repeat the various parts of the experiment several times so that they can reach the best possible results. We recommend averaging the results of five successful time measurements.

Tablet PC option

Apart from the traditional variant, the students can also use a tablet PC in combination with the "measure" app in order to create media objects, such as photos or videos. For this experiment, this facilitates the later reproduction and evaluation of the results. The students can record visual proof of their observations to review or compare them among each other at a later time. We recommend storing the resulting media in the app in a project folder to ensure a clear assignment.

- As an alternative to the stopwatch, it is also possible to use the "measure" app for measuring the time. The advantage is that the times during several experiment runs can be directly averaged. As a result, your students can obtain more accurate results without any separate calculation.
- Apart from measuring the time, it is also possible to record a video of the motion during the experiment. As a result, the measured time can be verified based on the video.

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Experiment

Introduction

Using a skateboard on a flat surface should not be difficult for you. However, things can be a bit trickier when you roll down a hill or ramp. Why is this more exciting?

Skateboard on a half-pipe

Application

Roller coaster in an amusement park: At the beginning, the car is pulled upwards. Afterwards, it moves on its own, sometimes fast and sometimes slowly.

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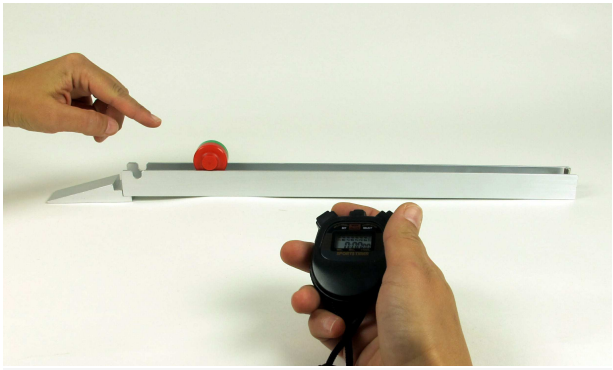
Task

Position one end of the track on different steps of the platform and measure the time that the roller needs for reaching the other end of the track.



Experiment set-up

Assumption

Will the movement become faster?

Initial question

Think about the way the roller will behave during the experiment.
What will happen to the roller when one end of the track is located on the highest step?
Will the speed of the roller be the same as at the beginning of the series of experiments?

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Material and procedure

Position No.	Material	Order No.	Quantity
1	Roadway for magnets	11066-00	1
2	Stairs for roadway	11066-01	1
3	Magnetic roller, spare	11065-01	1
4	Digital stop watch, 24 h, 1/100 s and 1 s	24025-00	1

Procedure

It is not easy to measure the time during this experiment. Repeat the measurement several times for every step until you feel that the measurement was OK.
You can also measure the time several times and average the results.

1. Position one end of the track on the lowest step of the platform. Hold the roller in position at the start of the track directly in front of the small recess as shown in Fig. 1.

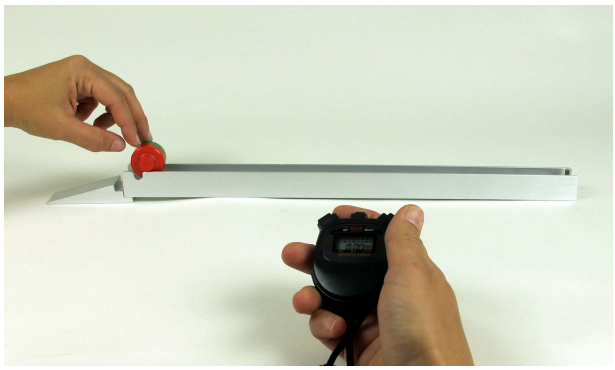

Fig. 1

Release the roller and start the time measurement at the exact same time.

Stop the time measurement immediately when the roller touches the end of the track.

If you use a tablet PC, you can also use the stopwatch of the "measure" app instead of the real stopwatch included in the experiment set.
In addition, you can film the motion with the "measure" app and store the video in a project folder on the tablet PC. This enables you to verify the measured time at a later time.

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2. Repeat the experiment with the track on the second and third step of the platform.

   Enter the measured time values into the experiment report.

Evaluation

During this experiment, you have studied the way the inclination of the track affects the speed of a roller.

Go to the experiment report and answer the questions about the experiment.

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Report: Fast and slow motion

Observation - Question 1 (3 points)

Enter the measured times here.

	Time in s
Lowest step	1 ±0.6
Middle step	1 ±0.4
Highest step	1 ±0.3

Observation - Question 1 (1 point)

Which step of the platform made the roller move the fastest along the track?

- [ ] Lowest step
- [ ] Middle step
- [ ] Highest step

Evaluation - Question 1 (2 points)

The steeper the track is, the ..... the movement of the roller will be.

The..... the distance is that the roller moves downhill, the faster the roller will roll.

Initial question (repeated) (1 point)

Think about the way the roller will behave during the experiment.

What will happen to the roller when one end of the track is located on the highest step?
Will the speed of the roller be the same as at the beginning of the series of experiments?

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