Demonstrator # 19

Motion on an inclined plane

TEACHER NOTES

Activity title:

Forces

Theme:

Motion on an inclined plane

Student age:

13 years

Time:

100 min

Scientific content

gives needed science background (concepts, definitions, laws etc) including pre-requisite knowledge required and science concepts developed in the activity, includes relevant students' difficulties,
Concepts: forces, inclined plane, graphic representation, dependent variable/independent variable,
Elementary and basic skills: observation, identification of variables, practice graphic representation, registration and use of registered data

Learning Objectives

At the end of the lesson the pupils will be able to :

- ⇒ interpret the graphic of acceleration as a function of time;
- ⇒ recognise different types of motion from the specific regidstered graphic;
- ⇒ measure and determine different motion' parameters;
- ⇒ exercize critical thinking skills by approaching the study of motion in different imposed conditions;
- ⇒ use accurately the scientific language;
- ⇒ compare different motions.

Inquiry based character of activity

highlights the IBSE character of the activity, specifies a type of inquiry and lists inquiry-based skills (for details, definitions and terminology to use see 'Short guide for designing inquiry-based teaching materials')
Guided Investigatiom; Blended Investigation
Teacher guided discovery

Applied Technology (if necessary)

Materiale necesare

- **materials**: mechanical school kit, sensors, soft
- **time**: 100 min

Methodological Guide

describes method, student learning activities (discussions, investigations, data analysis, reflections etc.) and leading questions, includes a suggested time outline

Anticipation

- **Examples of contextual situated problems** - pretext
- **Observation of short film** sequences selected by the teacher

Building knowledge

- Teacher ask pupils to carefully watch the movie sequence and to identify and define the type of the observed motion.
- Pupils are organized in groupes of four, each group hase the needed materials from the physics kit in order to realize the specific settings for the comparative study of the motion of a given body (having different materials and surfaces on each side) on the inclined plane. In this configuration pupils accomplish the experiments described in the experimental activity worksheet, fixing for each surface, one after other, the accelerometer and registering their own data.
- The Caffeeshop methode (1 stay 3 go around): Each pupil recieve an experimental activity worksheet with the following tasks:
  - to realize the experiments with the body on the inclined plane;
  - to interpret the graphics obtained by mean of the accelerometer;
  - to compare the motion of the body depending on the type of material and surface;
  - to realize a poster in which they should present the summary/scheme/squetch of activities, results and descovered explanations.

After about 15 min activity in the group of four the teacher introduces a motion. In order to have a good reorganiation of the groups of pupils it is important that the initial number of groups to be equal with the number of pupils in the group. Pupils count inside of each group, and the pupil with number 1 stay at his/her place in the initial setting; the pupil with number 2 goes to the next, closest neighbour group; the pupil with the number 3 goes ito the second next group away and so on in such a way that, at the end, in the new setting all members, except one, come from different groups. The pupil which kept his/her initial place presents to his/her colleagues what they accomplished in the first 15 min, in the first setting; the other pupils ask questions, suplimentary information, explanations, arguments in order to find out as much as possible new aspects of the studied theme. This secquence take about 20 min, time during which the teacher monitor the quality of discussions between the pupils, their focus on the investigated subject, the relevance, pertinence and acuracy of the scientific language and approach. The final step, pupils come back to their initial places – first setting – where they share their impressions, information, explanations learned/discovered in the previous sequence and they have about 10 min more in order to finalize and present/expoze the poster with the results they obtained together with the corresponding arguments**.**

Reflection/Consolidation

- **Assessment methode**: galery *tour* – the groups of four pupils expose the A3 paper sheets on which they synthetizeied the common negociated answers; each group receive a number of paper sheets (post-it) equal with the number of exposed posters, except for their own poster and they read the conclusions of their colleagues and after that they write down a question for each group. As a function of the time remaind, it is possible that each group to answer in classroom at all the questions that they received or every group take its questions and solves them as homework.

Evaluation instruments: worksheets fill in; the classroom map/observation grid for the group activities

Assessment

provides suggestions how to asses the activity, preferable with concrete questions and expected student answers

⇒ Observation of group activities;
⇒ oral, conversation;
⇒ written ending sheets

STUDENT WORKSHEET

Activity title:

Measure of a body'acceleration on an inclined plane

Introduction

states a driving (research) question and outlines objectives
Which are the forces acting on a body situated on a inclinated plane?
Which is the equilibrium condition for the translation motion on a given direction?
What kind of motion has the body? Describe and argue.

Thinking about the question

An inclined plane is a plane that makes an angle with the horizontal surface. The elements of a tilt plane are:
- the length of the plane – l
- the high of the plane – h
- the angle of the plane: α
if needed provides information about the science addressed

Materials needed

Inclined plane, body with different kind of surfaces (wood, metal, abrasive paper), accelerometers, antenna, computer
if needed provides list of materials

Safety

If needed lists warnings and cautions concerning the investigation

Investigation

1. *Represent the forces acting on the body moving on the tilt plane.*
2. *Write down the formula for the net force.*
3. *Write down the formula for the acceleraton of the body on the tilt plane.*

Depending on the type of inquiry involved provides guidance on how to carry out the investigation

Analysis

If needed suggests analysis that can help interpret data

Further investigation

If needed provides suggestions for a next possible investigation or additional, deeper investigations

Assessment

An artificial satellite is circling the globe at the equator, going eastward at constant speed. Its acceleration is:

a) *zero;*
b) *eastward;*
c) *northward;*
d) *downward;*
e) *upward.*

A tennis ball is struck into a high lob. As it travels it will have a constant:

a) *horizontal velocity;*

b) vertical velocity;
c) horizontal acceleration;
d) net velocity;
e) net acceleration.

In the spin cycle of a washing machine the clothes must be accelerated at 75 m/s^2 in order squeeze the water out of them. If the radius of the basket is 30 cm how many revolutions must it makes per minute?

If needed includes student assessment