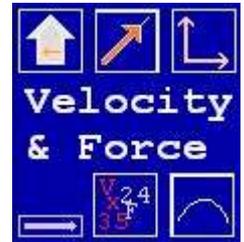




Velocity & Force microworld

short description



The microworld is developed to support applied mathematics and physics teaching / learning on secondary education level (age 12 - 18) in different countries. There is a translation of texts utility attached, instruction and a workbook.

Aims of the microworld

The aim of this microworld is to introduce vectors in physics and to analyze the role of velocity and force (acceleration) vectors. It helps to understand how force is changing velocity vector and thus how force rules the body movement (second Newton's Law). It contains 2 important examples:

- body movement in uniform gravitational field – near the Earth surface – to analyze different kinds of “shots”,
- body movement in central gravitational field, for example satellite or planetoid movement.

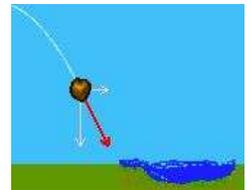
The example of steering the body movement on a round track gives the possibility to understand the role of centripetal force.

The exercises are “open”. There are possibilities of different kinds of activity, gathering the experience, answering questions: what will happen when we change...?

Model

A rocket or a stone is moving according to the Second Newton's Law. During the motion velocity vector is changing only due to the acting force. There are three possibilities.

- If a rocket is somewhere deep in space, far from other bodies, the only force changing its movement is due to rocket engine.
- If a stone is near the Earth surface, then the motion of a stone is under gravity force directed top-down. It is the motion in uniform gravitational field near Earth surface. No friction or resistance is taken into account.
- If a stone (planetoid or planet or even a satellite) is somewhere in a Solar System, far from planets, the only force acting on it is gravitational pull from the Sun directed always to the centre of Sun. The force is described by Newtonian Law of Gravity. It is inversely proportional to the square of distance between Sun and a stone.



Parts of microworld

1. Free control (steering a rocket in space)

Imagine that you are steering the movement of a rocket. A rocket is somewhere deep in space, far from other bodies. The only force changing its movement is due to rocket engine. Your steering centre is a black arrow of a force vector. You can change force value and direction by dragging black arrow. You can also change initial velocity vector.

2. Constant gravity (throwing a stone)

Imagine you throw a stone. Throwing you set initial velocity. Then the motion of a stone is under gravity force directed top-down. You can set initial velocity vector. During the motion you can watch how velocity is changing due to gravitational force.

3. Central gravity (launching a planetoid)

Imagine a little planetoid moving near the Sun. The only force acting on a planetoid is gravitational pull from the Sun. You may change initial velocity vector. You cannot change the force vector because it is dependent only on the distance from the Sun. It's worth trying how the planetoid is moving when it starts with different velocity values.

4. Round track (controlling circular movement)

How can be circular motion achieved? Try to steer the rocket in such a way, that it could move inside round track. Try to control movement by changing force vector. You may also change initial velocity vector.



5. Painted track (game for two)

Paint a track using pencil. Try to control movement on a track by changing force vector.

The microworld is a product of **CoLabs** project prepared by Polish team from **OEEIZK**. The idea was developed by Andrzej Walat, programming is done mainly by Witold Kranas, many improvements are due to Katarzyna Ołędzka, Polish teachers, co-operating in a project and international partners giving devices. Microworld is prepared in two versions:

- Imagine Project, • WWW page (<http://colabs.oeiizk.waw.pl/prisi.php>).

Both versions are equally functional and may be used by students.