

## Velocity & Force microworld instruction

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). The microworld could be named "Movement Laboratory". It contains 2 important examples: body movement in uniform gravitational field – near the Earth surface – enables to analyze different kinds of "shots" and 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...?

### Microworld pages

#### 1. Free control

##### *Exercise.*

Try to control movement by dragging force black arrow. You may change initial velocity by dragging red arrow.

##### *On screen:*

links to other pages,

title of current page (underlined), showing short explanation after pointing,

blue circle with black force vector (to drag),

button **go** / **new** – start movement / stop movement and return to initial position,

button **pause** / **resume** – movement pause / resume,

hidden fields with velocity and force values,

blue pane with a body at initial position, on its borders body stops,

body (a rock) with red velocity vector, dragging an arrow changes initial velocity.

#### 2. Constant gravity

##### *Exercise.*

Try to hit the lake. Avoid clouds. Change initial velocity by dragging red arrow. Change initial height using slider. You may also change gravitational force by dragging black arrow.

##### *On screen:*

links to other pages,

title of current page (underlined), showing short explanation after pointing,

blue field with black force vector (to drag, but not during the movement),

button **go** / **new** – start movement / stop movement and return to initial position,

button **pause** / **resume** – movement pause / resume,

hidden fields with velocity components values and force value,

blue pane with a body at initial position and:

body (a rock) with red velocity vector, dragging an arrow changes initial velocity.

slider to change the height of starting point,

green earth surface with a small lake (target – when the rock hits the lake it disappears, hitting the ground stops movement),

two white clouds stopping a rock.

#### 3. Central gravity

##### *Exercise.*

Check different paths when you change initial velocity by dragging red arrow.

##### *On screen:*

links to other pages,

title of current page (underlined), showing short explanation after pointing,

blue circle with black force vector (not to be changed),

button **go** / **new** – start movement / stop movement and return to initial position,

button **pause** / **resume** – movement pause / resume,

hidden fields with velocity and force values,

blue pane with a body at initial position and:

body (a rock) with red velocity vector, dragging an arrow changes initial velocity.

massive central body (Sun), hitting it stops the movement.

#### 4. Round track

##### *Exercise.*

Try to control movement on a track by dragging force black arrow. Change initial velocity by dragging red arrow.

##### *On screen:*

links to other pages,  
title of current page (underlined), showing short explanation after pointing,  
blue circle with black force vector (to drag),  
button **go** / **new** – start movement / stop movement and return to initial position,  
button **pause** / **resume** – movement pause / resume,  
hidden fields with velocity and force values,  
dark pane with blue track, on its borders body stops,  
body (a rock) with red velocity vector, dragging an arrow changes initial velocity,  
slider to change track thickness,  
on the right text field showing how long the body is in a move.

#### 5. Painted track

##### *Exercise.*

Paint a track using pencil. Try to control movement on a track by dragging force black arrow. Change initial velocity by dragging red arrow.

##### *On screen:*

links to other pages,  
title of current page (underlined), showing short explanation after pointing,  
blue circle with black force vector (to drag),  
button **go** / **new** – start movement / stop movement and return to initial position,  
button **pause** / **resume** – movement pause / resume,  
hidden fields with velocity and force values,  
dark pane to paint a track, on its borders the body will stop,  
body (a rock) with red velocity vector, dragging an arrow changes initial velocity,  
a pencil to paint a track,  
slider to change track thickness,  
on the right text field showing how long the body is in a move.

##### **Buttons:**



Jump to the main page, project icon.



Show / hide velocity vector.



Show / hide velocity vector components.



Show / hide values (velocity, force).



Trace on / off.



Draw new track (page 5).



Previous page.



Next page.