



Virtual laboratory



PHYSICS

Archimedes

User
manual



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Terms and Definitions

The following general terms are used in the User Guide:

Term	Definition
Virtual Laboratory	Application "Virtual Laboratory "Physics", section "Archimedes".
Scene	A virtual three-dimensional space within which the user can interact with the Virtual Laboratory objects. The concept of "scene" also includes the data of the current research (positions of objects, their parameters, etc.)
Desktop	Part of the scene within which the user can place Virtual Laboratory objects and interact with them.
Process simulation	The process of interaction between objects in a scene modeled in the Virtual Laboratory.
Camera	A scene tool with which the user observes everything that happens in the Virtual Laboratory.
Click	To make a click: - When using a mouse, move the mouse pointer to the object, press and release the left mouse button without moving the pointer; - When using a touchscreen, press the object with a finger and release it without moving the finger along the screen.
Toggle Button	A button that changes its state from inactive to active and vice versa after being pressed. The state is retained until the next interaction.

1 System requirements

The minimum system requirements for running the application "Virtual Laboratory "Physics", section "Archimedes " are:

- **Processor:** Intel Ivy Bridge series / AMD Bulldozer series.
- **RAM:** 4 GB.
- Graphics Card:
 - Integrated: Intel HD Graphics 5000 / Intel Iris;
 - Discrete: GeForce 400 series or newer / Radeon HD 7000 series.
- **Screen Resolution:** 1920x1080 / 1920x1200 and higher (4K and Retina displays require a more powerful graphics card for comfortable operation).
- **Supported Browsers:** Chrome, Yandex.Browser, Opera 44+, Firefox 51+, Edge 79+, Safari 15+.
- **Supported Operating Systems:** Microsoft Windows 7 (x64 versions) with WebGL 2.0 driver support, MacOS X "Snow Leopard" 10.6 with WebGL 2.0 driver support, Linux or Debian with WebGL 2.0 driver support.

2 Interface of the application

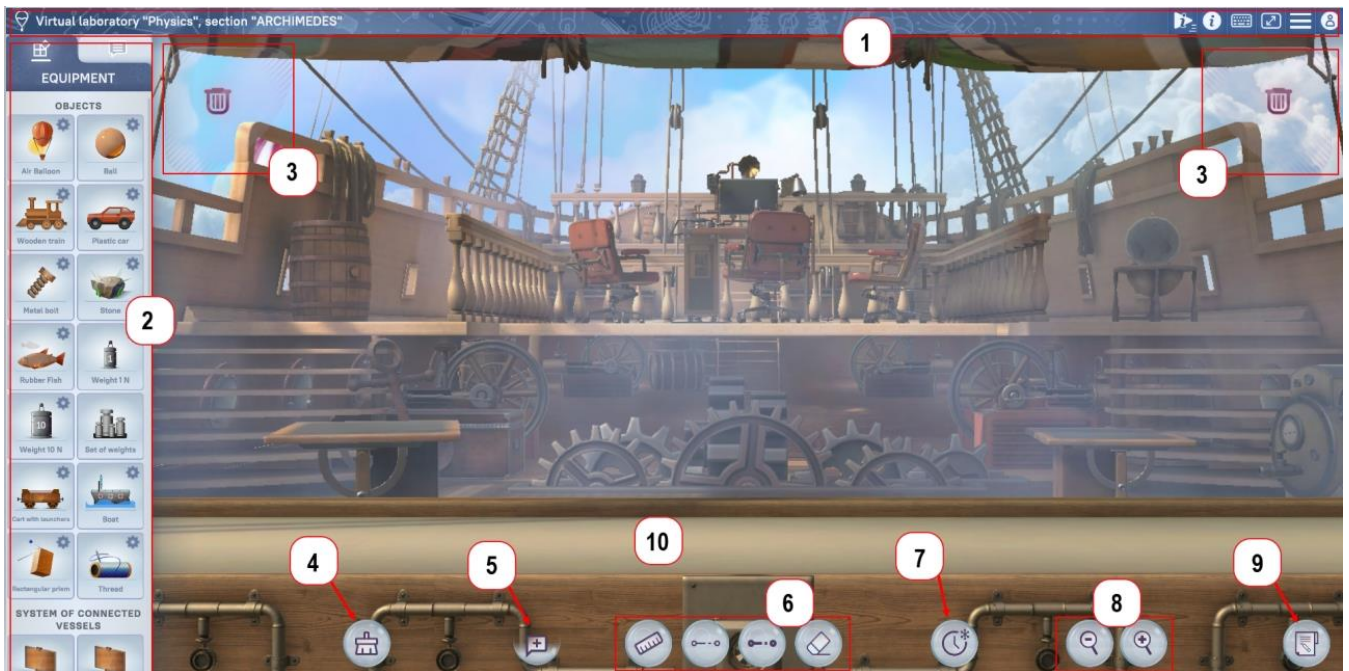


Figure 1 – The Interface of the Virtual Laboratory "Physics", section "Archimedes"

The Interface of the Virtual Laboratory (Figure 1) includes the following elements:

- 1) **The Application Header** panel (1) contains the logo and name of the Virtual Laboratory (on the left) and a set of functional buttons (on the right) (see **4 Application Header panel**).
- 2) **The component panel** has 2 tabs (see **7 Equipment Panel**):
 -  the Equipment tab contains cards of devices that can be used in the scene (see **9 Description of objects**);
 -  The Comments tab contains all the comments for the scene (see **7.2 Comments Tab**).
- 3) **Areas for removing objects** (see **8.6 Deleting objects**).
- 4) **Clear Scene** button (see **5.1 Clear Scene Button**).
- 5) **Create comment** button (see **5.2 Create Comment Button**).
- 6) **Instruments** (see **5.3 Instruments**)
- 7) **Time Freeze** button (see **5.4 Time Freeze button**).
- 8) **Camera control** buttons (see **3 Camera control**)
- 9) **Scene Card** button (see **6 Scene Card**).
- 10) **The desktop** is a part of the scene within which you can create circuits from available equipment and interact with them.

3 Camera control

The camera is controlled using the magnifying glass buttons on the control panel (8 in Figure 1), the mouse or your fingers (when using a touch screen).

While the application is loading, the camera is in **default position** — aimed at the center of the table.

To **zoom in/out**, press the buttons  /  or rotate the mouse wheel. When using the touch screen, touch the screen with two fingers, spreading them apart or pressing them together.

To **move** the camera, click on any free place in the scene with the left mouse button (or with one finger when using a touch screen) and, without releasing, drag the pointer in the desired direction. You can also move the camera along the desktop while moving the object: to do this, move the cursor with the object to the right or left edge of the work area and drag further (Figure 2).

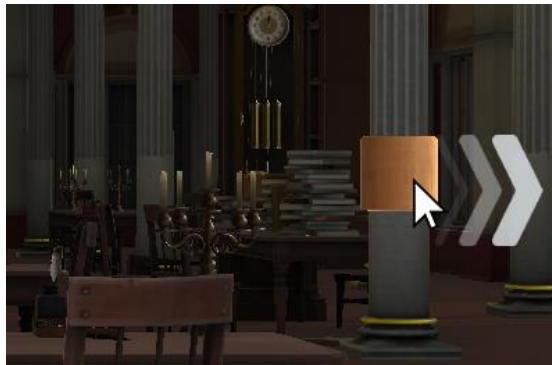


Figure 2 – Moving the camera while the subject is moving

4 Application Header panel

The "Application Header" panel on the left contains the logo and name of the Virtual Laboratory, and on the right — a set of functional buttons (Figure 3):



Figure 3 – Functional buttons of the Application Header panel

- Video instruction button  (see **4.1 Instruction**);
- Tips mode activation button  (see **4.2 Interactive Tips**);
- Virtual keyboard activation button  (see **4.3 Virtual Keyboard**);
- Fullscreen mode on/off button  (see **4.4 Fullscreen Mode**);
- Scene dropdown menu call button  (see **4.5 Scene Interaction Menu**);
- User menu button  (see **4.6 User Profile**).

4.1 Instructions

The Virtual Laboratory offers you User Manual and two video instructions:

- "Introduction video" — to get an idea of how to work with objects;
- "Saving and Loading" — to get acquainted with the application's saving and loading options.

Press the **Instruction** toggle button  on the **Application Header** panel to watch the manual and a video instruction selection menu will open. Select the variant you are interested in (Figure 4).

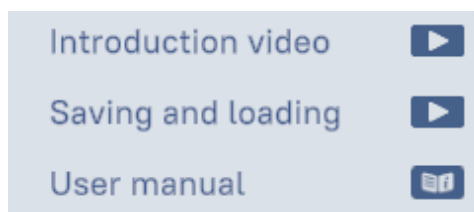


Figure 4 – Instruction selection menu

A screen with a video instruction will appear over the scene. Control playback using the built-in player (Figure 5). A **Close button** is located in the upper right corner of this window.



Figure 5 – Player controls

4.2 Interactive Tips

Press the **Tips**  toggle button on the **Application Header** panel to switch to interactive tip mode. Tip points will appear near the objects in the scene (Figure 6).

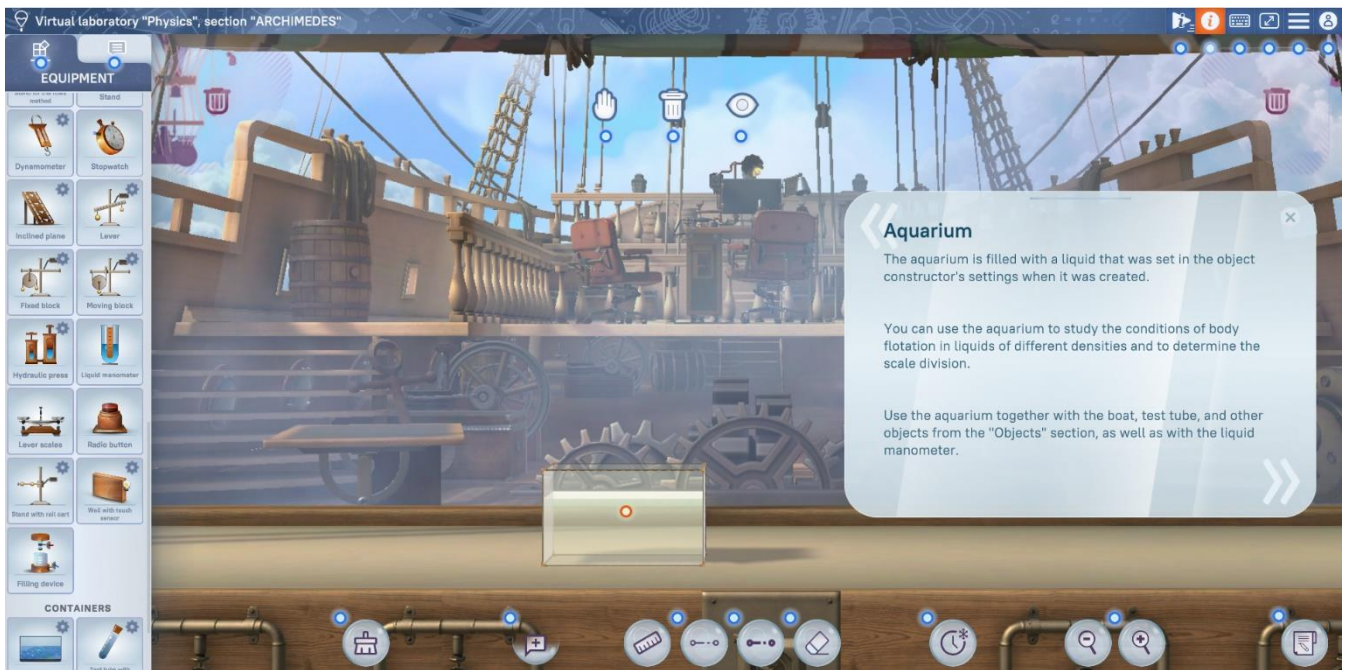


Figure 6 – Tips mode

To view a tip, press the point. To close the tip panel, press the tip point again or click on the cross in the upper right corner of the panel.

Tip points change their outline colour depending on whether the user has viewed the tip (Figure 7):

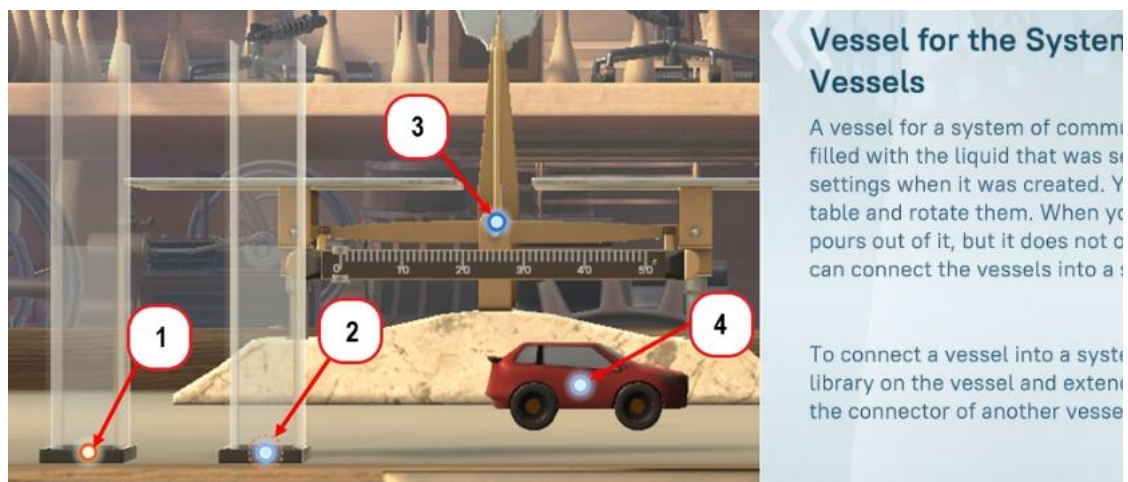


Figure 7 – Different outline colours for tip points

- 1) Dot with orange outline  — the prompt is open on the screen (as in Figure 7).
- 2) If several objects have the same tooltips and one of these tooltips is currently open, then the tooltip points of other objects with the same tooltip will have a double outline: dotted gray and orange .
- 3) Dot with gray outline  — the user previously viewed and closed the tooltip.
- 4) Dot with blue outline  — the user has not yet viewed this tip.

In addition, there are three hidden icons with tips in the Virtual Laboratory (Figure 8): «Moving objects» (1), «Deleting objects» (2), «Moving around the scene» (3). They are visible only in the Tips mode.



Figure 8 – Icons with tips at the top of the work area

To exit the Tips mode, press the  button in the **Application Header** panel.

4.3 Virtual Keyboard

To be able to use the virtual keyboard, press the toggle button  on the **Application Header** panel. In this mode, a virtual keyboard is displayed on the screen after clicking on the text fields in the scene card (Figure 9).



Figure 9 – Virtual Keyboard

The virtual keyboard has two layouts: Latin and symbolic. The layout is changed using the button  on the virtual keyboard.

To exit the virtual keyboard mode, press the button  on the **Application Header** panel.

4.4 Fullscreen Mode

To enable full screen mode, press the **Fullscreen Mode** button  on the **Application Header** panel. The application will expand to full screen, hiding the browser frame and the OS taskbar. To exit full screen mode, press the button  again.

4.5 Scene Interaction Menu

While working in the Virtual Laboratory, you can:

- save the current scene (see **4.5.1 Saving the Scene**);
- save a copy of the current scene (see **4.5.2 Saving a Copy of the Scene**);

- create a new scene (see **4.5.3 Creating a New Scene**);
- open the "My Scenes" library (see **4.5.4 Viewing and Loading User Scenes**);
- share a link to the current scene (see **4.5.5 Saving a Link to a Scene**).

All these actions can be performed using the drop-down scene work menu (Figure 10). The menu opens when you press the button  on the **Application Header** panel.

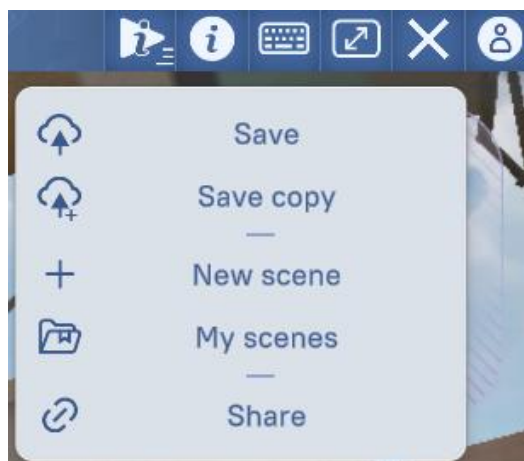


Figure 10 – Drop-down scene work menu

To close the menu, press the button  or any free scene area.

4.5.1 Saving the Scene

To save the scene to the "My Scenes" library, select "Save" in the drop-down menu (Figure 10). If this scene has never been saved before, the saving window will be opened (Figure 11).

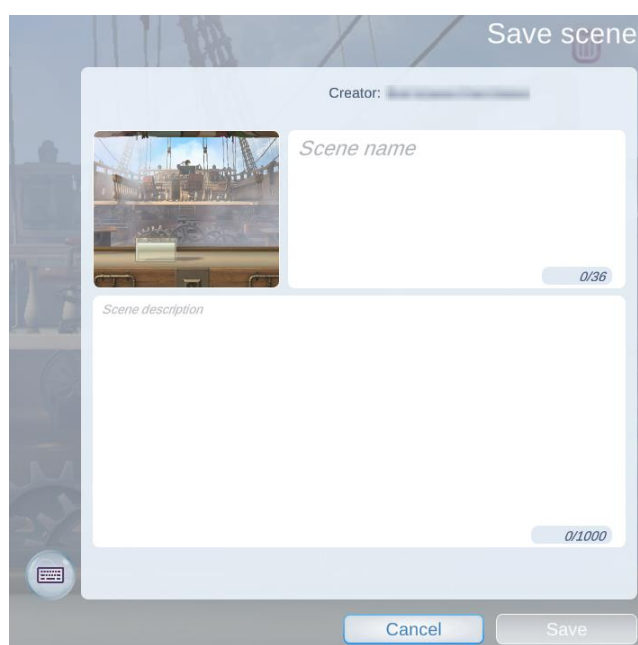


Figure 11 – Scene saving form

Enter the **name** of the scene to be saved (no more than 36 characters) and its **description** (no more than 1000 characters) in the appropriate fields of the form and click the button .

If the «Scene Name» and «Scene Description» fields were filled in in the scene card, then these values will be displayed when saving the scene (see **6 Scene Card**).

You can use the virtual keyboard if necessary. To do so, use the button , located to the left of the saving form. This button duplicates the button  in the **Application Header** panel (see **4.3 Virtual Keyboard**): if the Main menu had the virtual keyboard mode enabled , then the button next to the scene saving form will also be in the active state  and vice versa.

If you want to cancel the saving of the scene, press the button .

4.5.2 Saving a Copy of the Scene

To save a copy of the scene in the "My Scenes" library, select "Save Copy" in the drop-down menu (Figure 10). This will open the form for saving a copy of the scene, which is similar to the scene saving form (Figure 11).

If the scene is being saved for the first time, you must fill in the «Scene Name» (no more than 36 characters) and «Scene Description» (no more than 1000 characters) fields.

If the scene has already been saved, the previously saved scene name with the copy number in brackets will be displayed in the «Scene Name» field — **Scene 1(3)**. The scene name and copy number can be adjusted or left unchanged.

If the «Scene Name» and «Scene Description» fields were filled in in the scene card, then this data will be displayed when saving a copy of the scene (see **6 Scene Card**).

Click the  button to save a copy of the scene.

After you have saved a copy, you will continue to work with it, and the copy of the scene you worked with before will remain in the state of its last save.

If you do not need to save the scene copy, press the button .

4.5.3 Creating a New Scene

To create a new scene, select "New Scene" in the drop menu (Figure 8Figure 1). If there are unsaved data, a window with a warning about possible data loss (Figure 12) will open.

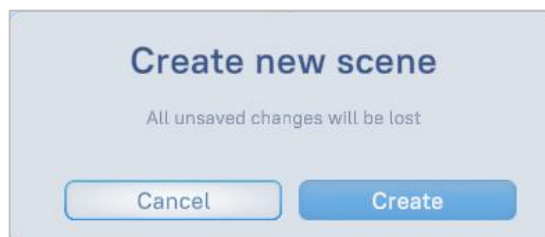


Figure 12 – "Create New Scene" Window

To avoid losing current data, click the button  and continue working with the scene. If you do not need to save the data, click , after which all unsaved data will be lost and a new empty scene will open.

4.5.4 Viewing and Loading User Scenes

To view a list of scenes, select "My Scenes" in the drop-down menu (Figure 10). The "My Scenes" library page (Figure 13) will open.

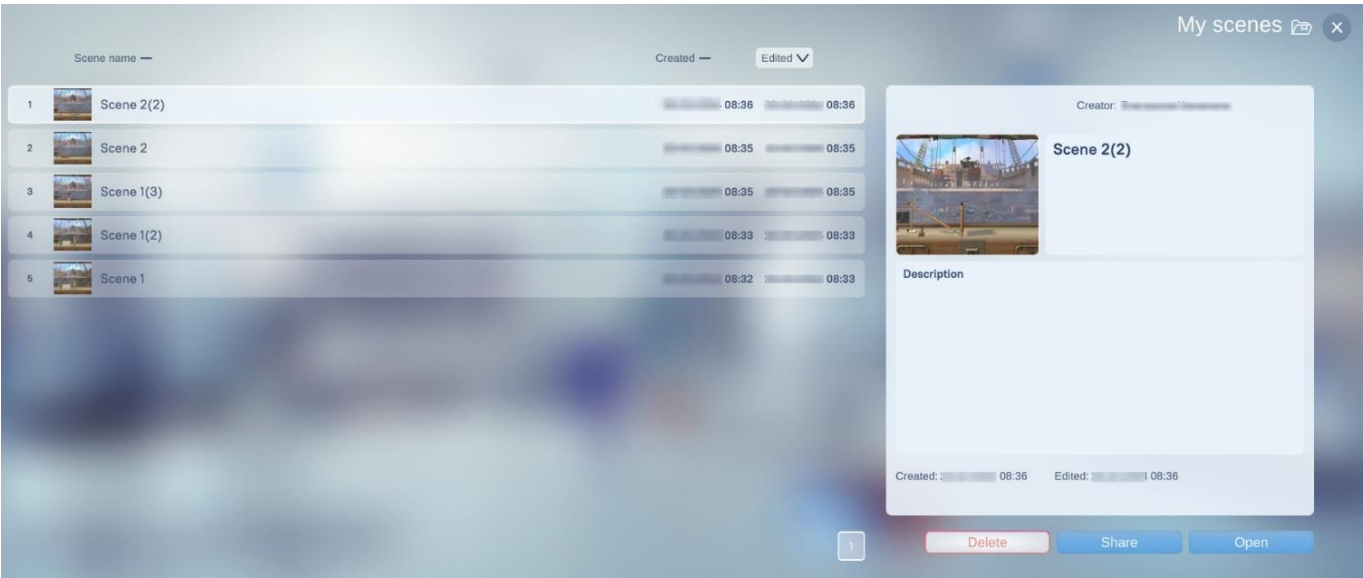


Figure 13 – "My Scenes" Library

On the left side of the screen, a list of all saved scenes will be displayed. You can sort the data by scene name, creation date, and modification date. To sort, click on the name of the corresponding table column ("Name", "Created" or «Modified»). The "-" icon next to the name will change to a check mark,

indicating the sorting direction .

If the list of scenes does not fit on one screen, it will be split into pages. Navigation through the pages is done using a series of buttons with page numbers, located to the right under the table.

The information about the selected scene is in the scene card to the right of the table. If necessary, you can open, delete, or share the selected scene using the buttons located under the scene card.

4.5.5 Saving a Link to a Scene

To share a link to the current scene, select "Share" in the drop-down menu (Figure 10). The link will be copied to the clipboard, and you can save or share it. At this point, the scene needs to be saved, and if you have not yet saved this scene, the save form (Figure 11) will appear. You can save the link from the clipboard or send it to someone.

4.6 User Profile

When you press the **Profile** button  on the **Application Header** panel, the user's login is displayed and the user menu opens (Figure 14).

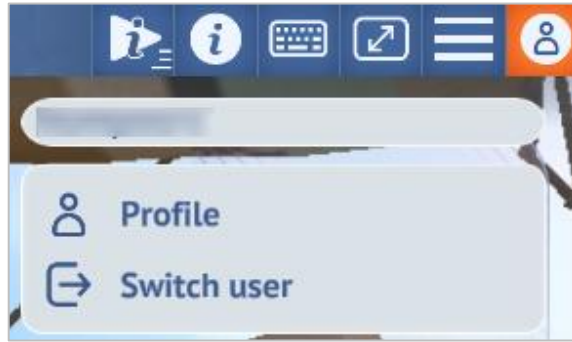


Figure 14 – User Menu

Select the Profile menu item to access your profile information. The data will open in a new browser tab.

When you select "Switch User", two buttons appear under the menu: press  , to change the current account, or  , to continue working under the current account.

To close the menu, press the button  or click anywhere else on the scene.

5 Scene Control Panel

The **Scene Control** panel is located at the bottom of the screen and consists of the following elements (Figure 15):

- 1) Clear Scene button (see **5.1 Clear Scene Button**);
- 2) Create aComment button (see **5.2 Create Comment Button**);
- 3) Instruments Panel (see **5.3 Instruments**);
- 4) Time Freeze button (see **5.4 Time Freeze button**);
- 5) Camera Control buttons (see **3 Camera control**).

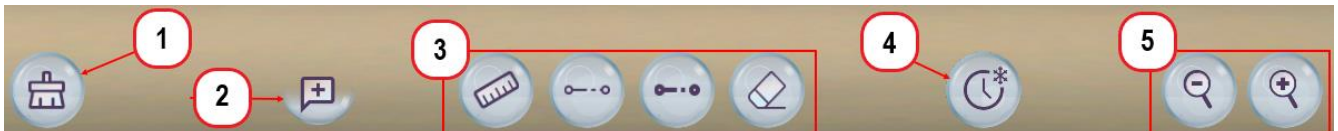


Figure 15 – Scene Control Panel

5.1 Clear Scene Button

The **Clear Scene** button  is available if at least one object is placed on the scene. When you click on the button, a confirmation window is opened (Figure 16).

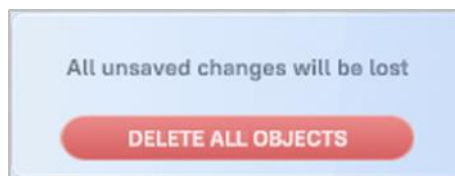


Figure 16 – Confirmation window to clear the scene

Click the **Delete all objects** button to clear the scene. Click anywhere on the screen outside the window to cancel the action if you don't want to delete all objects.

5.2 Create Comment Button

To add a comment to a scene, hold down the  button, drag the pointer into the scene and release it — the comment will be created at the point where you release the pointer (Figure 17). You can place a comment anywhere in the workspace, including equipment.

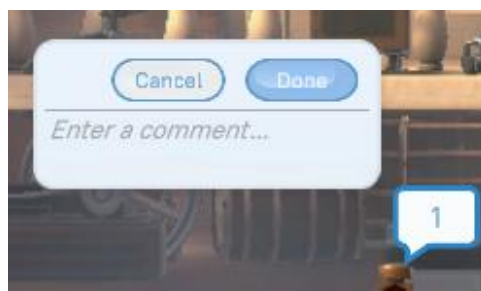


Figure 17 – Comment creation window

Enter the comment text using the keyboard of your device or use the virtual keyboard (see **4.3 Virtual Keyboard**). Click the  button, to save a comment. To cancel creating a comment, click .

All comments are numbered in the order in which they were created; the comment number is displayed on its icon (Figure 17).

All comments are displayed on the Comments tab of the component panel on the left side of the screen (see **7.2 Comments Tab**).

To move a comment, hold down the icon with its number and drag it to the desired location on the desktop. To change a comment, select it by clicking on the icon with the number  or by card in the list of comments on the «Comments» tab (see section **7.2 Comments Tab**). The selected comment icon will change color — , the comment editing window will open (Figure 18).



Figure 18 – Comment editing window

Click  to change a comment, add changes and save them with the button . You can cancel changes using the button .

To delete a comment, select it and click the icon in the comment editing window.

5.3 Instruments

Instruments Panel is located at the bottom of the screen and consists of four buttons (Figure 19):

- 1) Ruler (see **5.3.1 Ruler**);
- 2) Thin line (see **5.3.2 Lines**);
- 3) Thick line (see **5.3.2 Lines**);
- 4) Eraser (see **5.3.3 Eraser**).



Figure 19 – Instruments Panel

5.3.1 Ruler

To create a ruler, click the button on the Instruments Panel  (Figure 19). A ruler will appear in the center of the screen (Figure 20).

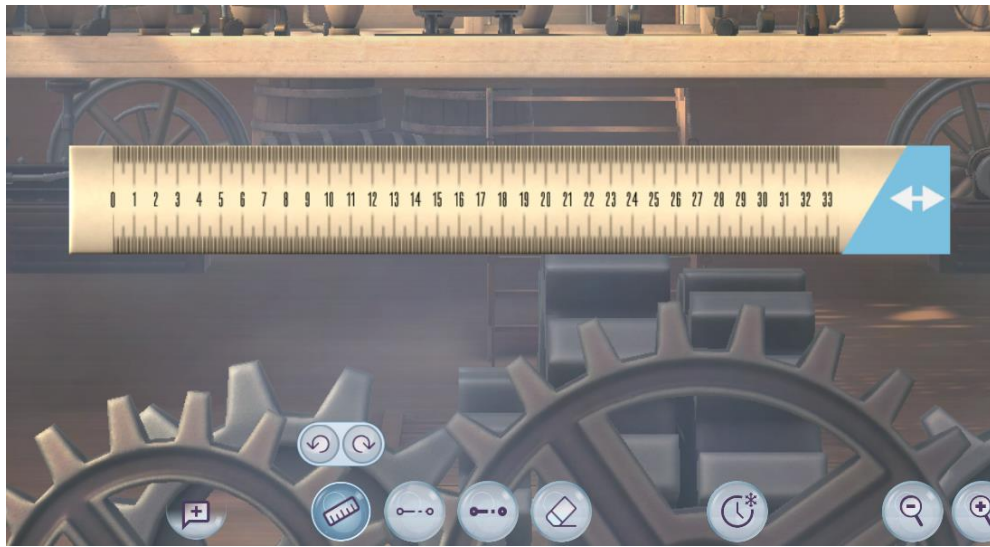


Figure 20 – Activation of the ruler

To move the ruler, hold down the right mouse button or click on the ruler with two fingers (if using a touch screen) and drag it to the desired location.

The ruler can be moved strictly vertically or horizontally — to do this, hold it with the left mouse button or with one finger and drag it up, down, right or left to the desired position.

To rotate the ruler, point to it and roll the mouse wheel or pinch it with two fingers. The ruler will rotate relative to the position of the pointer or fingers. To turn the ruler exactly 90°, use the buttons



(Figure 20).

To align the ruler vertically or horizontally, click the . This icon is available when the ruler position is other than strictly vertical or strictly horizontal.

To adjust the length of the ruler, drag the right edge to the right or left.

To delete a ruler, click the  button on the Instruments Panel.

5.3.2 Lines



Figure 21 – Drawing lines on a dynamometer without a scale

The Lines tool is used to draw lines on a table, on a ship, and on a dynamometer without a scale.

Select the line thickness by clicking the button: for thin lines —



, for thick lines —



To create a line, point and hold the pointer over the drawing surface. A dotted line will appear on the surface (Figure 21). Drag the pointer to the desired line position and release it — a solid line of the selected thickness will be created at the point where you release the pointer.

To create a line at a precise location, select a thickness and click on the surface to draw. The created line will pass through the click point.

The lines on the table can be moved. To do this, hold down the button on the edge of the desktop with the left mouse button, drag it to the desired location and release it (Figure 22).

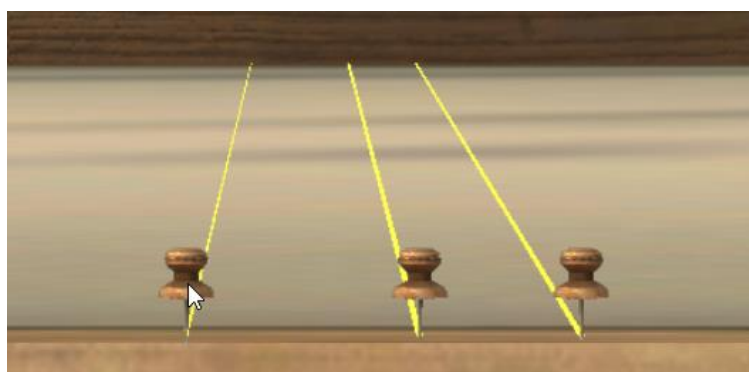


Figure 22 – Moving a line on the desktop

To turn off the Lines tool, click  and  buttons on the Instruments Panel.

5.3.3 Eraser

To remove lines on the table or objects, use the Eraser tool. Click the  button on the Instruments Panel (Figure 19) and hold down the left mouse button on the desktop. A deletion zone will be displayed around the mouse pointer, and the lines in the deletion zone will be colored red (Figure 23).

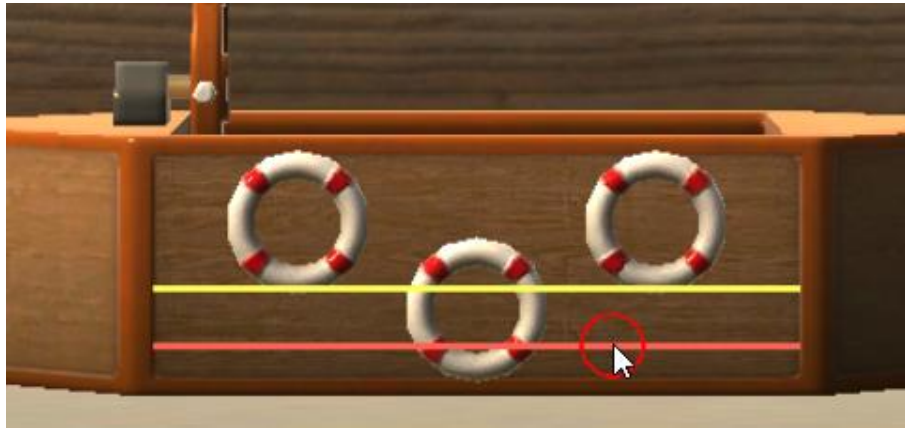


Figure 23 – Eraser removal area

Release the left mouse button to delete lines in the deletion zone.

To turn off the Lines tool click the  button on the Instruments Panel.

5.4 Time Freeze button

To stop simulating the passage of time in the application, click the button  (7 in Figure 1). All processes in the scene will be suspended for the duration of the freeze. To return to work, click the button , create a new object or click on any object on the desktop.

6 Scene Card

The scene card (Figure 24) allows you to fill in and view the information about the scene that will be required for saving. The scene card opens:

- by clicking on the «Scene Card» button  in the lower right corner of the application window (9 in Figure 1),
- by saving a scene or its copy (see **4.5.1 Saving the Scene** and **4.5.2 Saving a Copy of the Scene**),
- by selecting a scene in the «My Scenes» library (see **4.5.4 Viewing and Loading User Scenes**).

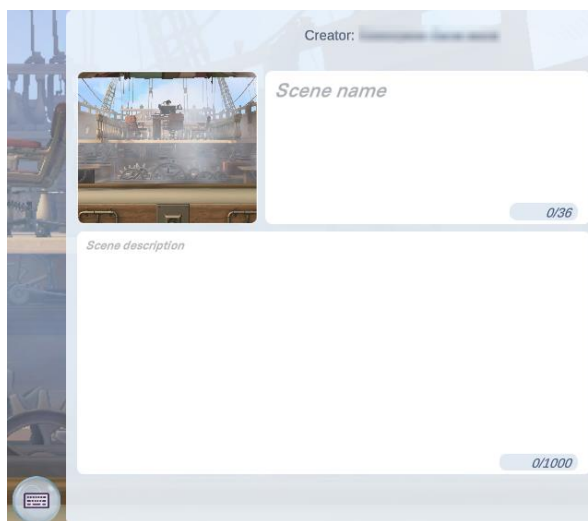


Figure 24 – Scene Card

The «Scene Name» and «Scene Description» card fields will be filled in if:

- you have already filled out the scene card,
- you have already saved the scene or a copy of it,
- you opened a scene with a completed card using a link from another user,
- you have opened a public scene with a completed card.

In other cases, the «Scene Name» and «Scene Description» fields will be empty.

Information on the card can be edited and deleted. You can use your device's keyboard or the virtual keyboard to fill out or edit the Scene Title and Scene Description fields. For more information about using the virtual keyboard, see **4.3 Virtual Keyboard** and **4.5.1 Saving the Scene**.

To close the scene card, press the **Scene Card** button again or click anywhere in the application window outside the card.

7 Equipment Panel

The components panel is located on the left side of the Virtual Laboratory screen (2 in Figure 1) and contains cards of equipment that can be used in the scene (see **9 Description of objects**).



Figure 25 – Equipment Panel

Equipment cards are grouped by category (Figure 25):

- objects (see **9.1 Objects**);
- a system of communicating vessels (see **9.2 System of connected vessels**);
- instruments (see **9.3 Instruments**);
- containers (see **9.4 Containers**).

Each card contains a picture and name of the equipment. Cards of some objects are marked with an icon . These objects can be customized before they are placed in the scene using the object constructor.

When you click on the object card (1 in Figure 26), an information panel opens with a description of the selected object (2), and if a constructor is provided for the object, then the constructor panel will also appear (3) (see **7.1 Object Constructor**).

Clicking on the card again closes the information panel and the constructor panel.



Figure 26 – Activating an object card

7.1 Object Constructor

The object constructor contains settings for object parameters (Figure 27).

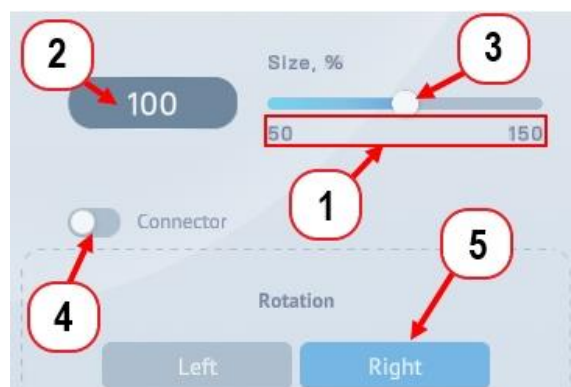


Figure 27 – Object Constructor

The application provides three options for setting parameters:

- selecting a value within the range;
- select the «yes/no» value;
- select a value from the list.

For parameters configured within the range, a range of possible values is indicated (1 in Figure 27). To set the exact value of a parameter within the range, click in the field (2) and enter the value using the keyboard of your device or the virtual keyboard (see **4.3 Virtual Keyboard**). You can also set the value within the range using the slider slider (3): drag the slider to the desired position on the slider or click on the slider to move the slider to the click point. The set value will be displayed in the value input field (2).

The «yes/no» value is selected using the switch button (4). Switch position  means Yes, switch position  means No. To change the position of the switch, click on it.

To set the value of a parameter from the list, left-click on the desired option (5 in Figure 27).

To close the constructor, click on the object card on the **Equipment** tab. The object's settings are saved after the constructor is closed. When you place another object of the same type in the scene, changes in the constructor will be applied to it.

7.2 Comments Tab



Figure 28 – Comments tab

To go to the **Comments** tab, click on the tab icon



on the **Components** panel (Figure 28).

You can switch between comments in a scene by clicking on them in the comment list.

For more information about creating comments and working with them, see **5.2 Create Comment Button**.

8 Interaction with devices

8.1 Creating a device

To create a device on the desktop:

- 1) If you need to configure the parameters of the object being created, click on its card. An information panel and a designer panel will be displayed on the screen (Figure 26). Set parameter values in the constructor (Figure 27).
- 2) Drag the object onto the desktop and drop it at the location where you want to place the device. When the pointer moves to the desktop area, a three-dimensional model of the device being created appears under the pointer.

The device model changes color to red in an area where it is impossible to place the device. If you release the pointer at this point, the device will not be created (Figure 29). Until the object is placed on the table, time in the scene stops and all instruments freeze.



Figure 29 – Device in an area inaccessible for placement

To adjust an object already placed in the scene, use the adjustment elements of the object itself (buttons, knobs, switches, controls) — press or drag in the desired direction, as in real life.

8.2 Moving objects

To move an object, hold the pointer on the part of the device that does not interact with other equipment and drag it to the desired location. Some devices can only be moved along the desktop (for example, lever scales and stopwatches).

Devices on the table cannot intersect: when a device is moved into an area inaccessible for placement, its model changes color to red (Figure 29). Some devices can be placed one behind the other.

8.3 Rotating objects

To rotate a device, point to it, hold down the left mouse button and roll the mouse wheel. The object will rotate around the pointer. When using the touch screen, pinch the device with two fingers and rotate one finger around the other. The object will rotate around the stationary finger.

Objects that move only along the desktop cannot be rotated.

8.4 Connecting objects with magnetic connectors

Devices and objects can be connected to each other using magnetic connectors (Figure 30). Some items have magnetic connectors installed by default (such as stands and dynamometers). For some objects (for example, a ball), magnetic connectors can be added in the object constructor (see **7.1 Object Constructor**).

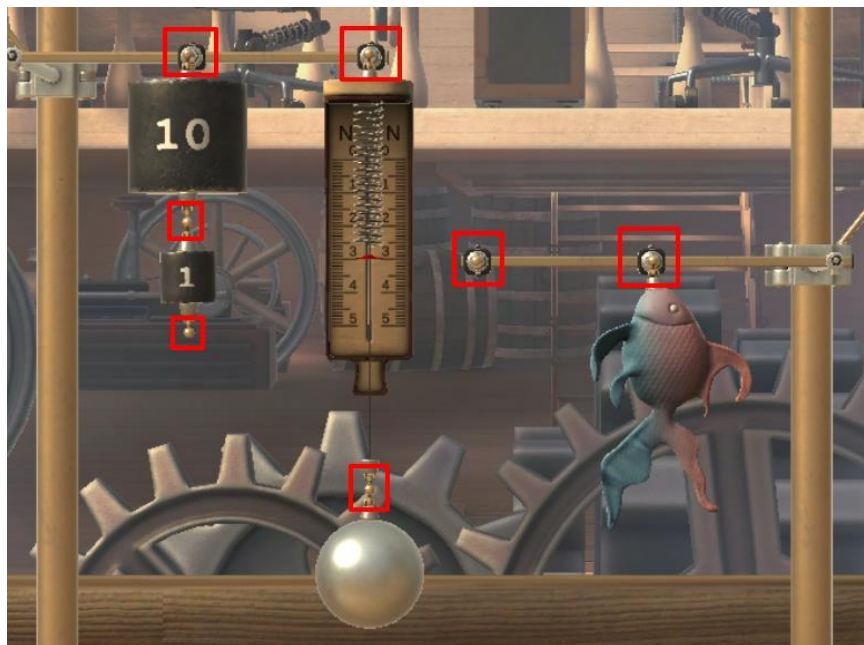


Figure 30 – Magnetic connectors on the objects

To connect objects through magnetic connectors, move one of the objects to a position so that the connectors are as close to each other as possible or intersect (Figure 31). If necessary, rotate the object with the mouse wheel.

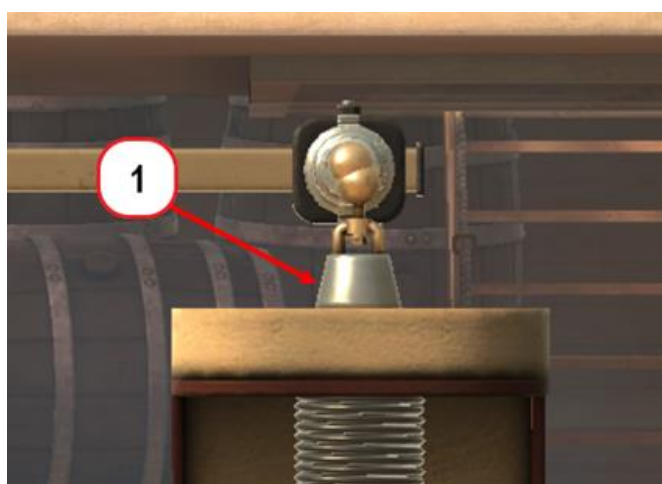


Figure 31 – Intersection of magnetic connectors of objects



Figure 32 – Example of connecting objects

You can connect several objects at one point, and you can also create chains of connected objects (Figure 32).

To disconnect the magnetic connectors, pull the base of the connector (1 in Figure 31) or the object itself until the connectors separate.

8.5 Reception and transmission of signals

Radio point is a unit for receiving and transmitting radio signals based on the principle of a walkie-talkie.

Using radio points, you can configure the remote start or stop of some devices. There can be several radio points on one object, each of which runs a function associated with this radio point. For example, you can activate the stopwatch based on a signal from the inclined plane stopper and stop timing based on a signal from the touch detector.

The application uses two types of radio points:

- two-channel (receive and send signals) (Figure 33);
- single-channel (only send signals) (Figure 34).

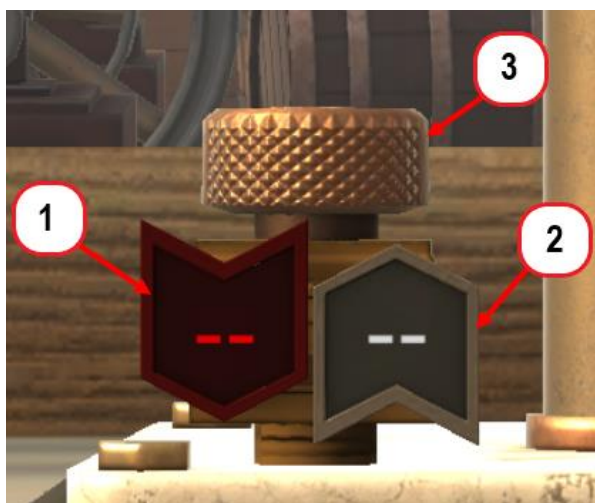


Figure 33 – Two-channel radio point

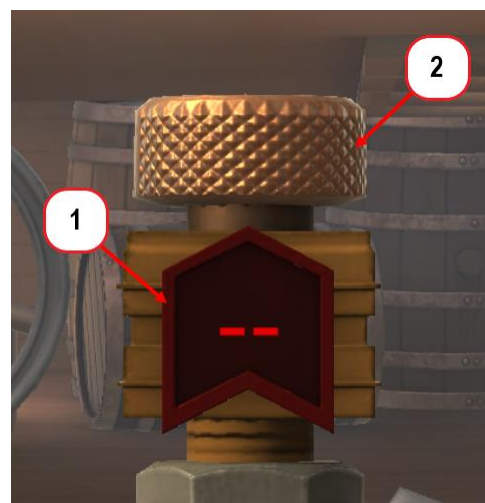


Figure 34 – Single-channel radio point

The incoming channel (1 in Figures 33 and 34) is responsible for receiving signals from other devices. On the devices, incoming channels are depicted as down arrows . The outgoing channel (2) sends a signal to other devices, it is depicted as upward arrows . For radio points on devices to receive signals from each other, their channels must be tuned to the same frequency.

To adjust the frequency of a radio point channel, highlight the desired channel by clicking on it (the arrow will change its color to red ) , and turn the tuning wheel (3 in Figures 33 and 34) to the desired frequency value. When setting the frequency value, the arrow changes color to the one corresponding to this frequency (Figure 35).

For example, to start the stopwatch when the inclined plane stopper is triggered (Figure 35), you need to set the same frequency on the outgoing channel of the inclined plane radio point and on the incoming channel of the radio point of the stopwatch start button (1).

You can continue the experiment by setting the timing to stop based on a signal from the touch detector. To do this, you need to set the same frequency on the outgoing channel of the touch detector and on the incoming channel of the stopwatch stop button (2).

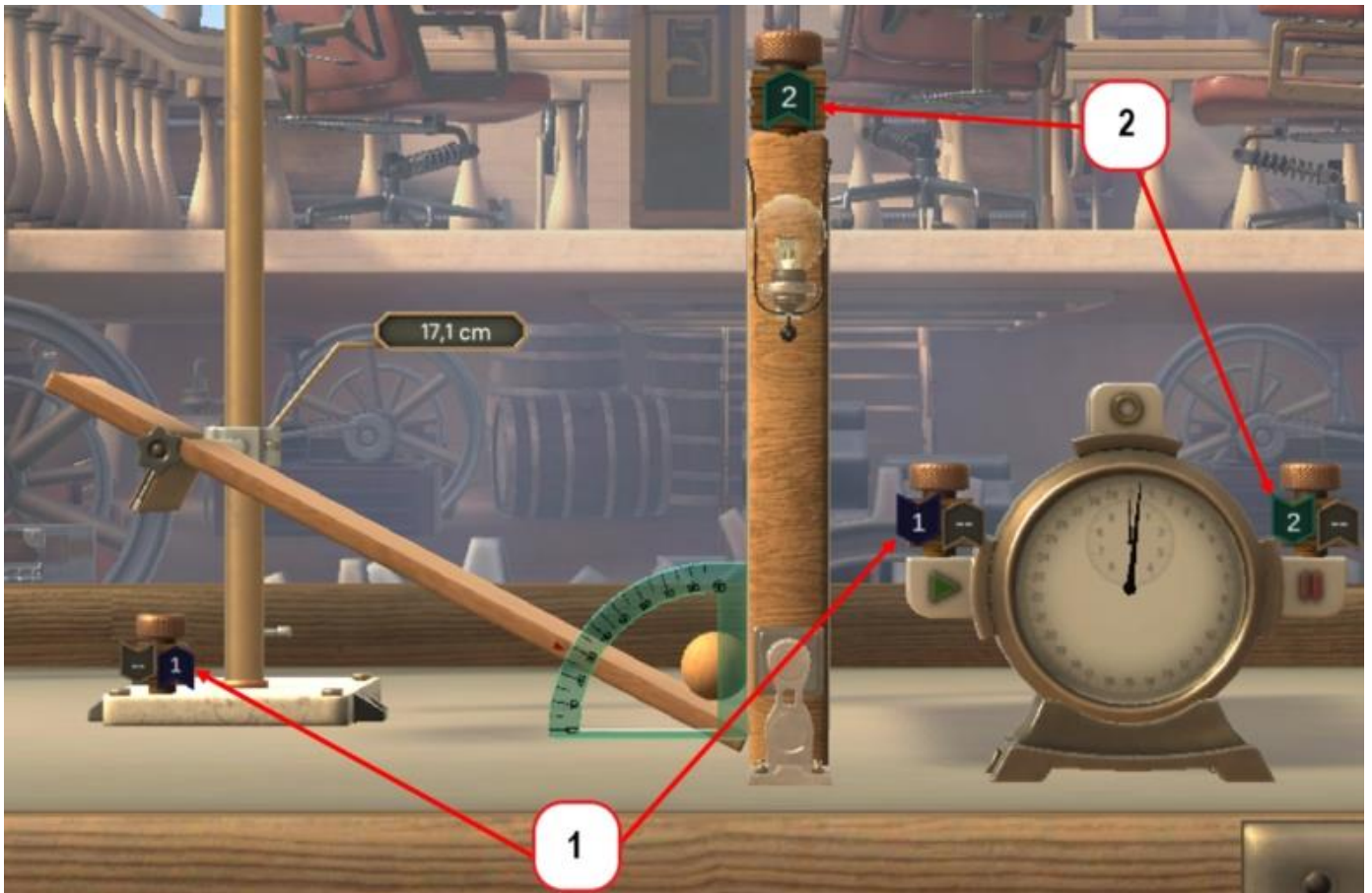


Figure 35 – Example of radio points' settings

To cancel signal reception and transmission, set the channel frequency to "--".

8.6 Deleting objects

To delete an object, hold it with the left mouse button, drag it to one of the deletion zones at the top of the work area until the device image turns red and an open trash can icon appears in the deletion zone, then release the button (Figure 36).

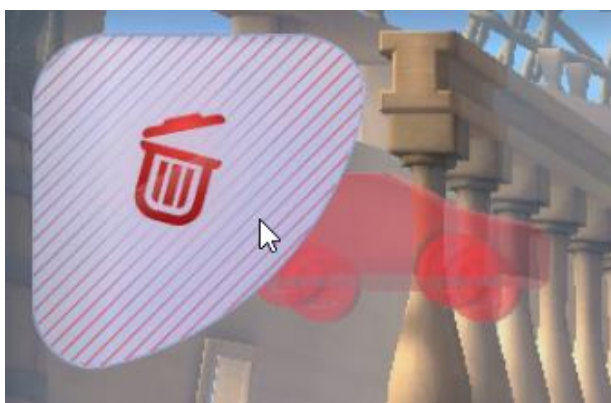


Figure 36 – Image of the device in the removal area



Figure 37 – Deleting an object that moves only along the table

If the object moves only along the desktop, also hold down the left mouse button, drag the pointer to one of the delete zones and then release the button (Figure 37).

To remove all objects in a scene, use the **Clear Scene** button  on the **Scene Control panel** (see 5.1 **Clear Scene Button**).

9 Description of objects

9.1 Objects

9.1.1 Air balloon

An air balloon is a physical object made of a stretchable shell filled with gas. The balloon is used for experiments with aeronautics. The balloon shell is infinitely stretchable and does not create internal pressure. The weight of the shell depends on the color of the ball:

- Purple shell — 5 g;
- Red shell — 8 g;
- Green shell — 12 g.

To select the color of the ball and the filling gas, as well as adjust the volume of the ball before placing it in the scene, click on the object card on the **Equipment** tab (Figure 38) and set the required values in the constructor (see **7.1 Object Constructor**). When filling the balloon with air, you can also adjust the air temperature.

By default, when creating an object, the following values are set:

- gas volume: 100 l;
- shell color: red;
- filling gas: hydrogen;
- air temperature: 20°C.



Figure 38 – Air balloon card

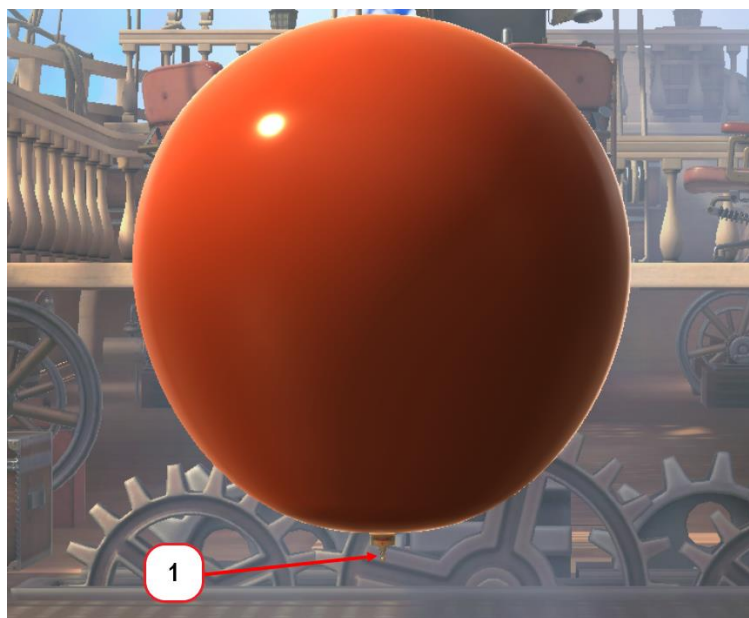


Figure 39 – Air balloon

To fill the balloon after placing it in the scene or to deflate it, use a filling device (see **9.3.14 Filling device**).

Use a magnetic connector (1 in Figure 39) to connect the ball to other objects (see **8.4 Connecting objects with magnetic connectors**).

9.1.2 Ball

A ball is a ball-shaped object for conducting experiments.

To select the material of the ball, adjust its diameter and add a connector before placing it in the scene, click on the object card on the **Equipment** tab (Figure 40) and set the required values in the constructor (see **7.1 Object Constructor**).

By default, when creating a ball, the following values are set:

- material: aluminum;
- diameter: 6 cm;
- connector: no.



Figure 40 – Ball card

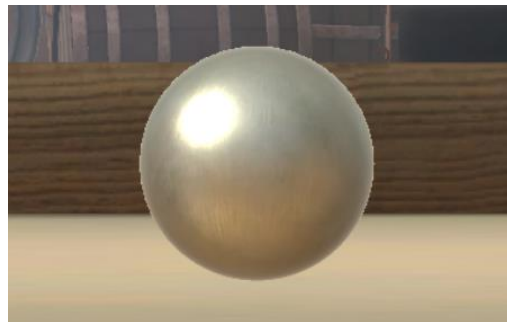


Figure 41 – Ball

9.1.3 Wooden train

A wooden train is a solid, homogeneous object made of wood in the shape of a steam locomotive with moving wheels.

To add a connector, adjust the size and rotation of the train before placing it in the scene, click on the object card on the **Equipment** tab (Figure 42) and set the required values in the constructor (see **7.1 Object Constructor**).

By default, when creating a steam locomotive, the following values are set:

- size: 100%;
- connector: no;
- turn: right.



Figure 42 – Wooden train card



Figure 43 – Wooden train

9.1.4 Plastic car

A plastic car is a solid, homogeneous object made of plastic in the shape of a car with moving wheels.

To add a connector, configure the size, model and rotation of the car before placing it in the scene, click on the object card on the **Equipment** tab (Figure 44) and set the required values in the constructor (see **7.1 Object Constructor**).

By default, when creating a car, the following values are set:

- size: 100%;
- connector: no;
- turn: right;
- model: basic.



Figure 44 – Plastic car card



Figure 45 – Base model plastic car

9.1.5 Metal bolt

A metal bolt is a solid, homogeneous object made of steel in the form of a threaded bolt.

To add a connector and adjust the size of an object before placing it in the scene, click on the object card on the **Equipment** tab (Figure 46) and set the required values in the constructor (see section **7.1 Object Constructor**).

By default, when creating a bolt, the following values are set:

- size 100%;
- connector: no.



Figure 46 – Metal bolt card



Figure 47 – Metal bolt

9.1.6 Stone

A stone is a solid, homogeneous object in the form of a rock.

To add a connector and adjust the size of an object before placing it in the scene, click on the object card on the **Equipment** tab (Figure 48) and set the required values in the constructor (see **7.1 Object Constructor**).

By default, when creating a stone, the following values are set:

- size 100%;
- connector: no.



Figure 48 – Stone card



Figure 49 – Stone

9.1.7 Rubber fish

Rubber fish is a solid, homogeneous object made of rubber in the shape of a fish.

To add a connector and adjust the size of an object before placing it in the scene, click on the object card on the **Equipment** tab (Figure 50) and set the required values in the constructor (see **7.1 Object Constructor**).

By default, when creating a fish, the following values are set:

- size: 100%;
- connector: no.



Figure 50 – Rubber fish card



Figure 51 – Rubber fish

9.1.8 1 N load

1 N load is a load with a weight of 1 N and a mass of 102 g for carrying out experiments.

To remove connectors before placing an object in the scene, click on the object card on the **Equipment** tab (Figure 52) and set the desired value in the constructor (see **7.1 Object Constructor**).

By default, a load will be created with connectors at the top and bottom.



Figure 52 – 1 N load card



Figure 53 – 1 N load

Use magnetic connectors (1 in Figure 53) to connect an object with other elements of the circuit (see **8.4 Connecting objects with magnetic connectors**).

9.1.9 10 N load

10 N load is a load with a weight of 10 N and a mass of 1020 g for conducting experiments.

To remove connectors before placing an object in the scene, click on the object card on the **Equipment** tab (Figure 54) and set the desired value in the constructor (see **7.1 Object Constructor**).

By default, a load with connectors will be created.



Figure 54 – 10 N load card

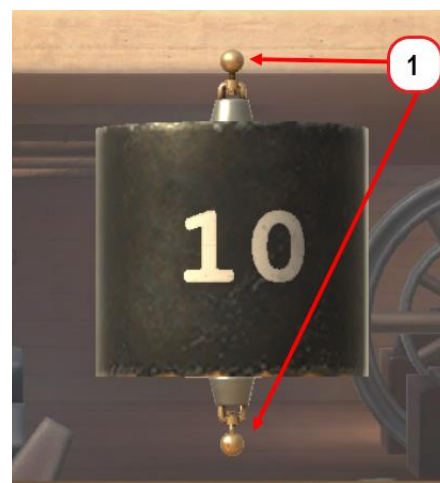


Figure 55 – 10 N load

Use magnetic connectors (1 in Figure 55) to connect an object with other elements of the circuit (see **8.4 Connecting objects with magnetic connectors**).

9.1.10 Set of weights

A set of weights is a set of weights of different masses for experiments with a hydraulic press and carts, as well as weighing bodies on lever scales (see **9.3.10 Lever scales**)



Figure 56 – Set of weights card



Figure 57 – Set of weights

9.1.11 Cart with launchers

A cart with launchers is a platform with four wheels and shots for conducting experiments on the interaction of bodies and inertia. The launchers can be replaced with magnetic connectors to connect the carts. The friction of the cart wheels in the Virtual Laboratory is not taken into account. You can place other objects on the cart platform.

To configure the presence of launchers and connectors and select the platform material before placing an object in the scene, click on the object card on the **Equipment** tab (Figure 58 – Cart with launchers card) and set the required values in the constructor (see **7.1 Object Constructor**).

By default, when creating a cart, the following values are set:

- left element: shot;
- element on the right: shot;
- fixing surface: no.



Figure 58 – Cart with launchers card

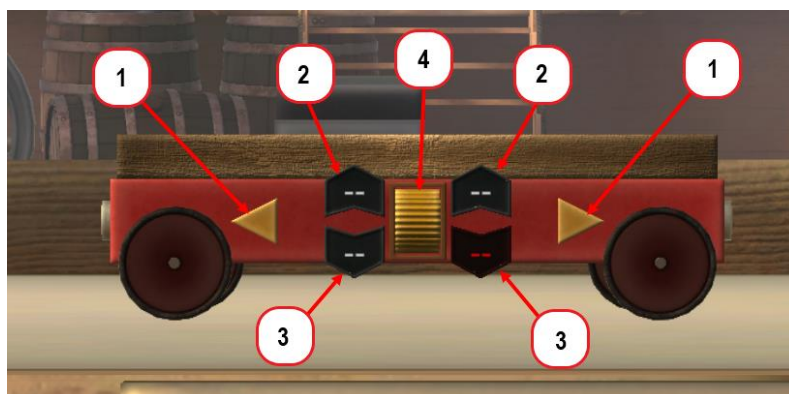


Figure 59 – Cart with launchers

To start the shot, press the button  or  (1 in Figure 59). The launcher will be set off on the corresponding side of the cart (Figure 60). To return the launcher to its original position, press the button again.

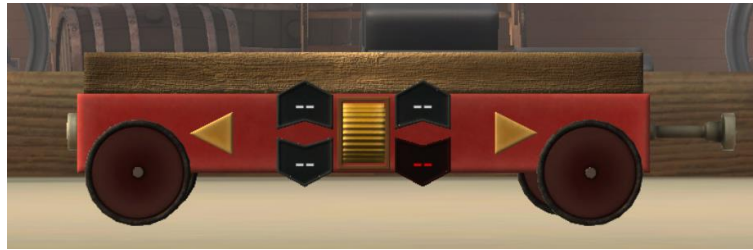


Figure 60 – Cart with set off shot on the right

Use outgoing (2) and incoming (3 in Figure 59) radio channels to remotely activate the device and communicate with other objects in the scene (see **8.5 Reception and transmission of signals**). To tune channels, rotate the tuning wheel (4). Reception and transmission of signals are configured separately for the shots on both sides of the cart. There is no radio point on the cart with two magnetic connectors.

9.1.12 Boat

A boat is a hollow object in the form of a ship for conducting experiments on the floating of bodies.

To select a material and adjust the height of the sides of the ship before placing it in the scene, click on the object card on the **Equipment** tab (Figure 61Figure 62) and set the required values in the constructor (see **7.1 Object Constructor**).

By default, when creating an object, the following values are set:

- material: wood;
- side height: 4 cm.



Figure 61 – Boat card



Figure 62 – Boat

The boat can be placed in an aquarium. You can place other objects in the ship and on its deck. Use the «Lines» tools (see **5.3.2 Lines**) and the «Eraser» (see **5.3.3 Eraser**) to mark the level of immersion of the ship in the liquid (Figure 63).



When the boat is flooded, the accumulation of liquid into it in the Virtual Laboratory is not simulated.

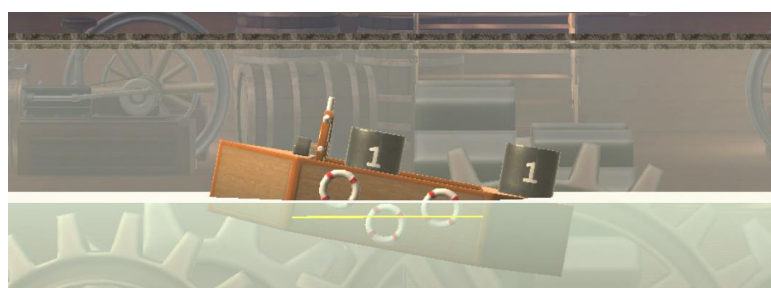


Figure 63 – Boat with objects in an aquarium

9.1.13 Rectangular prism

Rectangular prism — a parallelepiped-shaped object for conducting experiments.

To select the material, adjust the dimensions and add connectors before placing the Rectangular prism in the scene, click on the object card on the **Equipment** tab (Figure 64) and set the required values in the constructor (see **7.1 Object Constructor**).

By default, when creating an object, the following values are set:

- material: wood;
- length: 6 cm;
- height: 6 cm;
- width: 6 cm;
- connector: no.



Figure 64 – Rectangular prism card



Figure 65 – Rectangular prism

9.1.14 Thread

A thread with magnetic connectors is used to connect objects and create a pendulum. The thread weight is 20 g.

To adjust the length of the thread before placing it in the scene, click on the object card on the **Equipment** tab (Figure 66) and set the desired value in the constructor (see **7.1 Object Constructor**).

By default, a 30 cm long thread will be created.



Figure 66 – Thread card

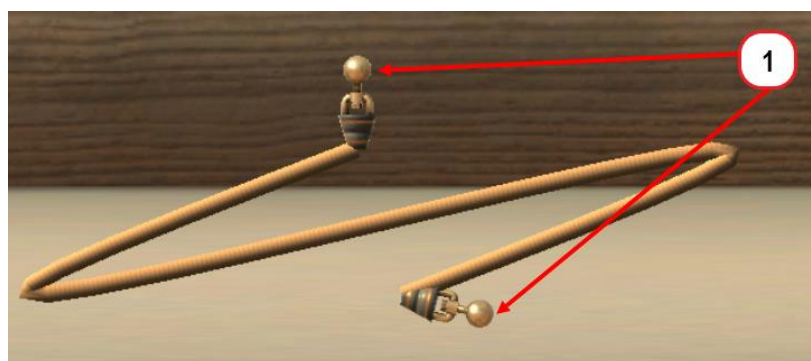


Figure 67 – Thread

To move the thread, pull one of the magnetic connectors (1 in Figure 67).

Use magnetic connectors (1) to connect the thread to other elements of the scene (see **8.4 Connecting objects with magnetic connectors**).

9.2 System of connected vessels

A system of connected vessels consists of vessels, stands on which the vessels can be placed, and connecting tubes with taps. The vessels can also be installed on the table and, if necessary, connected to the vessels on the stands with additional tubes using connectors (see **9.2.2 Connector**).

9.2.1 Stands with communicating vessels

There are 3 types of stands available in the Virtual Laboratory (Figure 71):

- 1) Connected vessels with non-homogeneous liquid — a stand with three vessels filled with different liquids: oil, water and kerosene;
- 2) Connected vessels with a homogeneous liquid — a stand with three vessels filled with water;
- 3) System of connected vessels — stand without vessels.



Figure 68 – Card of connected vessels with a non-homogeneous liquid



Figure 69 – Card of connected vessels with a homogeneous liquid



Figure 70 – Card of a system of connected vessels

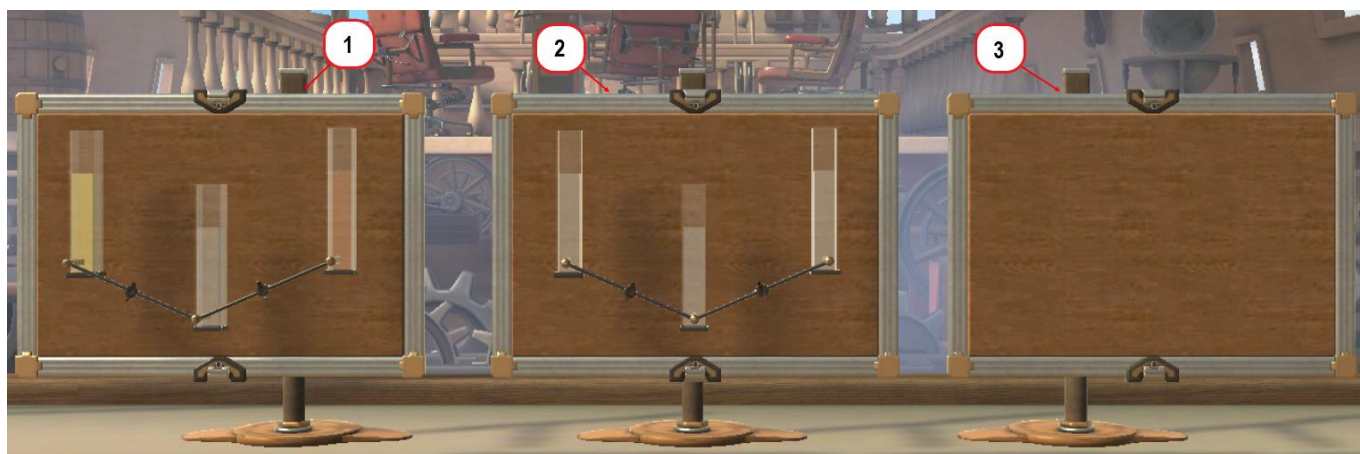


Figure 71 – Stands with connected vessels

To rotate the stand, hold down the left mouse button on its surface or frame (1 in Figure 72) and make a rotating motion. To move the stand, hold down the left mouse button on its base (2) and drag the stand to the desired location on the desktop.

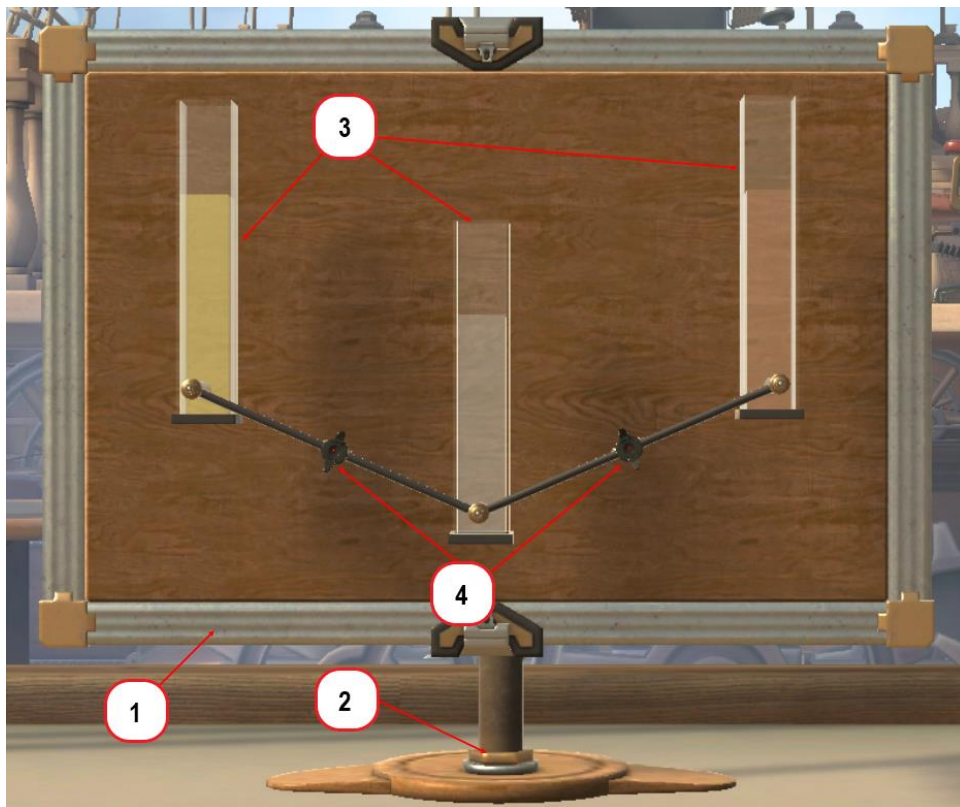


Figure 72 – Stand with connected vessels with a non-homogeneous liquid

To rotate the vessel (3) on the stand, hold it with the left mouse button and turn the mouse wheel. The vessel will rotate around the pointer. In this case, liquid may spill out of the container.

To move a vessel, hold down the left mouse button, drag it to the desired location on the stand or desktop, and release the button. If the vessel is placed incorrectly, a red color indication is displayed on the stand frame and on the vessel (Figure 73). When you move the vessels, the length of the connecting tubes changes automatically.

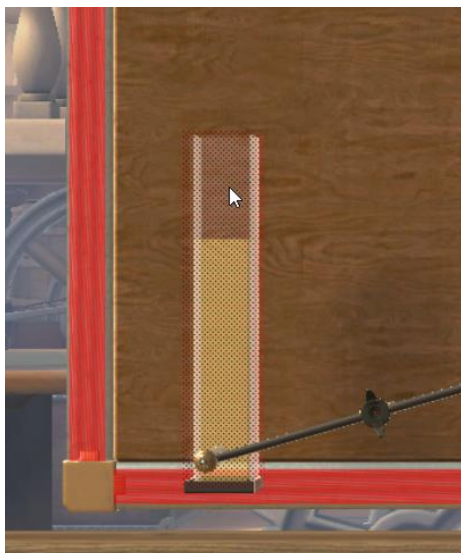


Figure 73 – Incorrect placement of the vessel

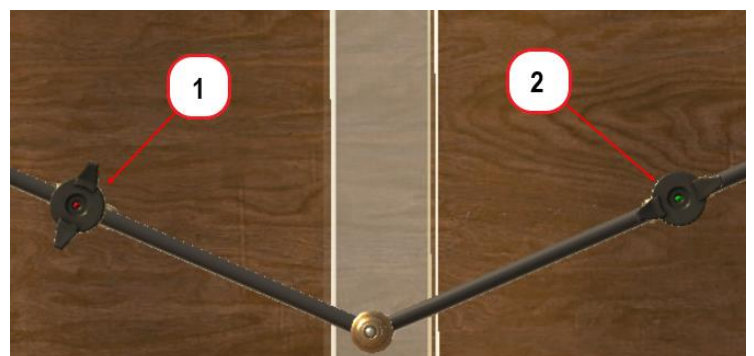


Figure 74 – Closed and open taps on the tubes

To open or close the tap (4 in Figure 72) on the connecting tube, click on it with the left mouse button. The handle of the closed tap is located across the tube (1 in Figure 74), the handle of the open tap is located along the tube (2 in Figure 74).

To add connecting tubes between vessels, use connectors (see **9.2.2 Connector**).

9.2.2 Connector

Connectors are used to install connecting tubes between vessels. Several tubes can be connected to one connector. You can connect vessels with tubes on one stand, on different stands, and on a desktop. The connector can only be placed on a vessel for a system of communicating vessels.

To add a connector to a vessel, left-click the connector card (Figure 75) on the **Equipment** tab, drag it to the desired location in the work area and release the button. Vessels available for placement of the connector will be highlighted in green (Figure 76). Placement location closest to the mouse pointer will be indicated by a blue indicator.



Figure 75 – Connector card

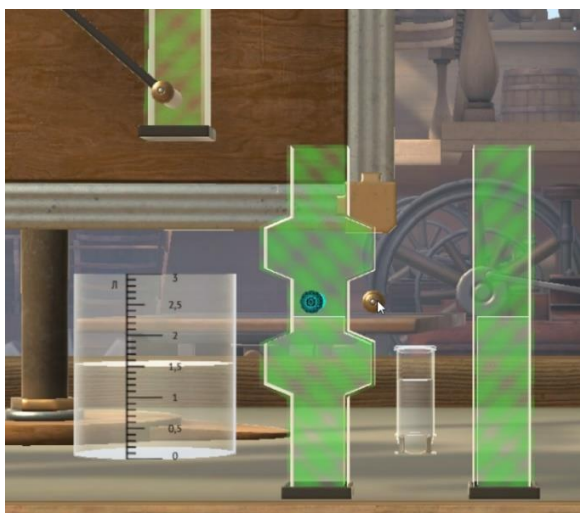


Figure 76 – Color indication of available zones for connector placement

There are two ways to create a connecting tube between connectors:

- **Connection by clicking.** Click on the start connector, then on the end connector. A tube between the connectors will be created automatically.
- **Connection by pulling.** Hold the start connector with the left mouse button, drag the pointer to the end connector and release. When dragging the pointer, the location of the designed tube will be indicated by a line of dots (Figure 77).



Figure 77 – Designation of the designed tube with a line of dots

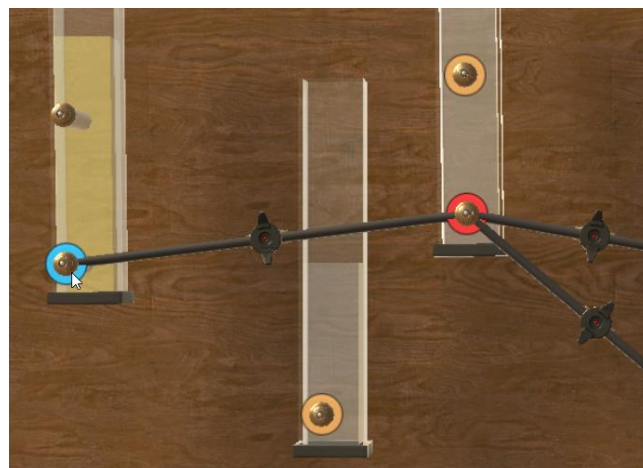


Figure 78 – Beginning of connecting connectors: highlighted connectors with a colored outline

In both cases, the connector from which the connection begins will be highlighted with a blue outline, all available connectors on the desktop will be highlighted with an orange outline, and the connector that is already connected to the initial one will be highlighted with a red outline (Figure 78).

The tap on the connecting tube is added automatically. The length of the tube automatically changes as the vessels move.

9.2.3 Vessels for a system of connected vessels

Vessels of 4 shapes are available in the Virtual Laboratory (Figure 80):

- 1) Straight vessel;
- 2) Vessel with two extensions;
- 3) Expanding vessel;
- 4) Curved vessel.

To configure the vessel size, filler type and fullness before placing the vessel in the scene, click on the object card on the **Equipment** tab (Figure 79) and set the required values in the constructor (see **7.1 Object Constructor**). For salt water, tint can also be adjusted.

By default, when creating vessels, the following values are set:

- size 100%;
- filler type: fresh water;
- fullness: 50%.



Figure 79 – Vessel cards

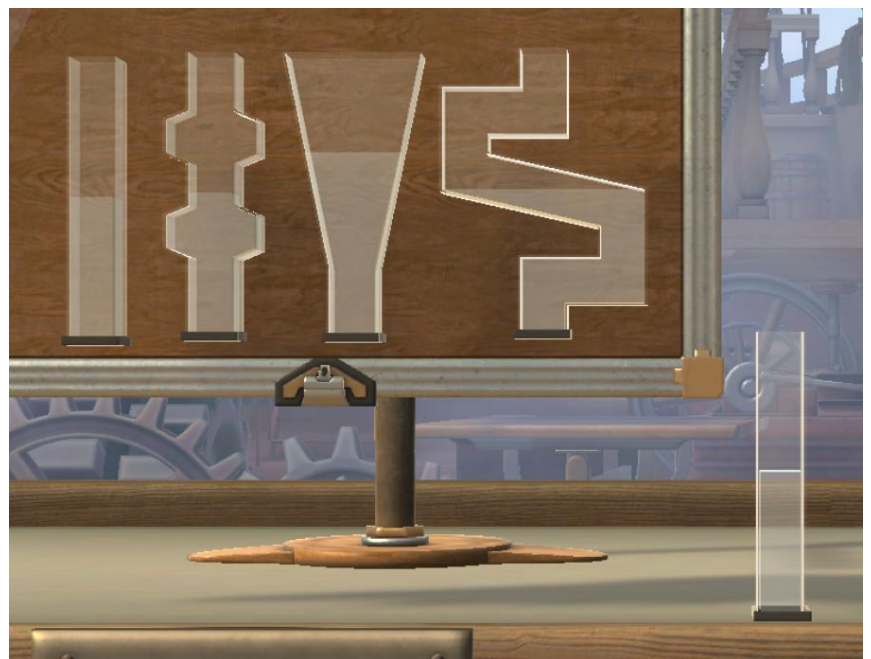


Figure 80 – Vessels for a system of connected vessels

To fill or empty vessels after adding them to the scene, use a filler device (see **9.3.14 Filling device**).

To connect vessels into a connected system, use connectors (see **9.2.2 Connector**).

9.3 Instruments

9.3.1 Stand for the rows method

The rows method stand is used to measure the sizes of small bodies.

To configure the number and type of small bodies in the stand before placing it in the scene, click on the object card on the **Equipment** tab (Figure 81) and set the desired value in the constructor (see 7.1 **Object Constructor**).

By default, a stand will be created with 30 pellets.



Figure 81 – Stand the rows method card



Figure 82 – Stand for the rows method

Use the «Ruler» tool (see 5.3.1 **Ruler**) to measure the dimensions of the bodies in the stand.

9.3.2 Stand

A stand is a vertical stand for attaching objects.

To configure the height of the base and the number of stand connectors before placing it in the scene, click on the object card on the **Equipment** tab (Figure 83) and set the required values in the constructor (see 7.1 **Object Constructor**).

By default, a tripod with a height of 50 cm and one holder will be created.



Figure 83 – Stand card



Figure 84 – Stand

Use the magnetic connector (1) to attach objects to the stand (see **8.4 Connecting objects with magnetic connectors**).

To change the height of the connector, pinch and pull the holder handle (2) up or down to the desired position. The set height value is displayed on the holder handle.

9.3.3 Dynamometer

A dynamometer is a device for measuring force.

To configure the measurement limit or hide the dynamometer scale before placing it in the scene, click on the object card on the **Equipment** tab (Figure 85) and set the values in the constructor (see **7.1 Object Constructor**).

By default, when creating a device, the following values are set:

- measuring limit: 5 N;
- hide scale: no.

On a device with a hidden scale (Figure 87), you can make marks with the «Lines» tool (see **5.3.2 Lines**) and erase them with the «Eraser» tool (see **5.3.3 Eraser**).



Figure 85 – Dynamometer card

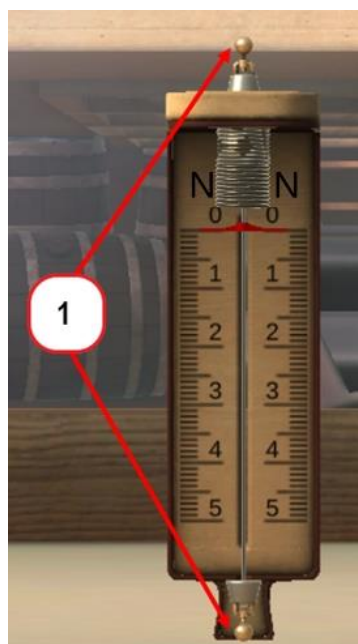


Figure 86 – Dynamometer with scale

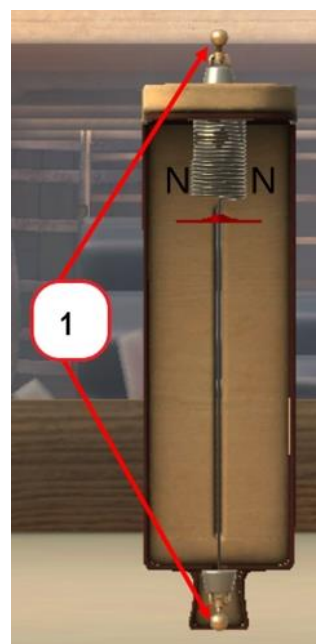


Figure 87 – Dynamometer without scale

Use magnetic connectors (1) to connect the dynamometer to other objects (see **8.4 Connecting objects with magnetic connectors**).

9.3.4 Stopwatch

A stopwatch is a device for measuring periods of time.

The stopwatch has two dials (Figure 89): seconds (1) and minutes (2). The division value of the second dial is 0.1 s, the minute dial is 0.5 min. Measurement time — up to 10 minutes.



Figure 88 – Stopwatch card

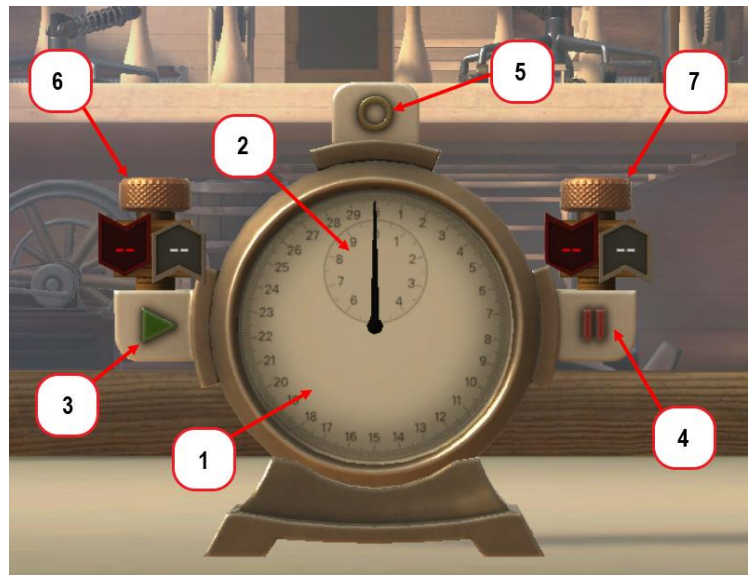


Figure 89 – Stopwatch

To start counting down the time, press the button  (3 in Figure 89). To stop the countdown, press the button  (4). To reset the stopwatch, press the button  (5).

Use the radio point above the start button (6) to remotely start the stopwatch and the radio point above the stop button (7) to remotely stop it (see **8.5 Reception and transmission of signals**).

9.3.5 Inclined plane

An inclined plane is a surface for creating a slope.

To configure the length of the inclined plane and the height of the stand, as well as select the material of the plane before placing it in the scene, click on the object card on the **Equipment** tab (Figure 90) and set the required values in the constructor (see **7.1 Object Constructor**) .

By default, an inclined 100 cm long plane with a 60 cm high base will be created from wood.



Figure 90 – Inclined plane card

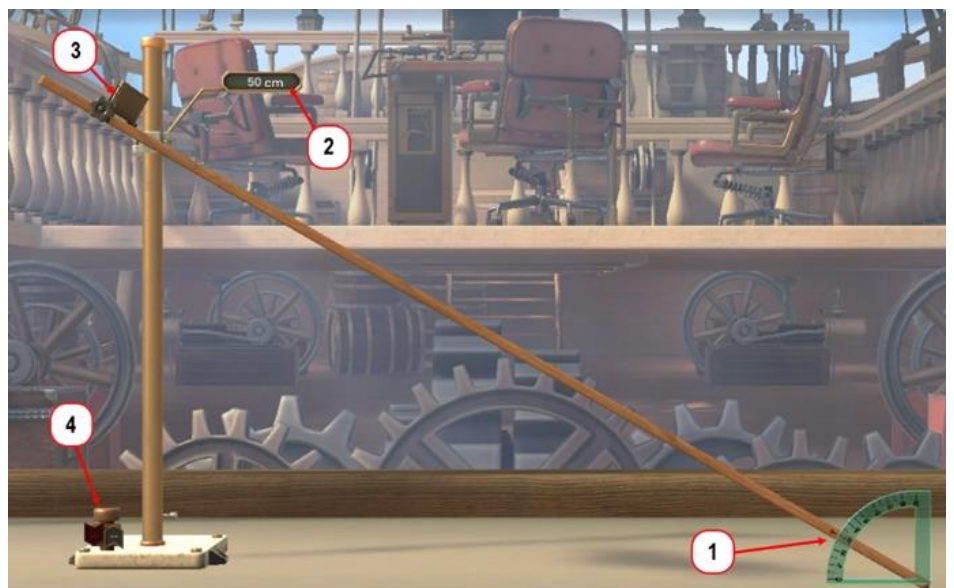


Figure 91 – Inclined plane

The angle of inclination of the plane can be determined using a protractor (1 in Figure 91). To change the angle of the plane, hold and pull the holder handle (2) up or down to achieve the desired position. The set height value is displayed on the holder handle.

A stopper is installed as an obstacle on the left side of the inclined plane (3). To place an item on the plane, place it to the left of the closed stopper. Press down on the stopper to open or close it.

Use the radio point (4) to remotely open and close the stopper and communicate with other objects in the scene (see **8.5 Reception and transmission of signals**).

9.3.6 Lever

The lever is a rod with a ruler and magnetic connectors attached to a stand.

To configure the number of magnetic connectors, the length of the rail and the height of its base before placing the device in the scene, click on the object card on the **Equipment** tab (Figure 92) and set the required values in the constructor (see **7.1 Object Constructor**).

By default, a 50 cm long lever with a 60 cm high base and 2 connectors will be created.



Figure 92 – Lever card

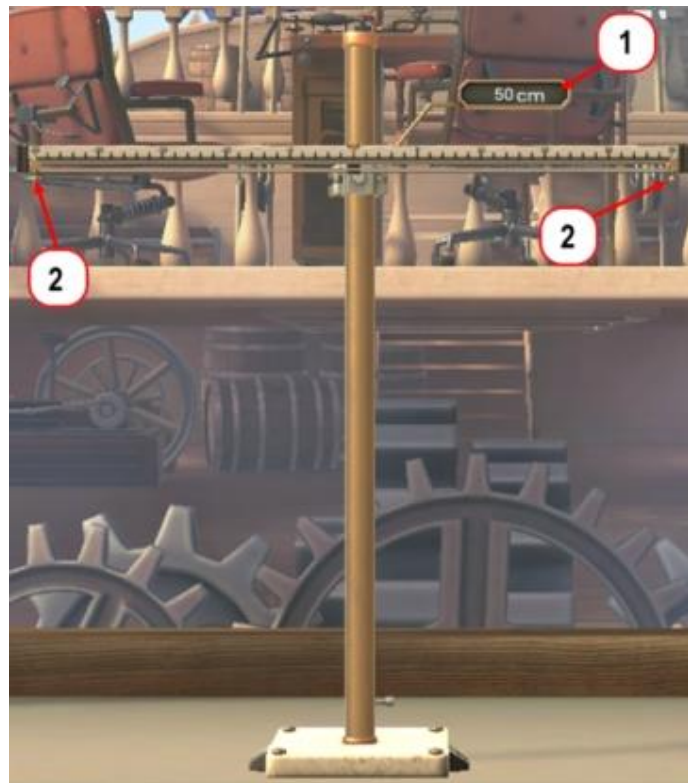


Figure 93 – Lever

To change the height of the rail, pinch and pull the rail or holder handle (1 in Figure 93) up or down to the desired position. The set height value is displayed on the holder handle.

To move the magnetic connector (2) along the rail, hold it with the left mouse button and pull it to the right or left to the desired position.

Use magnetic connectors to attach objects to the lever (see **8.4 Connecting objects with magnetic connectors**).

9.3.7 Fixed and moving blocks

Fixed and moving blocks are mechanisms made of blocks placed on stands through which the threads pass. In a fixed block the axis of the mechanism is fixed, in a moving block it is not. The mass of the block is 20 g (0.2 N).

To adjust the height of the block base before placing the device in the scene, click on the object card on the **Equipment** tab (Figures 94 and 95) and set the desired value in the constructor (see **7.1 Object Constructor**).

By default, a block will be created with a base height of 60 cm.



Figure 94 – Fixed block card



Figure 95 – Moving block card

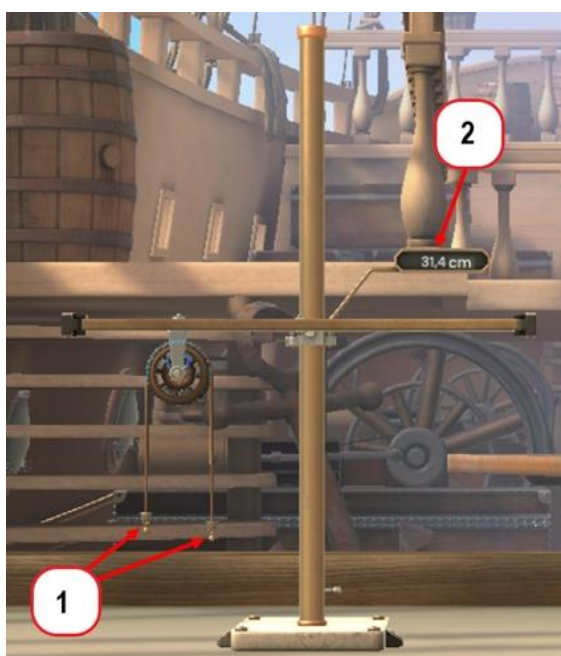


Figure 96 – Fixed block

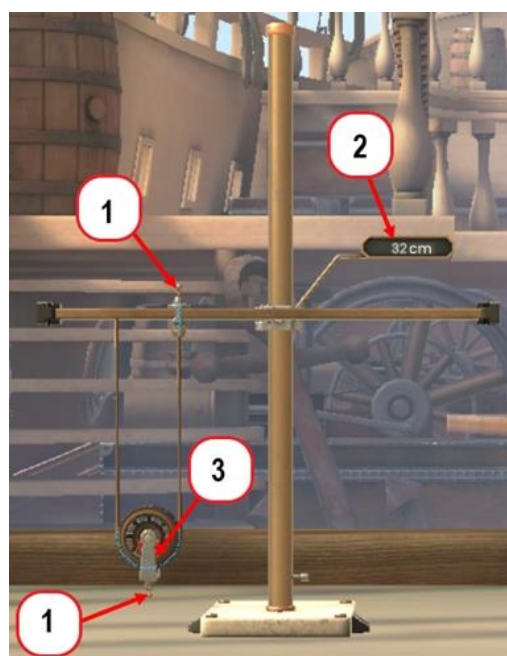


Figure 97 – Movable block

Use magnetic connectors (1 in Figures 96 and 97) to attach objects to the blocks (see **8.4 Connecting objects with magnetic connectors**).

To change the height of the rail on the stand, pinch and pull the rail or holder handle (2) up or down to the desired position. The set height value is displayed on the holder handle.

To apply force to the sliding block mechanism, pinch and pull the block bracket (3 in Figure 97) or the magnetic connector.

9.3.8 Hydraulic Press

A hydraulic press is a device consisting of two communicating cylindrical vessels with pistons. The height of the cylinders is 40 cm.

To configure the bottom areas of the cylinders before placing the press in the scene, click on the object card on the **Equipment** tab (Figure 98) and set the required values in the constructor (see **7.1 Object Constructor**).

By default, when creating a device, the following values are set:

- left cylinder area: 40 cm²;
- right cylinder area: 200 cm².



Figure 98 – Hydraulic press card



Figure 99 – Hydraulic press

To press the piston (1 in Figure 99), hold it with the left mouse button and pull it down. Objects can be placed on top of the piston.

9.3.9 Liquid manometer

A liquid manometer is a device for measuring pressure using a measuring scale and a U-shaped glass tube filled with water (density of water is 998 kg/m³). One end of the glass tube is connected to a membrane sensor. The other end of the tube is open.



Figure 100 – Liquid manometer card

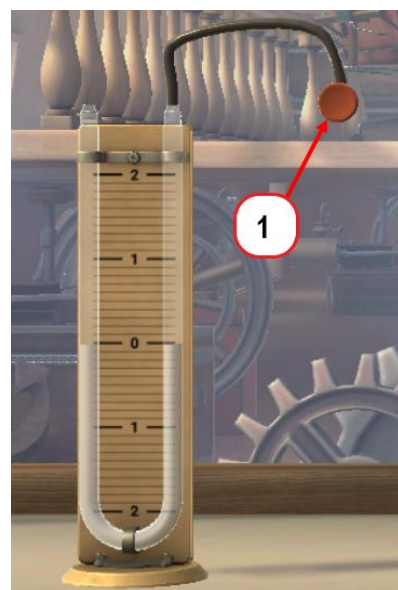


Figure 101 – Liquid pressure gauge

The liquid manometer sensor (1 in Figure 101) can be immersed in liquid in an aquarium or in a universal container. To move a sensor, hold down the left mouse button and drag it to the desired location. To rotate a sensor immersed in a liquid, hold it with the left button and, without releasing it, rotate the mouse wheel.

9.3.10 Lever scales

Lever scales are a device for determining the mass of bodies. The scale division price is 1 g.

The following objects can be placed on the scales: a deflated balloon, a ball, a wooden train, a plastic car, a metal bolt, a stone, a rubber fish, 1 N and 10 N loads, weights from a set of weights, a cart with launchers (without filling), a boat (without filling), a rectangular prism, test tube with stopper (with filling), universal container (with filling).



Figure 102 – Lever scales card

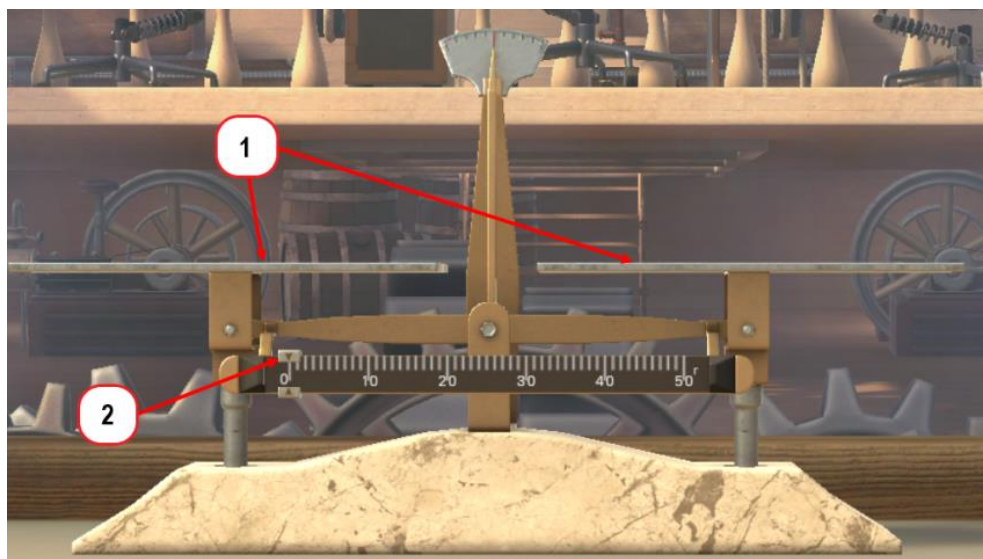


Figure 103 – Lever scales

To place an object on the scale pan (1 in Figure 103), hold it with the left mouse button, drag it to the area above the scale until a green color indication appears on the scale and then release the button (Figure 104). A red indication on the scale means there is not enough space to place the object (Figure 105).

For a more accurate weight measurement, use overloads (2 in Figure 103). To move the overload, hold it with the left mouse button and drag along the scale to the desired position.

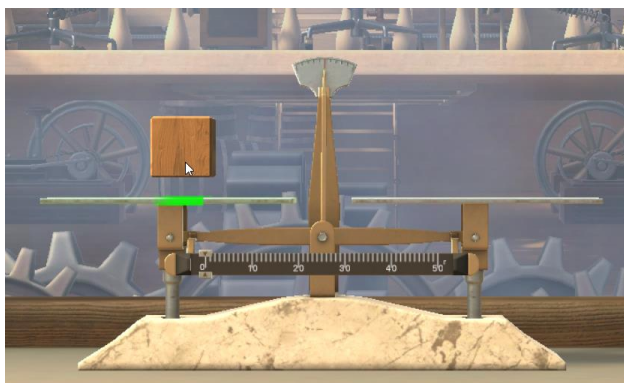


Figure 104 – Placing an object on the scales



Figure 105 – Red indication on the scales

9.3.11 Radio button

A radio button is a device with a radio point with an output signal for simultaneous activation of other devices.

To launch several devices simultaneously, set their incoming channels to the same frequency as the outgoing channel (1 in Figure 107) of the radio button (see **8.5 Reception and transmission of signals**) and press it (2).



Figure 106 – Radio button card

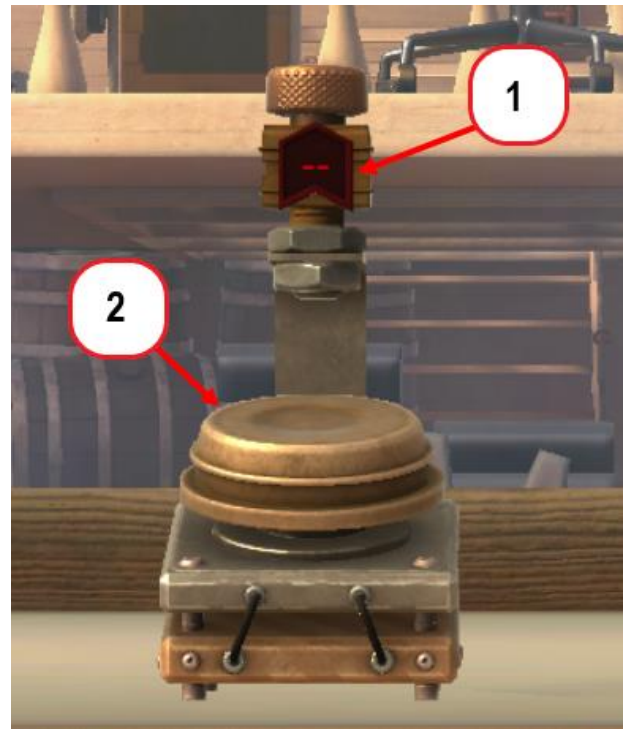


Figure 107 – Radio button

9.3.12 Stand with rail cart

A stand with rail cart 1 is a vertical stand with a rail and magnetic connectors for attaching objects.

To adjust the height of the base, the length of the staff and the rotation of the stand before placing it in the scene, click on the object card on the **Equipment** tab (Figure 108) and set the required values in the constructor (see **7.1 Object Constructor**).

By default, when creating a device, the following values are set:

- tripod base height: 60 cm;
- rail length: 20 cm;
- turn: right.

To change the number of connectors on the rail, change its length: for every 10 cm of the rail there is 1 magnetic connector.



Figure 108 – Card of the stand with rail cart

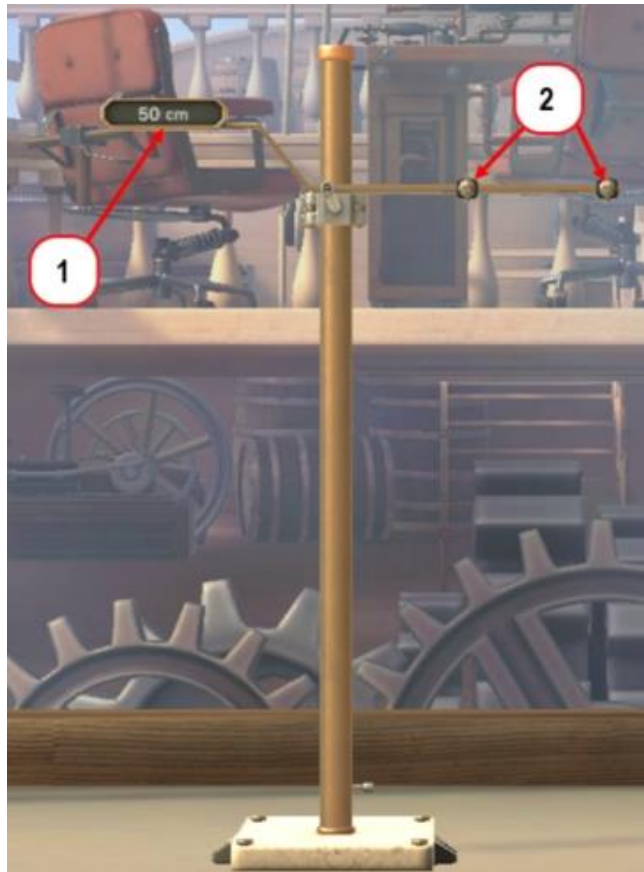


Figure 109 – Stand with rail cart

To change the height of the rail, hold and pull the holder handle (1 in Figure 109) up or down to the desired position. The set height value is displayed on the holder handle.

Use magnetic connectors (2) to attach objects to the stand (see **8.4 Connecting objects with magnetic connectors**).

9.3.13 Wall with touch detector

A wall with a touch sensor is used as an obstacle on the workbench to prevent objects (such as balls) from flying far away, and also as a touch detector.

To adjust the height of the wall before placing it in the scene, click on the object card on the **Equipment** tab (Figure 110) and set the desired value in the constructor (see **7.1 Object Constructor**).

By default, a wall will be created with a height of 50 cm.



Figure 110 – Card of the wall with a touch sensor

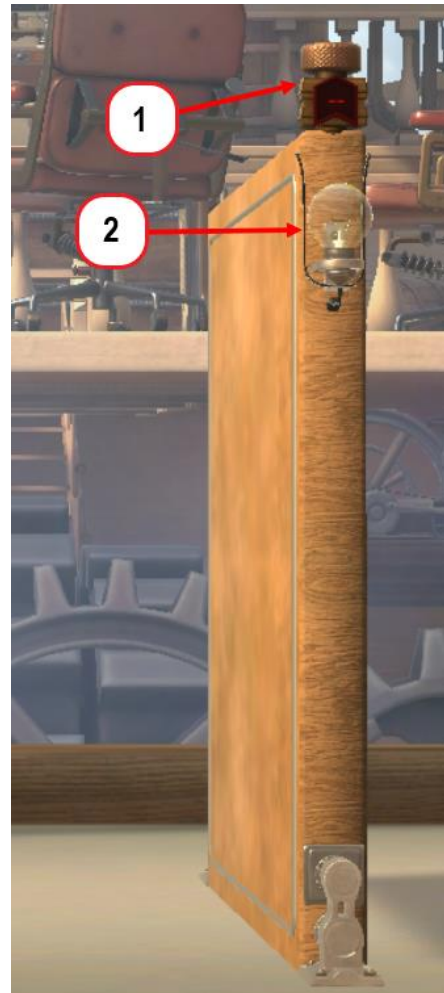


Figure 111 – Wall with a touch sensor

Use the radio point (1 in Figure 111) to transmit touch sensor data to other devices (see **8.5 Reception and transmission of signals**). The touch sensor radio only has an outgoing channel. When the device touches another object, the light bulb (2) lights up.

9.3.14 Filling device

The filling device is used to fill objects with gases, liquids and bulk products. Also, using a filling device, you can reduce the amount of substance in objects.

The filling device can accommodate a vessel for a system of connected vessels, a test tube with a stopper, a universal container and a balloon.

The following fillers are available in the filling device:

- gaseous: hydrogen, helium, air;
- liquid: fresh and salt water, oil, kerosene, mercury;
- bulk: sand, pellets, millet.



Figure 112 – Filling device card



Figure 113 – Filling device

To place an object in the filling device, move it to the green indication zone of the device — if placed correctly, the device will be highlighted with a green color indication (Figure 114). If another object is already installed in the filling device, the device will be illuminated with a red color indication (Figure 115). In this case, you must first remove the already installed object from the device and then place a new one.

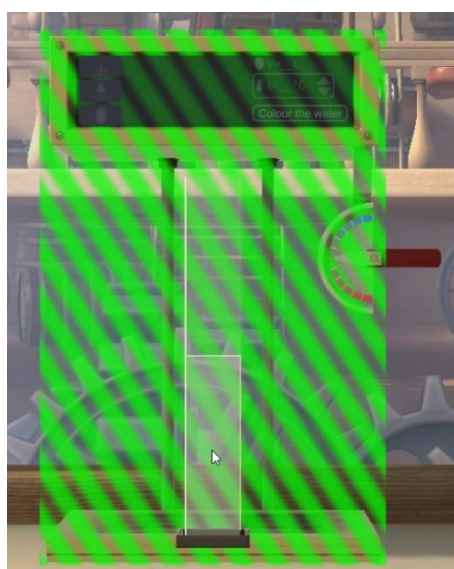


Figure 114 – Color indication of the filling device when the object is placed correctly



Figure 115 – Color indication of the filling device when the object is placed incorrectly

9.3.14.1 Filling a balloon with gas

To fill or deflate a balloon, drag it to the green indicator area of the filling device (Figure 116) and release the button — the balloon will automatically be connected to the gas pipe (Figure 118).



Figure 116 – Color indication of the filling device when placing a balloon in it

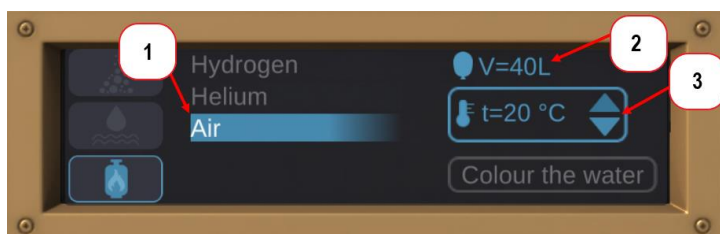


Figure 117 – Screen of the filling device during the work with a balloon

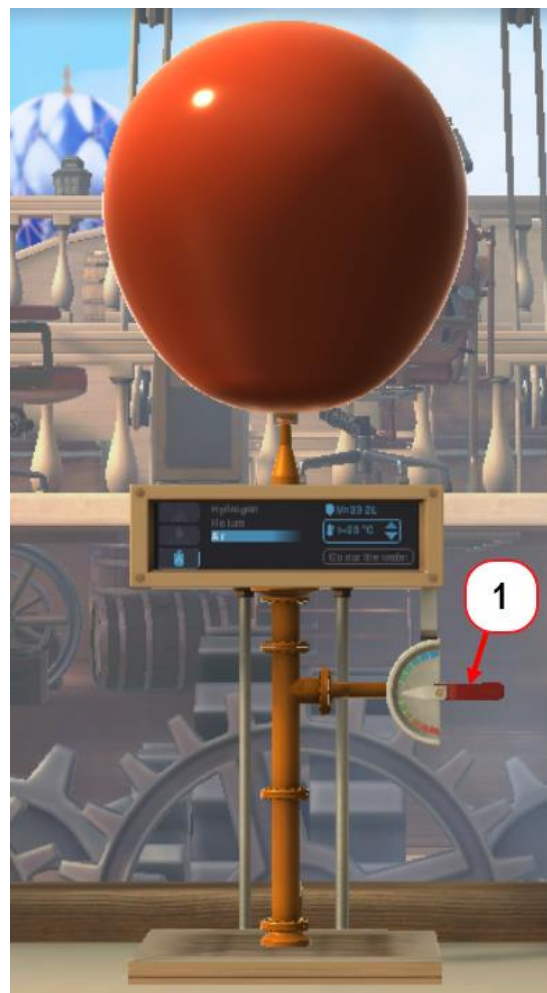


Figure 118 – Balloon with connection to a filling device

The name of the gas with which the ball is filled (1 in Figure 117), its volume (2) and temperature (3) will be displayed on the screen of the filling device.

To fill the balloon with gas, pull the regulator handle (1 in Figure 118) down and release it. To stop the filling, return the handle to its original position. While the balloon is filling, the screen will display the current volume of gas in the balloon. It is impossible to mix gases in a balloon. To adjust the air temperature, press the buttons ▲ and ▼ (3 in Figure 117).

To deflate the balloon, pull the control knob (1) up and release it.

9.3.14.2 Filling containers with liquid substances

You can put liquids into vessels for a system of connected vessels, a test tube with a stopper, and a universal container. You can add different liquids to one container. To fill a container, place it in the filling device (Figure 119), select the filler (1) on the control panel, and pull the handle (3) down.

To add salt water tint, press button (2). For other fillers, tinting is not available.

To stop the filling, return the handle to its original position.

To reduce the amount of substance in the container, pull the handle (3) up.

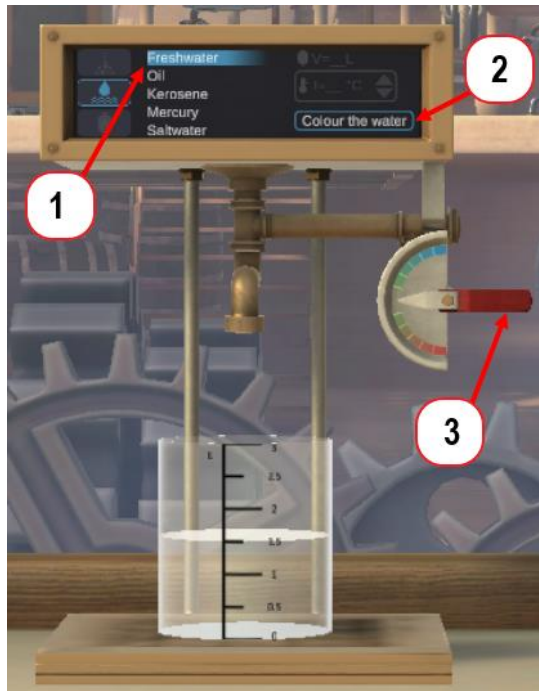


Figure 119 – Filling a container with liquids

9.3.14.3 Filling a test tube with bulk products

Bulk products can only be filled into an empty test tube with a stopper. A test tube can only be filled with one bulk filler; it is impossible to mix liquid and bulk fillers in a test tube.

To switch between liquid and bulk fillers, use buttons (1) and (2) in Figure 120. To fill a tube, place it in the filling device (Figure 120), select the filler (3) on the control panel, pull the control knob (4) down and release it.

To stop the filling, return the handle to its original position.

To reduce the amount of substance in the container, pull the handle (2) up and release it.

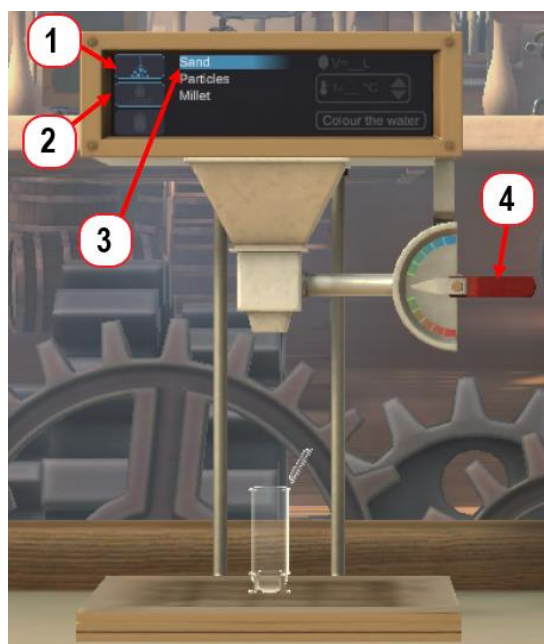


Figure 120 – Filling a test tube with bulk products

9.4 Containers

9.4.1 Aquarium

An aquarium is a glass container with liquid for conducting experiments.

To configure the display of the scale, fullness, size of the aquarium and select the filling liquid before placing the aquarium in the scene, click on the object card on the **Equipment** tab (Figure 121) and set the required values in the constructor (see **7.1 Object Constructor**) . For salt water, you can also adjust the color tint.

By default, when creating an object, the following values are set:

- scale display: no;
- fullness: 70%;
- size: large;
- filling liquid: fresh water.

The following aquarium sizes are available in the Virtual Laboratory:

- small: length 25 cm, width 20 cm, height 30 cm, volume 15 l;
- medium: length 37 cm, width 20 cm, height 30 cm, volume 22.2 l;
- large: length 50 cm, width 20 cm, height 30 cm, volume 30 l.



Figure 121 – Aquarium card



Figure 122 – Aquarium

To place an object in the aquarium, hold it with the left mouse button, place it over the aquarium and release it. If an object cannot be placed in the aquarium, a red color indication is displayed along the top edge of the aquarium (Figure 123).

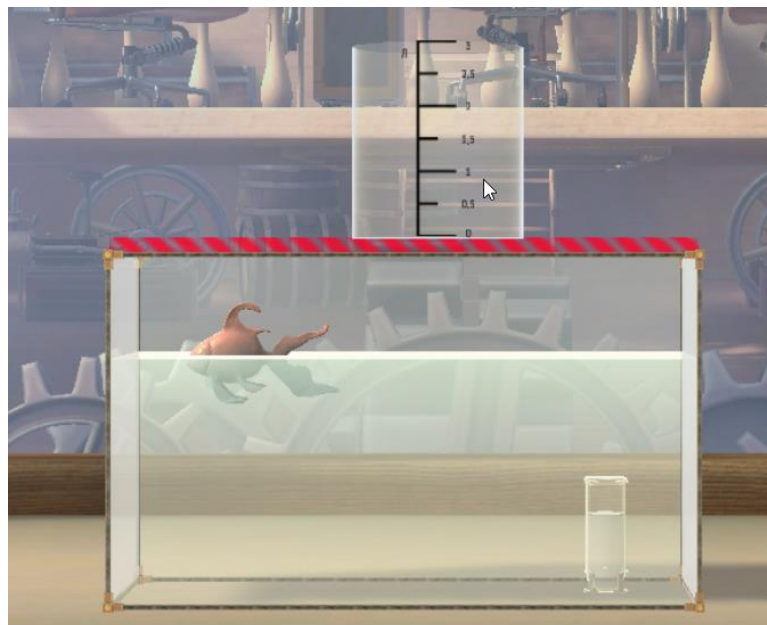


Figure 123 – Red color indication of the aquarium when the object is placed incorrectly

9.4.2 Test tube with stopper

A test tube with a stopper is a closed glass container for filling with liquids and bulk products, as well as for conducting experiments. The plug opens and closes automatically.

To configure the fullness of the test tube and select the liquid to be filled before placing an object in the scene, click on the object card on the **Equipment** tab (Figure 124) and set the required values in the constructor (see **7.1 Object Constructor**). For salt water, tint can also be adjusted.

By default, when creating a test tube, the following values are set:

- fullness: 70%;
- filling liquid: fresh water.



Figure 124 – Test tube card with stopper



Figure 125 – Test tube with stopper

To fill the test tube after placing it on the desktop, use a filler device (see **9.3.14 Filling device**). The test tube can be placed in an aquarium and in a universal container.

9.4.3 Universal container

A universal container is an open glass container for filling with liquids and bulk products, as well as for conducting experiments.

To configure the presence and location of holes in the container, scale display and volume, as well as select liquids for filling before placing the container in the scene, click on the object card on the **Equipment** tab () and set the required values in the constructor (see **7.1 Object Constructor**). The container can be filled with different liquids and the fullness can be set for each of them. For salt water, you can also adjust the color tint.

By default, when creating a container, the following values are set:

- hole on the left: no;
- hole on the right: no;
- scale display: no;
- volume: 3000 ml;
- filling liquid: fresh water;
- fullness: 50%



Figure 126 – Universal container card

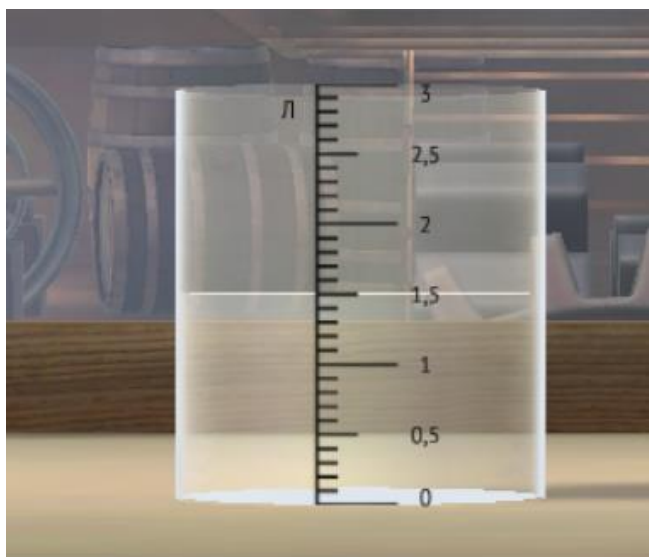


Figure 127 – Universal container

To fill the container after placing it on the desktop, use a filler device (see **9.3.14 Filling device**).