Go-Lab

Global Online Science Labs for Inquiry Learning at School

Collaborative Project in European Union's Seventh Framework Programme

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Inquiry Learning Space (ILS): Series and parallel circuits

About Go-Lab

The Go-Lab project aims to encourage young people to engage in science topics, acquire scientific inquiry skills, and experience the culture of doing science by undertaking active guided experimentation. Targeting students from 10 to 18 years old, Go-Lab offers the opportunity to perform personalized scientific experiments with online labs in pedagogically structured and scaffold learning spaces that are extended with collaboration facilities.

The Go-Lab thus offers students:

- access and use of scientific instruments (remote and virtual laboratories) for investigations
- access to research data and archives
- use of advanced tools for data acquisition, analysis, and visualization
- structured learning spaces based on a well-defined inquiry cycle
- cognitive scaffolds for the inquiry process
- facilities and support for communication and collaboration on scientific topics and data

One of the main components of the Go-Lab Portal is the Inquiry Learning Space (ILS). Inquiry Learning Spaces are online labs embedded in resources and scaffolds to offer students a complete inquiry learning experience. The Go-Lab portal offers school teachers the possibility to create learning spaces customized for their classes and students or to adapt existing inquiry spaces. Another benefit of Go-Lab is the possibility to share Inquiry Learning Spaces with other teachers and adapt it to fit their purpose.

Below you will find the content of the “Series and parallel circuits” ILS which can be accessed also online under:

http://graasp.eu/ils/54759c91e9934012b7c661af?lang=en

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1 Orientation

Dear Student,

The challenge of this lesson is to determine how the light fixtures in a house are connected, in series or in parallel? Your task is to perform a scientific investigation in order to provide enough arguments for the appropriate setup.

In the Orientation phase you will learn about the simple electric circuit and in series and parallel setup.

Related resources

- YouTube video 1: https://youtu.be/YHqszZ_wFls
    - Step 1: Have you ever wondered if you can make a bulb light up using a battery and a wire? Could this be possible? Watch the video to see what graduates of an Institute of Technology think.
- Quiz: http://graasp.eu/ils/54759c91e9934012b7c661af?lang=en
    - Take the quiz, examine the arrangements and guess which bulb(s) will light up.
    - **Step 2**: It is about time to check our predictions. In order to do that, get a wire, a bulb and a battery from your teacher and investigate if the bulb will light up, in each one of the arrangements, with one or two peers.
    - Simple electric circuit: In order for a bulb to light up, we need to have a wire, a battery, and a bulb connected in a proper way to create a close circuit. This arrangement is called a “simple electric circuit". Each of the three electrical elements of the simple electric circuit (namely, the wire, the buttery, and the bulb) has two electrical ends, which are called “conductive parts". Conductive parts must connect in series in a closed circular arrangement. This means that one of the conductive parts of the battery needs to connect to a conductive part of the bulb. The free part of the bulb connects to an end of the wire and the free end of the wire connects to the free part

of the battery. The battery creates a potential difference, which is called “voltage", and forces electrons to flow from the negative to the positive side of the battery. More specifically, the chemical reactions in a battery cause a buildup of electrons at the negative pole of the battery and thus there is an electrical difference between the two sides (the negative and the positive). The electrons want to move to a place with fewer electrons, but this cannot be done through the battery. When a circuit is closed (that means the two sides of a battery are connected with a conductive material) electrons find a way to move from the negative to the positive side.

- YouTube video 2: https://youtu.be/RQ3djos_LY8
    - Types of electrical circuits: How many types of electric circuits are there? Watch the video and take some notes.

2 Conceptualisation

In the Conceptualisation phase you will identify which variables are related to the phenomenon you're studying and you will formulate hypotheses in order to help you address the challenge of the lesson.

Related resources

- YouTube video 1: https://youtu.be/L5Tku5LRh5k
    - Step 1: During the lesson you will discover more details about electric circuits and various types of setups, using the Electrical Circuit Lab. The video will help you to familiarize yourself with the lab, its tools, symbols and functions.
- Electrical Circuit Lab: http://graasp.eu/ils/54759c91e9934012b7c661af?lang=en
    - Create a simple electric circuit and measure the electric current.
- Hypothesis Scratchpad tool: http://graasp.eu/ils/54759c91e9934012b7c661af?lang=en
    - Step 2: In the previous phase you learned useful information about the simple electric circuit. There can be setups in series and in parallel. Will there be any change to the electric current if we add bulbs in series or in parallel?
      In order to respond to the above concern, you will first formulate hypotheses which you will test in the following phase. In order to do that you will use the Hypothesis Scratchpad tool.
    - A good hypothesis can be formulated in the form of an "If ... then..." statement, which will include one dependent variable and at least one independent variable. This is an example of how variables are linked in a hypothesis: "If the independent variable increases, then the dependent variable decreases."
      We should incorporate only one independent variable in each hypothesis. This will ensure that we will investigate the impact that this variable has on the dependent variable.

3 Investigation

In the Investigation phase you will plan, design and carry out your experiments. You have already familiarized yourself with the Electrical Circuit Lab and now you will use it to collect data for your hypotheses, which you have formulated in the previous phase.

Related resources

- Experiment Design tool: http://graasp.eu/ils/54759c91e9934012b7c661af?lang=en
    - Step 1: Use the Experiment Design tool to plan and design your experiments. Follow the step by step instructions in order to complete your experiments.
- Observation tool: http://graasp.eu/ils/54759c91e9934012b7c661af?lang=en
    - Each time you test what happens to the electric current when you add bulbs either in series or in parallel, keep notes in the Observation tool, below the Electrical Circuit Lab, concerning the following:
      - Compare the brightness of the bulbs in each circuit.
      - Is the brightness of the bulbs the same as the brightness of the bulb in a simple electric circuit?

4 Data Interpretation

In the Data Interpretation phase, you will create graphs or/and tables and you will answer questions that will help you to interpret your data.

Related resources

- Data Viewer tool: http://graasp.eu/ils/54759c91e9934012b7c661af?lang=en
    - Step 1: The Data Viewer tool will help you to create data graphs and/or tables in order to identify what is the relation of the number of bulbs and the electric current in each setup.
    - Step 2: The following questions will help you to interpret your data.
      1) What is the effect of adding bulbs in a circuit on the electric current? Try to explain your reasoning, taking into account your data.
      2) How the brightness of the bulbs changes when adding bulbs in series? What about when adding bulbs in parallel?
      3) Consider that the brightness of a bulb is an indicator of the electric current flows through it. How the electric current flows through each bulb changes when adding bulbs in series and in parallel?

5 Conclusion

In this phase, you will use the Conclusion tool in order to retrieve your previous work (hypothesis, graphs) and formulate your conclusions. In addition, you will be able to give an answer about the light fixtures in a house.

Related resources

- Conclusion tool: http://graasp.eu/ils/54759c91e9934012b7c661af?lang=en
    - Give an answer to the initial concern of our lesson, "How are the light fixtures in a house connected?". In your answer you have to give enough evidence from your investigation in order to explain your reasoning.

6 Discussion

This is the last phase of the lesson. First you have to reflect on the processes followed and then participate in a discussion in order to communicate about your findings.

- Step 1: By now you must have completed your investigation and it is time to reflect on your work. Write down your thoughts based on the following:

  1. Describe the various steps you have taken in order to test your hypotheses.

  2. Did you complete all activities?

  3. Evaluate your success or failure in accomplishing all phases of the learning process.

  4. Consider alternative viewpoints for doing your work in different ways and identify activities that could be done similarly or differently.

- Step 2: Discuss with your teacher and peers about your investigations and conclusions.