

TIWI: Multiplier Event

Inquiry Based Learning for science education in primary and secondary school.
The Go-Lab ecosystem for innovative STEM education

Olga Dziabenko – University of Deusto, Spain

Roadmap / outline

- TIWI Project briefly
- Inquiry learning as active learning
- How to make inquiry effective
- The Go-Lab ecosystem at a glance

TIWI --> Teaching **ICT** With **Inquiry**

MAIN IDEA:

Structure of STEAM career (*present + future*):
a composition of the science and ICT:

Science: Inquiry-based Learning approach (Go-Lab ecosystem)

ICT: coding languages (Scratch, Python, and Excel)




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TIWI using Go-Lab ecosystem

GO-LAB Labs Apps Spaces Authoring Support Premium About News

Photovoltaic System: Is It The Answer?




Creator: diguzlabenko
Age Range: 15-16, Above 16
Big Ideas Of Science: Energy Transformation
Subject Domains: Environmental Education, Engineering, Physics, Geography And Earth Science, Technology
Language: English
Average Learning Time: 135 Minutes
License: Creative Commons Attribution Noncommercial (CC BY-NC) - default
Works Offline: No

[Preview](#)
[Duplicate Space](#)

Recommendations:
Can Scientists Collaborate For Climate Change?
Can You Be A Better Basketball Player Than Sabonis (Learning By Critiquing)
Winemaking Science Journal
Orapal Vikonjula
Fit Eco, Fit Usant!
Types Of Seismic Waves
Mercuries And Their Impact On Earth
Energie Alternative (à Impactual Impact)
Mediula

Description
After this ILS, students should be able to: (1) describe a photovoltaic system. How it works? and how energy does.

Augmented Reality




Creator: Mohammed Oubella
Age Range: 11-12, 13-14, 15-16, Above 16
Big Ideas Of Science: Our Universe
Subject Domains: Mathematics, Technology
Language: English
Average Learning Time: 135 Minutes
License: Creative Commons Attribution Noncommercial (CC BY-NC) - default
Works Offline: No

[Preview](#)
[Duplicate Space](#)

Description
Augmented reality (AR) is an interactive experience of a real world environment where the objects that reside in the real-world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory and olfactory.

Problem Solving And Computational Thinking For Urban Planing



Creator: Gheorghe Ciuparu
Age Range: 11-12, 13-14, 15-16
Subject Domains: Engineering, Geography And Earth Science, Mathematics
Language: English
Average Learning Time: 45 Minutes
License: Creative Commons Attribution Noncommercial (CC BY-NC) - default
Works Offline: No

[Preview](#)
[Duplicate Space](#)

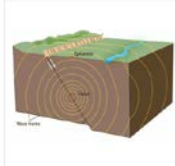
Description
Following this ILS, students should be able to:
• use google maps to plan their trip,
• find location coordinates,
• understand the importance of urban planning.

<https://bit.ly/2u1cn7W>

<https://www.golabz.eu/ils/augmented-reality>

<https://bit.ly/30sGily>

Types Of Seismic Waves




Creator: Maria Iakovou
Age Range: 11-12, 13-14, 15-16, Above 16
Subject Domains: Physics, Geography And Earth Science
Language: English
Average Learning Time: 135 Minutes
License: Creative Commons Attribution Noncommercial (CC BY-NC) - default
Works Offline: No

[Preview](#)
[Duplicate Space](#)

Description
In this lesson students will get familiar with the types of seismic waves and the seismic wave propagation combining inquiry based learning and programming.
This ILS was developed according to frameworks developed in the SSE, SNAC and TIWI projects.

Pharmacokinetics




Creator: Maria Iakovou
Age Range: 13-14, 15-16, Above 16
Subject Domains: Chemistry
Language: English
Average Learning Time: 135 Minutes
License: Creative Commons Attribution Noncommercial (CC BY-NC) - default
Works Offline: No

[Preview](#)
[Duplicate Space](#)

Description
In this lesson, students have the opportunity to learn about the factors that affect the amount of drug reaching systemic circulation, what bioavailability is, and how it is used in pharmacology, combining questioning approach and programming.

Can You Be A Better Basketball Player Than Sabonis (Learning By Critiquing)



Creator: Iliana Iakovou
Age Range: 11-12, 13-14, 15-16
Big Ideas Of Science: Energy Transformation
Subject Domains: Physics, Technological Applications, Robotics, Forces And Motion, Velocity, Useful Materials And Products, Everyday Materials, Waves, Wave Speed, Longitudinal Waves, Tools For Science, Laboratory Measuring Instruments, Including Sensors And Motors, Online Laboratories, Geography And Earth Science, Geography, Projection, Technology, Computer Science And Technology, Programming Languages, Design, Aspect Design, View Design, Internet, Digital Information, Information Search

[Preview](#)
[Duplicate Space](#)

Description
This lesson plan aims to learn about the use of physical knowledge about the of a projectile motion and the creation of a script for "a robot basketball player" by using the Scratch application.

Prior Knowledge Requirements
- to describe the motion of a projectile launched horizontally in terms of the horizontal and vertical components of the motion.

<https://bit.ly/2BbhqCM>

<https://www.golabz.eu/ils/pharmacokinetics>

<https://bit.ly/2owljQe>

<http://tiwi.eun.org/>



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Inquiry learning as active learning



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The discourse

➤ The problem for STEM education

- Students often do not reach (deep) conceptual knowledge
- Students often lack motivation

➤ The solution

- Introduce active learning
- Technology to foster and enable the transition between traditional and active learning

What is an Active Learning?

Active learning is any learning exercise in which a student is actively engaged, i.e. participates or interacts, with the learning process, as opposed to passively taking in the information.

Active Learning (evidence 1)

- **62 introductory courses**
- **6542 students**
- **Standardized conceptual knowledge**
- **test, pre- and post**
- **14 traditional (T) courses (N = 2084)**
- **48 interactive engagement (IE)**
- **courses (N = 4458)**

Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses

Richard R. Hake^{a)}

Department of Physics, Indiana University, Bloomington, Indiana 47405

(Received 6 May 1996; accepted 4 May 1997)

A survey of pre/post-test data using the Halloun–Hestenes Mechanics Diagnostic test or more recent Force Concept Inventory is reported for 62 introductory physics courses enrolling a total number of students $N=6542$. A consistent analysis over diverse student populations in high schools, colleges, and universities is obtained if a rough measure of the average effectiveness of a course in promoting conceptual understanding is taken to be the average normalized gain $\langle g \rangle$. The latter is defined as the ratio of the actual average gain $(\% \langle \text{post} \rangle - \% \langle \text{pre} \rangle)$ to the maximum possible average gain $(100 - \% \langle \text{pre} \rangle)$. Fourteen “traditional” (T) courses ($N=2084$) which made little or no use of interactive-engagement (IE) methods achieved an average gain $\langle g \rangle_{T\text{-ave}} = 0.23 \pm 0.04$ (std dev). In sharp contrast, 48 courses ($N=4458$) which made substantial use of IE methods achieved an average gain $\langle g \rangle_{IE\text{-ave}} = 0.48 \pm 0.14$ (std dev), almost two standard deviations of $\langle g \rangle_{IE\text{-ave}}$ above that of the traditional courses. Results for 30 ($N=3259$) of the above 62 courses on the problem-solving Mechanics Baseline test of Hestenes–Wells imply that IE strategies enhance problem-solving ability. The conceptual and problem-solving test results strongly suggest that the classroom use of IE methods can increase mechanics-course effectiveness well beyond that obtained in traditional practice. © 1998 American Association of Physics Teachers.

I. INTRODUCTION

There has been considerable recent effort to improve introductory physics courses, especially after 1985 when Halloun and Hestenes¹ published a study using the Force

Concept Inventory¹¹ and pro¹² arguments as to whether a high FCI score indicates the attainment of a unified force concept. Nevertheless, even the detractors have conceded that “the FCI is one of the most reliable and useful physics tests currently available for introductory physics teachers”^{11(a)} and

- **Average gain IE almost two standard deviations higher than T**



Active Learning (evidence 2)

- “The active learning interventions varied widely in intensity and implementation, and included approaches as diverse as occasional group problem-solving, worksheets or tutorials completed during class, use of personal response systems with or without peer instruction, and studio or workshop course designs.” (p. 8410)
- Meta-analysis of 225 studies
 - Active learning increases performance by 0.47 SD
 - Students in traditional lectures were 1.5 times more like to fail in final exam than students in active learning classes
- “If the experiments analyzed here had been conducted as randomized controlled trials of medical interventions, they may have been stopped for benefit—meaning that enrolling patients in the control condition might be discontinued because the treatment being tested was clearly more beneficial” (p. 8413)

Models & Strategies of Active Learning



Chris O'Neal and Tershia Pinder-Grover, Center for Research on Learning and Teaching, University of Michigan,
http://crlt.umich.edu/sites/default/files/resource_files/02_Active%20Learning%20Continuum.pdf



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Inquiry Learning (Inquiry Based Learning)

➤ Expository methods (traditional teaching)

- Teacher explains – students do exercises (ready made science)
- First: presentation of scientific principles (lecture)
- Then: experiment to verify (confirm) the principle (laboratory)

➤ Inquiry methods (learning)

- Students are **researchers**: do explorations first and design concepts and laws together with their teachers (science-in-the making)
- Students construct (not only confirm) meaning
- No clear separation between the lecture and the lab

Schuster, D., Cobern, W. W., Adams, B. A. J., Undreiu, A., & Pleasants, B. (2018). Learning of core disciplinary ideas: Efficacy comparison of two contrasting modes of science instruction. *Research in Science Education*, 48, 389-435.

Trout, L. Lee, C., Moog, R., Ricky, D. (2008). Inquiry learning: What is it? How do you do it? In: *Chemistry in the National Science Standards, 2nd Edition*, S.L. Bretz (Ed.). Washington, DC: American Chemical Society.



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Main features of inquiry learning

- Learners try to formulate hypotheses and scientifically oriented questions and get answer on them
- Learners collect evidence by actively performing experiments
- Learners formulate explanations from evidence
- Learners evaluate their explanations in light of alternative explanations
- Learners communicate and justify their proposed explanations

Four Forms of Inquiry (instructional settings)

- *Confirmation inquiry*

Learners are given a question, as well as a method, to which the end result is already known. The goal is to confirm the results.

- *Structured inquiry*

Learners are given the question and the method of achieving the result, but the goal is to provide an explanation that is already supported by the evidence gathered during and through the investigative process.

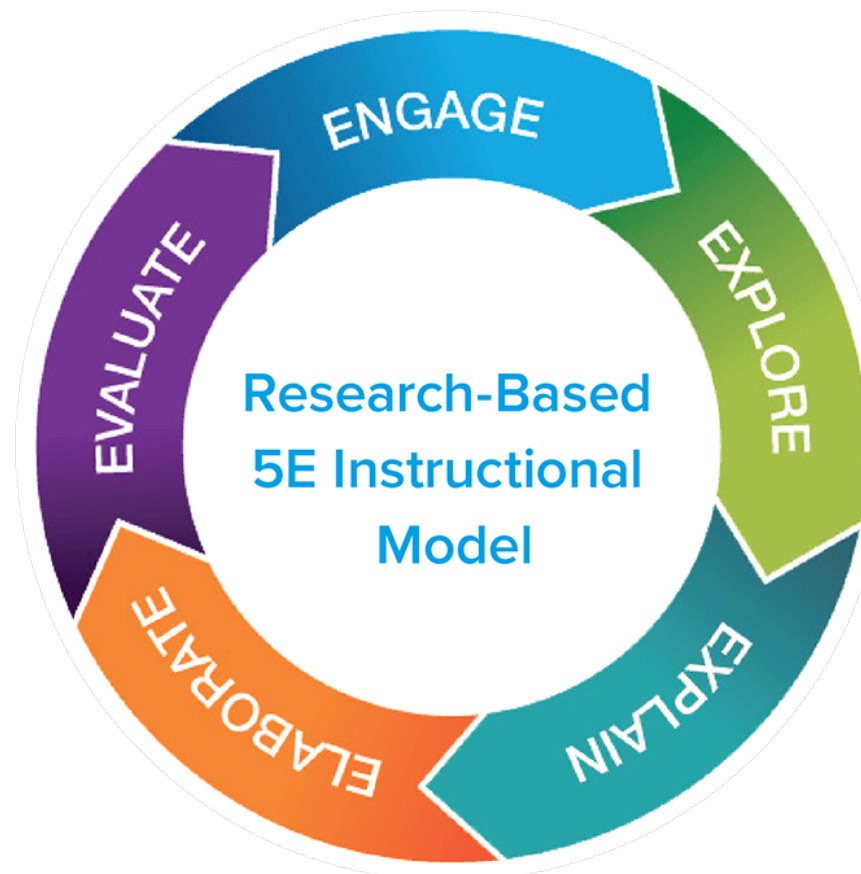
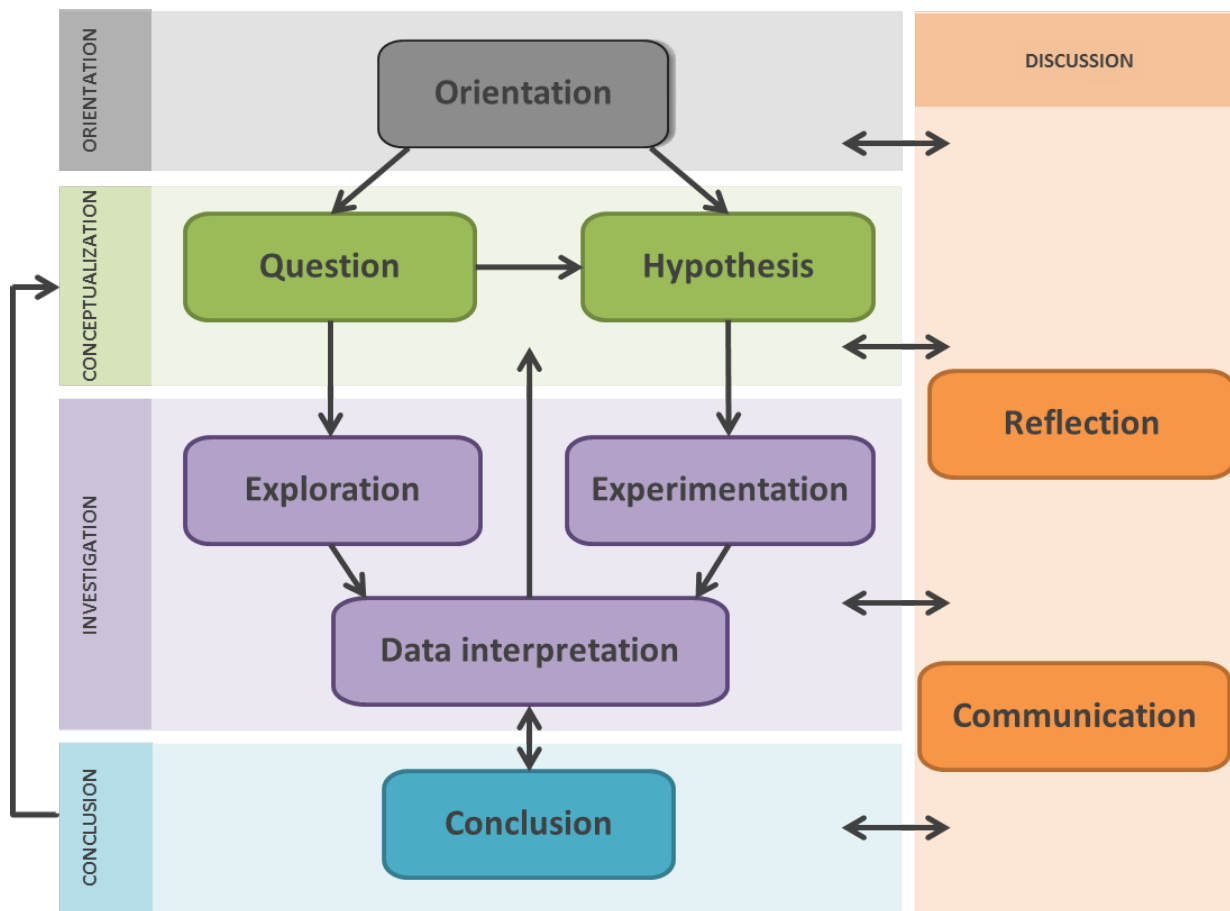
- *Guided inquiry*

Learners are only given a question. The main goal is to design the method of investigation and then test the question itself. This type of inquiry is not typically as structured as the previously mentioned forms.

- *Open inquiry*

Learners must form their own questions, design investigative methods, and then carry out the inquiry itself. They must present their results at the end of the process.

The Go-Lab inquiry cycle & 5E



Pedaste, M. Mäeots, M. Siiman L. A., de Jong, T., van Riesen, S. A. N., Kamp, E. T., Manoli, C. C., Zachariac, Z. C., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: definitions and the inquiry cycle. *Educational Research Review*, 14, 47-61.

Bybee, R., Taylor, J. et al. (2006). *The BSCS 5E instructional model: Origins and effectiveness*. Colorado Springs, CO: BSCS.

Study: cultural differences in the business

FIGURE 3.1. PERSUADING



GO-LAB
Inquiry
Cycle



Hands-on Inquiry Activity

Floating and sinking

1. Explore the materials

Materials: bowl, water, paper, aluminium foil and several objects. Look at the materials and create a boat. Play with the boat and try to put on it as many objects as you can.



1.a Can you think of examples where you yourself deal with floating and sinking?

1.b When does an object float or sink?

2. Research Question

Think of a short question that you want to investigate regarding floating and sinking. Your question has to be clear enough so anyone that reads it, immediately understand what you want to investigate.



2.a Write down your research question.

2.b What do you think the answer is to your question? (Write down what you think will happen when you investigate your question)

3. Research Plan

There are a few things you can change about the floating and sinking; we call these things **variables**. When you investigate your question, you might want to change some variables, but not some other variables.

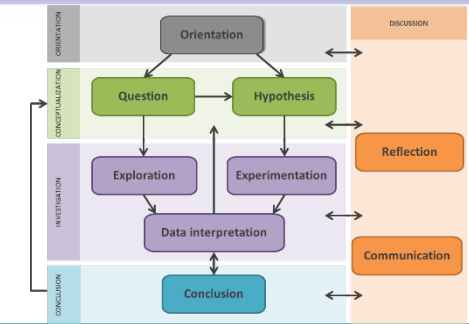


3.a Which variables can you identify?

3.b Write down for each variable whether you want to change it or not.

4. Experimentation

Conduct your experiment. You may need to keep records of your data.



5. Results

When you are done with experimenting and measuring, you will write down your results.



5.a Write down below what you have found and how your findings relate to your question.

5.b Is the result in line with what you expected would happen?

6. Outlook

6. Can you think of a new research question about floating and sinking based on your findings?

How to make inquiry effective



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Inquiry needs to be supported

➤ How to support students?

- By balancing instruction and inquiry
- By providing students with an overall strategy (inquiry cycle)
- By giving students the right level of control
- By providing students with scaffolds (apps)

➤ The trick is to give just enough domain knowledge and just enough structure (in strategy, control, and scaffolds).

Guiding inquiry with scaffolds (tools/apps)

- Enable to perform tasks a student could not do without the scaffold
- Geared towards specific difficulties that students experience
- Possibility of fading (spend more time on the some exercises)



Hands-on Inquiry Activity

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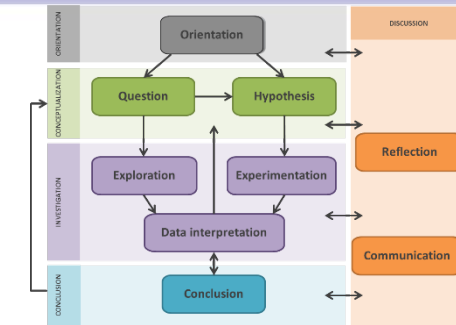
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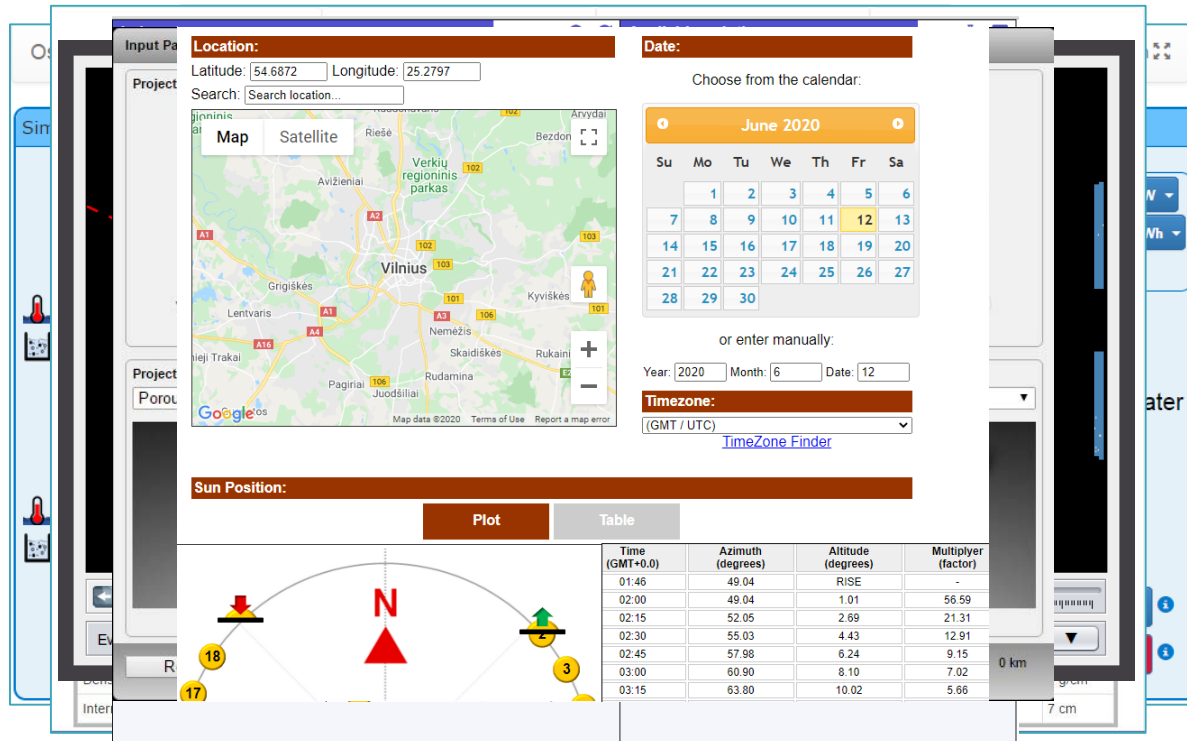
5.b Is the result in line with what you expected would happen?

6. Outlook

6. Can you think of a new research question about floating and sinking based on your findings?



Research Tool (Online labs) - golabz.eu



- 600+ labs
- STEM subject domains
- Types: virtual, remote and datasets
- Age range 6+
- 38 Languages

Scaffolds (apps) in Go-Lab (45+)- golabz.eu

- Concept map
- Hypothesis scratchpad
- Question scratchpad
- Experiment design tool
- Observation tool
- Data viewer
- Conclusion tool
- Reflection tool(s)
- Quiz tool
- Reporting tool


Organized in an inquiry cycle

- Learning Analytics Apps
 - Online Users Visualisation
 - Time Planner, Spent and Checker
 - Timeline....
- Collaboration Apps
 - Chat
 - Ride Assessment App
 - Peer Assessment Tool
 - Collaboration Tool
 - Zoom...
- Programming Apps:
 - Scratch
 - Python



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Inquiry Learning Space (ILS) - golabz.eu



Pusiausvyra

★★★★★ No votes have been submitted yet.


Students will become familiar with the concept of balance. Practice balance lab work. The Scratch program will create a program with two interlaced characters.



Vandens Apytakos Ratas

★★★★★ No votes have been submitted yet.


Mokinių pasiekimai: Naudodamasis schema paaiškina vandens apytaką gamtoje. Atpažįsta dažnai stebimus gamtos reiškinius, įvairias kritulių rūšis. Mokytojo veiklos siekiniai: 1. Padėti suprasti vandens apytakos principą ir jo svarbą gamtai.



Elektros Grandinė

★★★★★ Rating: 5 - 5 votes

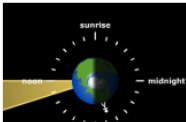
Elektros grandinės sandara, veikimo principas. Išsiaiškinti kas yra elektra, kaip ji atkeliauja į namus, medžiagas laidžias ir nelaidžias elektrai. 3 klasė



Physics On The Road

★★★★★ No votes have been submitted yet.

Uniformly variable movement.



Moon Phases

★★★★★ Rating: 1 - 1 votes

This learning environment helps to understand why and how the lunar phases change. The Lunar Phase Simulator is included.

Big Ideas Of Science

- Energy Transformation (1)
- Fundamental Forces (1)
- Our Universe (1)
- Planet Earth (1)

Age Ranges

- 9-10 (3)
- 11-12 (1)
- 13-14 (1)
- 15-16 (2)
- Above 16 (1)

Languages

- Arabic (1)
- Basque (41)
- Bulgarian (4)
- Catalan (42)
- Croatian (6)
- Czech (2)
- Danish (2)
- Dutch (56)
- English (303)
- Estonian (27)
- Finnish (17)
- French (80)
- Gaelic (10)
- German (50)
- Greek (137)
- Hungarian (1)
- Italian (34)
- Lithuanian (5)
- Macedonian Slavic (6)
- Polish (6)
- Portuguese (145)
- Romanian (108)
- Russian (8)
- Serbian (7)
- Simplified Chinese (4)



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Is inquiry learning with online labs effective?

- Inquiry-based learning with online labs (and simulations) shows an **advantage over expository instruction**
- Students in **online labs** gain the **same level of knowledge** or a **more advanced level of knowledge** than students who learn in a **real laboratory**
- Inquiry learning with online labs is only effective when well structured and designed, this is **guidance, e.g., scaffolds included**.

de Jong, T. (2006). Computer simulations - Technological advances in inquiry learning. *Science*, 312, 532-533.

de Jong, T., Linn, M.C., & Zacharia, Z.C. (2013). Physical and virtual laboratories in science and engineering education. *Science*, 340, 305-308



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The Go-Lab ecosystem at a glance

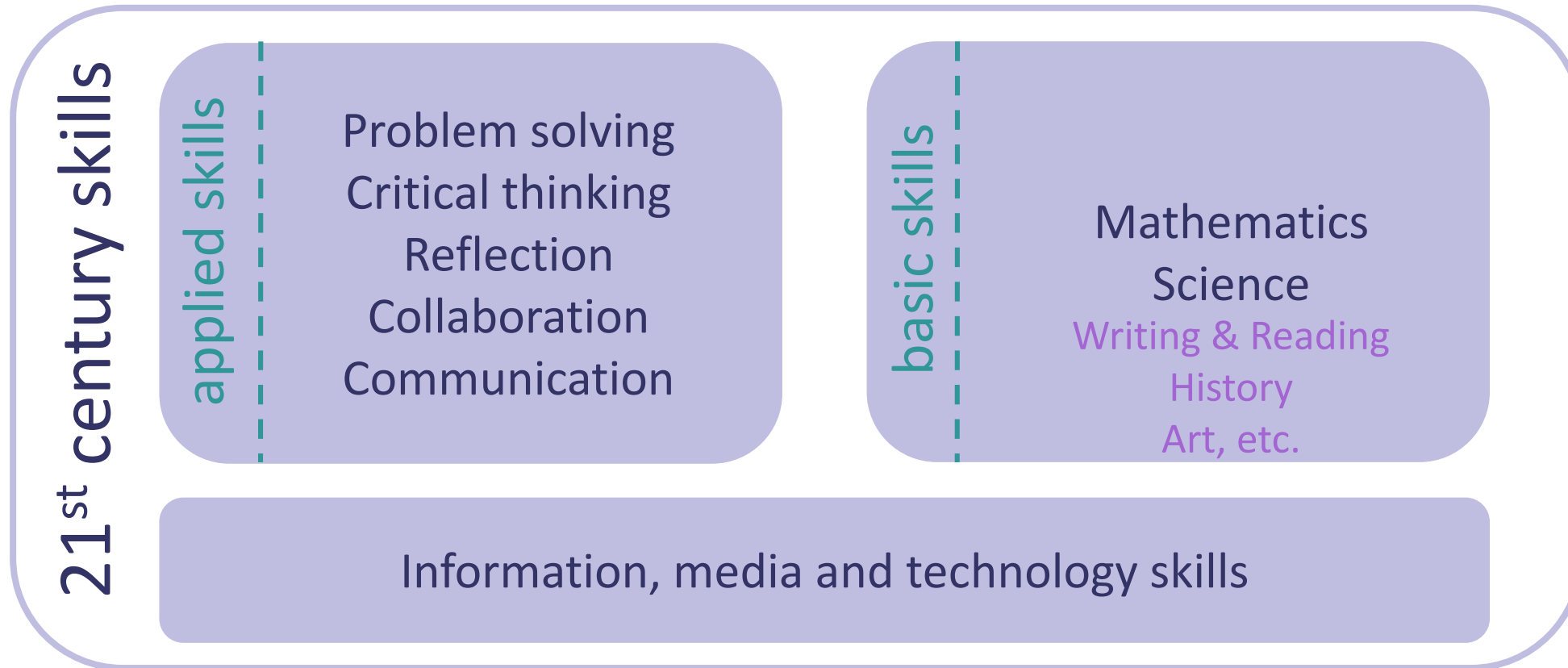


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Why Go-Lab ecosystem?

- Go-Lab offers:
 - the world largest collection of online labs
 - a unique collection of apps to support the inquiry process
 - an authoring platform for teachers to create, adopt and adapt/tailor inquiry learning spaces
 - an authoring platform for teachers to personalize inquiry learning spaces
 - collaboration and sharing facilities

Why Go-Lab ecosystem?



Go-Lab in one sentence

Federation of online labs

...Embedded into educational resources and guidance

... Shared with the community of users

GO-LAB Labs Apps Spaces Authoring Support Premium About News

Sharing and Authoring Platform

Find the largest collection of online labs, try-out interactive inquiry apps, combine labs and apps into Inquiry Learning Spaces, and share these with your students and colleagues.

Thousands of schools all over the world remain closed for the next weeks or even months due to the SARS-CoV-2 (COVID-19) pandemic. In order to support them in delivering online education, we invite all schools and teachers to use the Go-Lab Ecosystem for online STEM teaching. The platform and all tools (including premium labs and apps) are available free of charge. Find more information [here](#).

LAB	APP	LAB	LAB
Electrical Circuit Lab	Hypothesis Scratchpad	Gravity Force Labs	Acid-Base Solutions
In the Electrical Circuit Lab students			How do strong and weak acids



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Authoring Platform - graasp.eu

Search

Home Go-Lab

inSTEAM

inSTEAM

Write a description here

Back

New App from URL

Add App

Name

App URL

Add App

or choose an app

Select app from Golabz

- Activity Plot
This app shows a summary of the number of acti...
- Aggregated Concept Map
This app supports students in viewing a special c...
- App Overview
This tool shows the teacher what the students ha...
- Calculator
A normal calculator, which is showing the entered...
- Chat

Sharing

Rate this space:

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Page view

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Support Service


GO-LAB Labs Apps Spaces Authoring **Support** Premium About News Q EN ▼


Support Area


Need support with creating your own Inquiry Learning Space (ILS), configuring the Apps and choosing the right Scenario for your students? Are you interested in learning how Go-Lab supports inquiry, collaborative and self-regulated learning? Would you like to contact the Go-Lab representatives in your country or take Go-Lab's online training course? Then check out the navigation menu on this page to use the full services and benefits the Go-Lab ecosystem has to offer!

Check out our [glossary](#) to familiarize yourself with the Go-Lab ecosystem's terms and definitions.


How to...


Pedagogical


Trainings


Community

Go-Lab
Support

Content of the Support Area can be accessed using the **navigation menu on this page**. Most of the content can be **compiled and downloaded in 30 languages**. Use the **Compile your manual** button to see how.


Before going over the content overview of the different support sections, check out our **Why use Go-Lab** video below.

Why use Go-Lab? ▼

How to use Go-Lab ▼

Pedagogical Support ▼

Teacher Training ▼


Compile your manual

How to use Go-Lab

- How to start with Graasp
- How to create an ILS
- How to set up Apps
- Develop & use offline ILSs
- Learning Analytics
- Tips & Tricks

Pedagogical Support

- Go-Lab & IBSE
- Learning Theories
- Pedagogical Scenarios
- Big Ideas of Science
- How to design a good ILS

Teacher Training

- Go-Lab in your Country
- Teacher Training Institutions
- Online Training Modules



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- FP7 EU project
- 19 partners
- 4 years (2013-2016)
- Collaborative project



- H2020 EU project
- 12 partners
- 3 years (2017-2019)
- Innovation action



- H2020 EU project
- 8 partners
- 3 years (2018-2020)
- MI.TO. TECHNOLOGY SRL coordinator
- Innovation action

The future of Go-Lab ecosystem

- At the end of 2020 the EU funding of the Go-Lab ecosystem stops
- **Go-Lab will continue!**
- Two versions
 - I. Current version for free
 - II. Premium version with extra facilities (in the SARS-CoV-2 (COVID-19) pandemic time the platform and all tools including premium labs and apps are available free of charge)
- Professional training courses (Inquiry approach and Go-Lab ecosystem)
- Premium contracts with schools, governments etc.

Training courses set

Go-Lab Teacher Training

The Go-Lab Initiative team offers teachers, educators and school leaders a set of courses to help introduce Inquiry Learning with Go-Lab in the classroom. Ministries of Education, Teacher Training Institutes, and other stakeholders are also invited to book courses for their teachers!

Basic course (4 hours)

In this course, participants will learn in an interactive and playful way the basic principles of inquiry learning and how Go-Lab can help to introduce inquiry learning in the classroom. This course is suited for larger groups of teachers who would like to have a first and basic overview of the principles of inquiry learning and the technologies that can be used to support the inquiry process.

Advanced course 1 (4 hours)

In this course, the knowledge of inquiry processes is deepened, and characteristic problems of students are highlighted. Scientific evidence underlying inquiry learning is presented. During this course, participants will create their first and initial digital lesson or inquiry learning space (ILS) with the Go-Lab ecosystem. This is done in pairs or larger groups of teachers collaboratively creating an ILS.

Advanced course 2 (4 hours)

In the second part of the advanced course, advanced design elements of Inquiry Learning Spaces (ILSs) will be discussed and practiced. The topics include how to design an ILS based on principles of cognitive load theory, the use of learning analytics apps for teachers and learners, and inquiry learning and flipping the classroom with Go-Lab. Feedback on the initial ILS designs from the participants is given.

Dedicated course

If you have specific requirements, it is always possible to offer a tailor-made course. This can be an adaptation of an existing course or a newly designed course. All courses are given in an interactive way by instructors who have a solid background in inquiry learning and who have deep knowledge of the Go-Lab ecosystem. Topics in each course are related to the latest scientific findings from educational research. Courses can be given in English or in your local language.

<https://premium.golabz.eu/services/training>



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Project (Erasmus+)

- 25 inclusive Inquiry Learning Lessons, classroom-ready
- Social inclusion: cultural, socio-economic, learning styles, no gender differentiation
- Manual : UDL (Universal Design for Learning) + IBL + Design Thinking
- Primary and secondary schools
- Environmental Study: climate change, water management and renewable energy

PARTICIPATION: <https://insteam.deusto.es/participate/>



<https://www.facebook.com/erasmusK201>



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<http://tiwi.eun.org/>



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