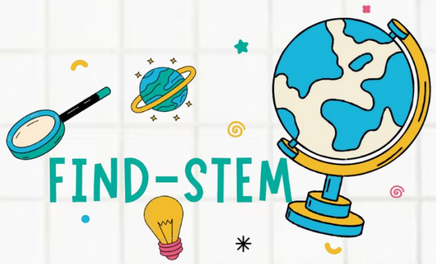
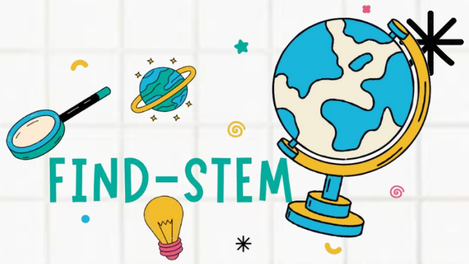


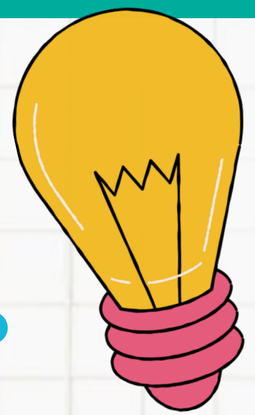
MODULE 3:

METHODOLOGICAL FRAMEWORK FOR HANDS-ON-LEARNING

Co-funded by the European Union

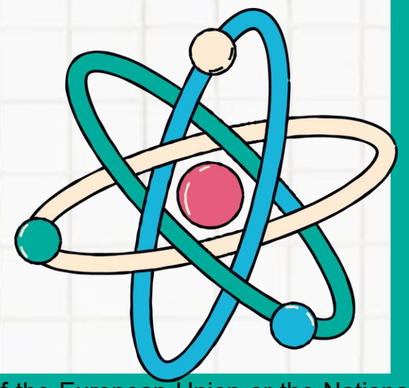
Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907





INTRODUCTION

Hands-on learning plays a crucial role in making STEM education more interactive and relevant. This module explores practical experiments, real-world problem-solving, and student-led investigations that encourage exploration and independent thinking.



Co-funded by the European Union

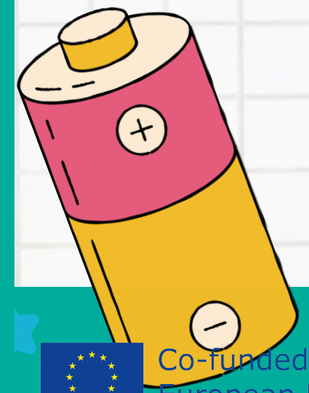
Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

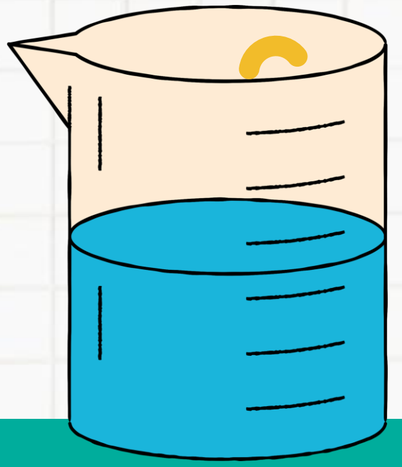
KEY TOPICS

01
Introduction to Hands-On Learning

02
Real-World Problem Solving in STEM Education

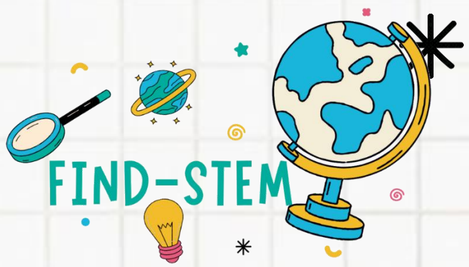
03
Inquiry-Based Learning Strategies



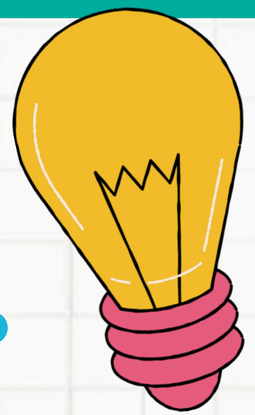


Co-funded by the European Union

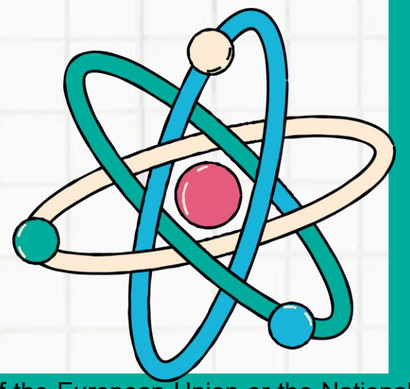
Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907



GENERAL LEARNING OUTCOMES



- Plan and execute hands-on STEM activities and experiments that make abstract concepts tangible and engaging.
- Use real-world problems and case studies to enhance the relevance and practical application of STEM subjects.
- Facilitate pupil-led investigations, encouraging student autonomy, inquiry, and collaborative learning.
- Assess the effectiveness of active learning techniques in improving student engagement and comprehension.
- Analyse the specific skills and knowledge learners will acquire.



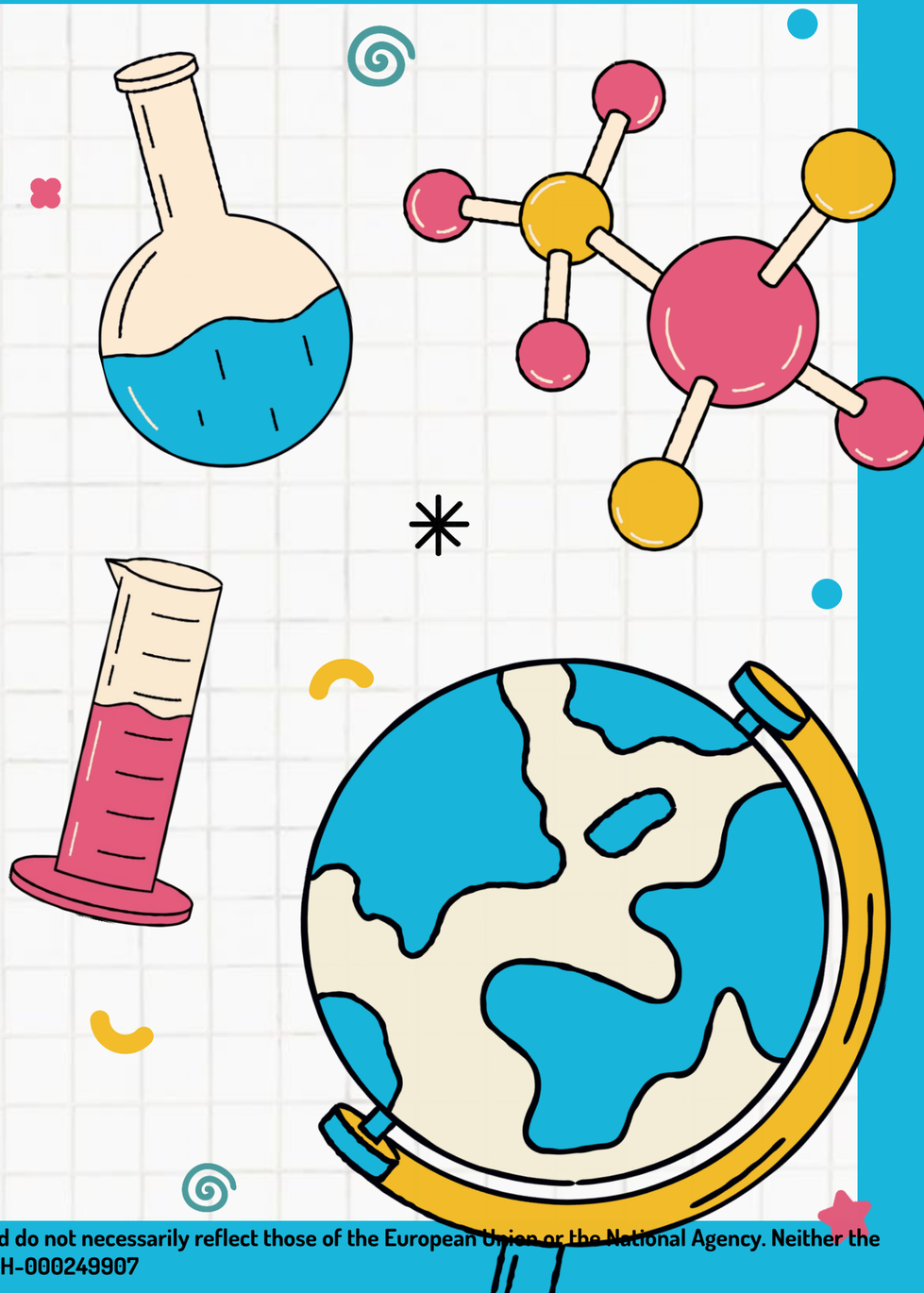
Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

FIND-STEM

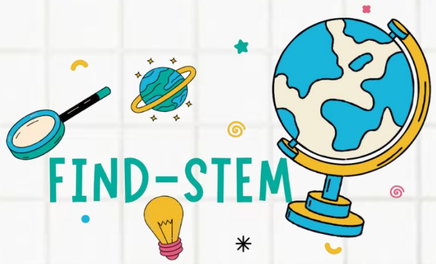
ACTIVITY 1

Building Simple Machines

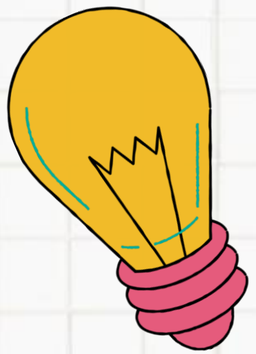


Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907



OBJECTIVES



1

Explore how simple machines help make physical principles tangible.

2

Gain practical experience through building and testing.

3

Reflect on how to adapt this activity for different learning needs.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

Hands on STEM Activity

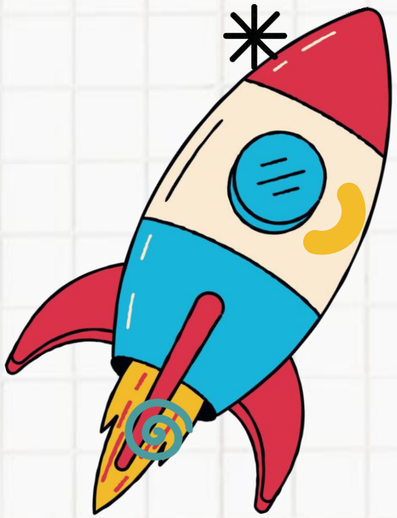
Challenge: In small groups design and build a simple machine to lift a small object 10 cm off the table!

Document:

- Type of machine chosen
- Problem being solved
- Construction process and challenges faced

How did physically building the machine change your understanding?

How could this type of activity benefit diverse learners?



Co-funded by the

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the

Additional Resources

NASA STEM Activities: https://www.nasa.gov/stem

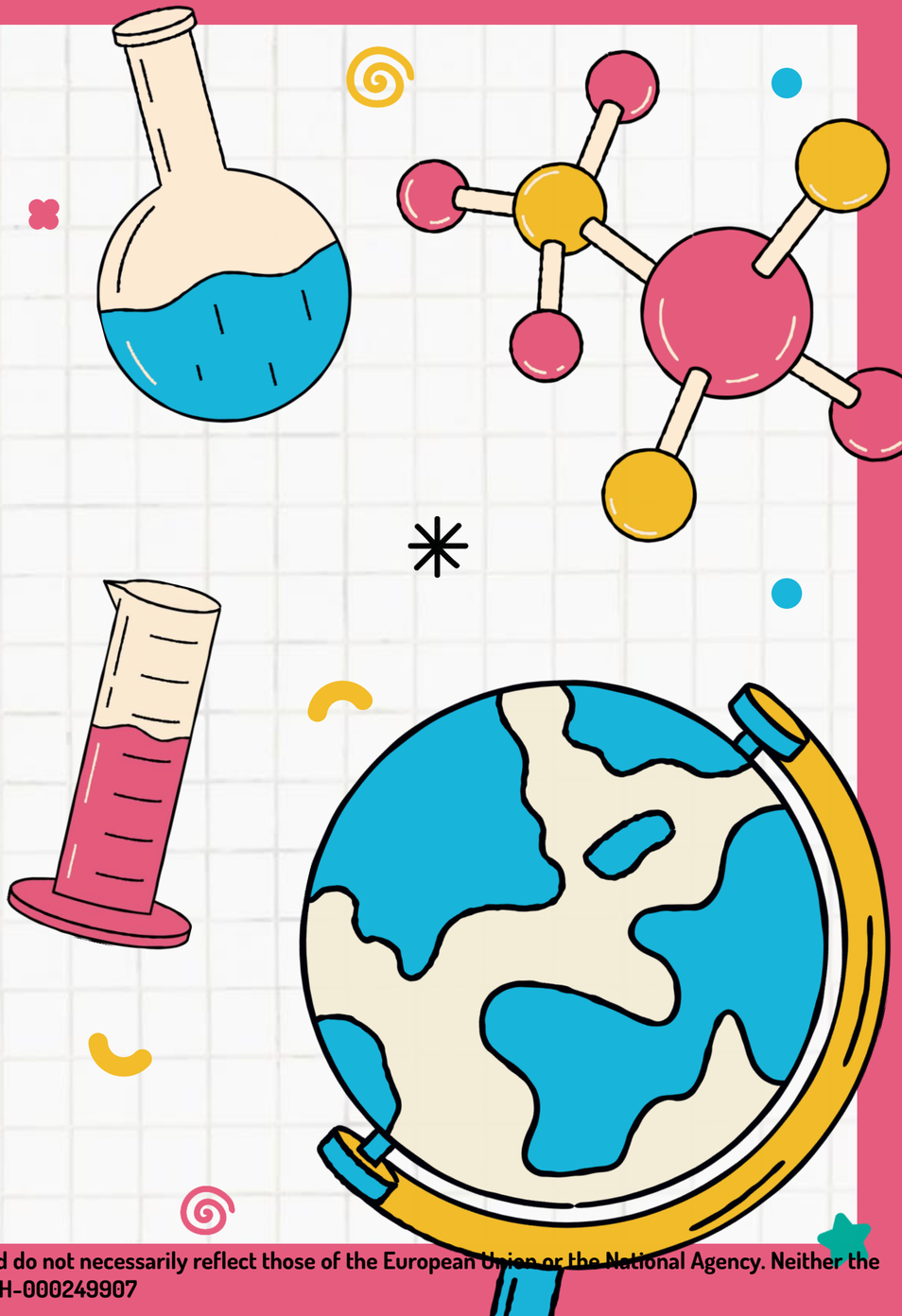
Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

FIND-STEM

ACTIVITY 2

Real-World Problem Solving



Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

FIND-STEM

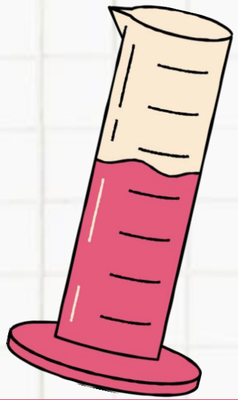
OBJECTIVES

1

Use innovative solutions to solve real-world STEM problems.

2

Develop classroom strategies for engaging students with data.

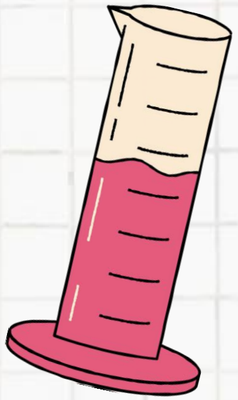


Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

REAL-WORLD PROBLEM SOLVING IN STEM EDUCATION

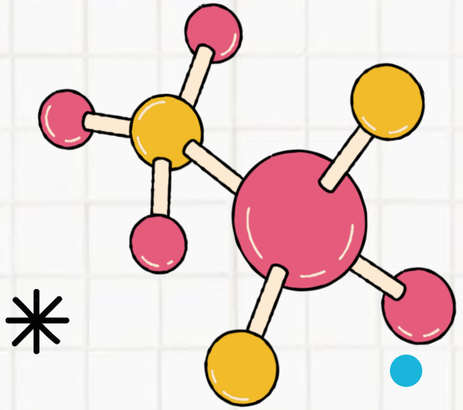
Real-world problem-solving in STEM education involves applying theoretical knowledge to practical, everyday challenges. This method enhances students' ability to think critically, innovate, and develop solutions that have tangible impacts.



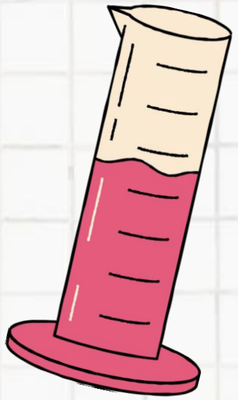
Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

REAL-WORLD PROBLEM SOLVING ACTIVITY



Challenge: In small groups Investigate local environmental issues (e.g., water pollution, waste management, renewable energy).



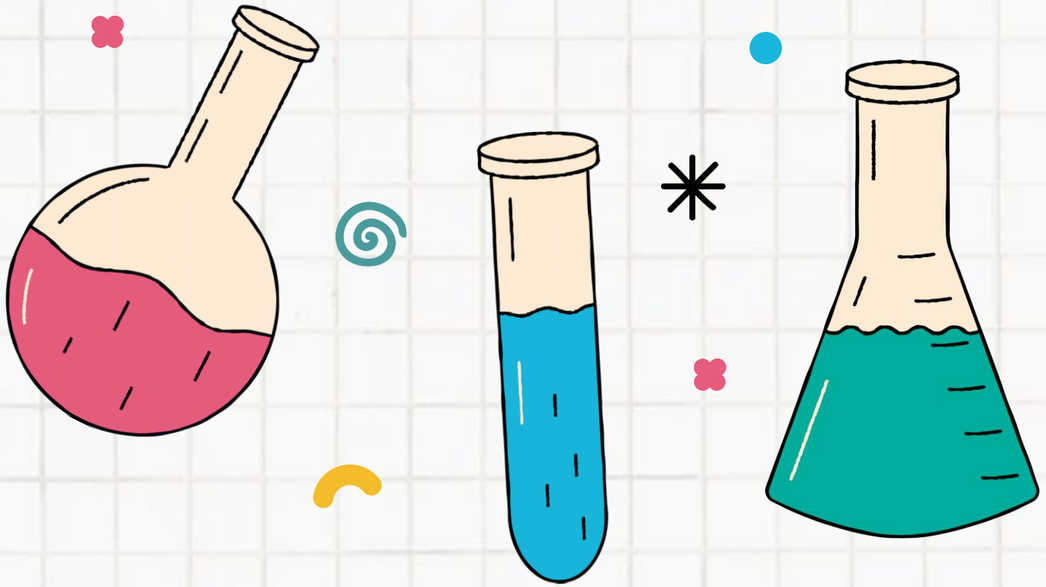
Work in teams to develop solutions!

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

FIND-STEM

STEPS

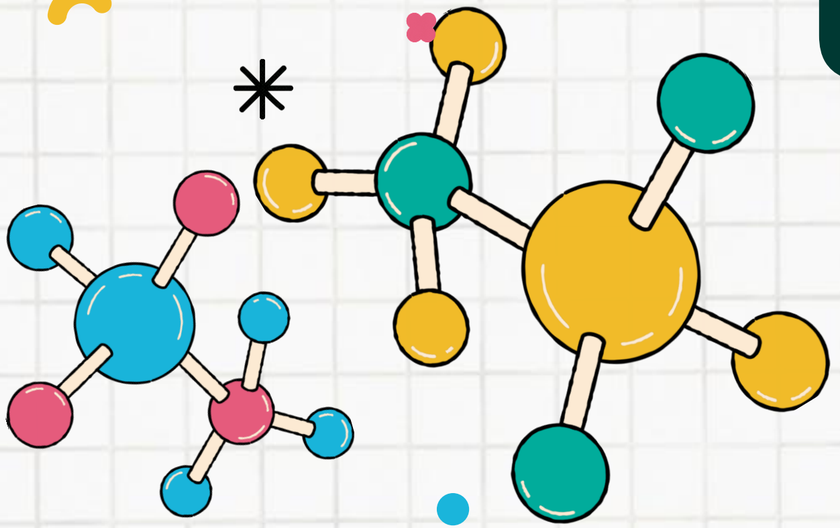


01 Identify a local environmental challenge.

02 Research current solutions and their limitations.

03 Design and prototype an innovative solution using STEM principles.

04 Present findings and prototypes.



Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

Additional Resources

Code.org Data Tutorials: https://www.code.org/

TED-Ed: Hands-on Learning:

https://www.youtube.com/watch?v=blZG-RSmMWk

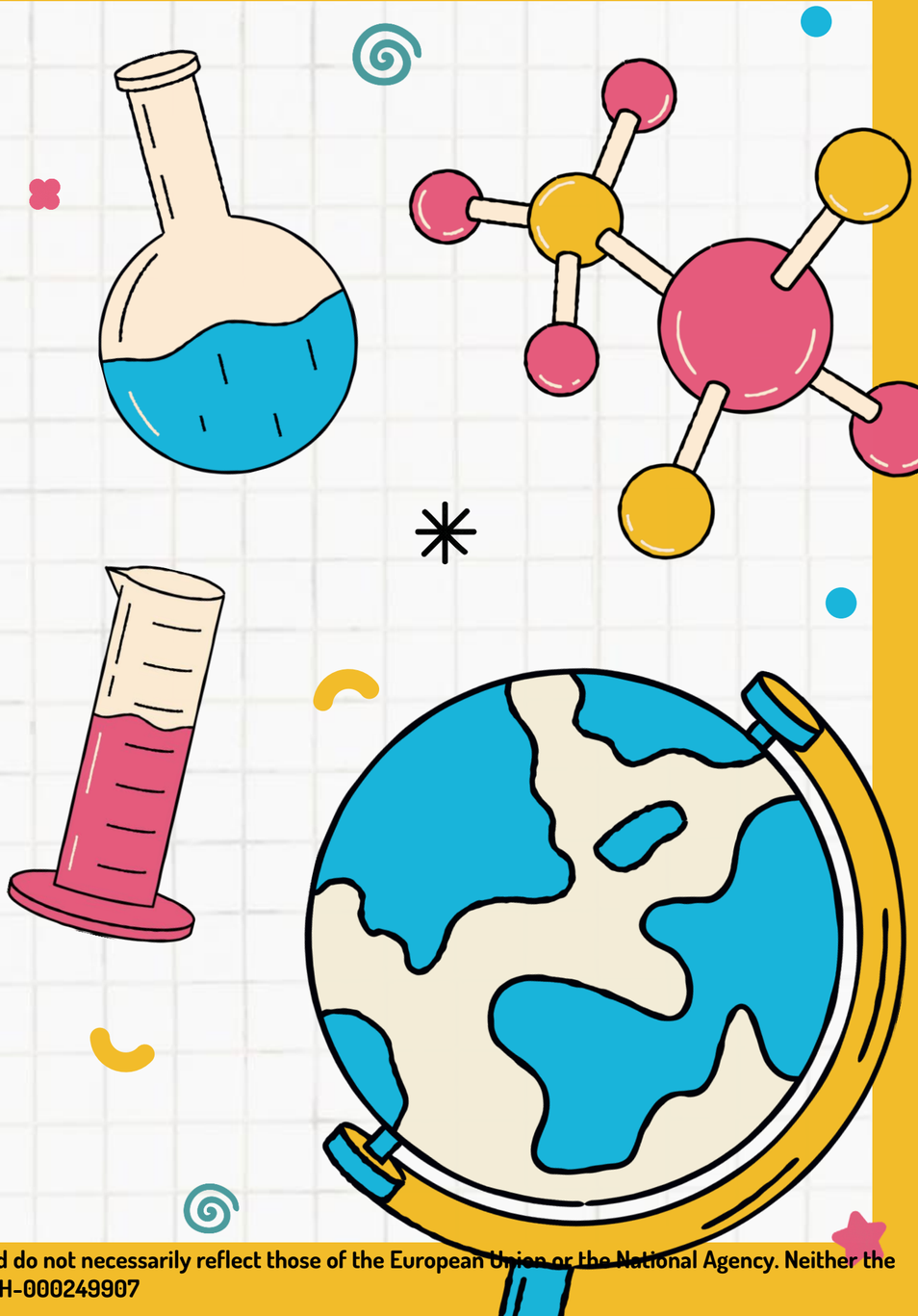
Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

FIND-STEM

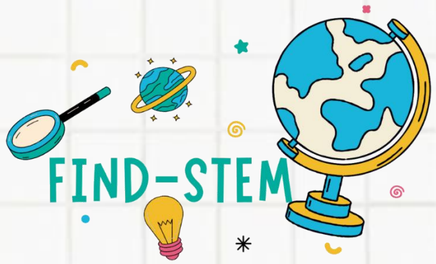
ACTIVITY 3

Student-Led Investigation in SteM

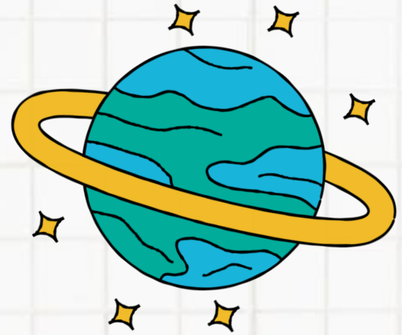


Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907



OBJECTIVES



1

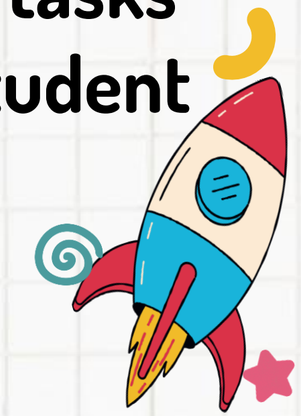
Understand the foundations of inquiry-based learning.

2

Support students in planning and carrying out their own investigations.

3

Design STEM tasks that foster student autonomy.



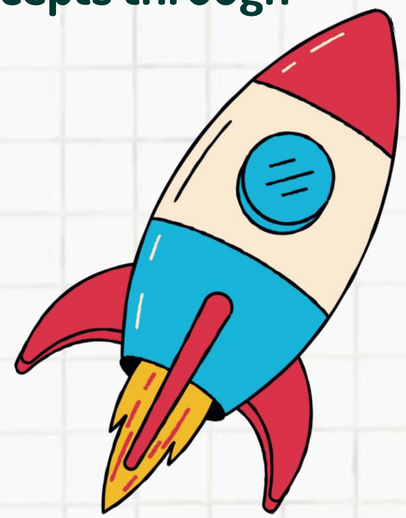
Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

INQUIRY-BASED LEARNING

Inquiry-based learning (IBL) is a student-centred approach that encourages exploration, questioning, and discovery. It fosters curiosity and deeper understanding by allowing students to investigate STEM concepts through guided inquiry and experimentation.

Ask → Investigate → Analyse → Explain

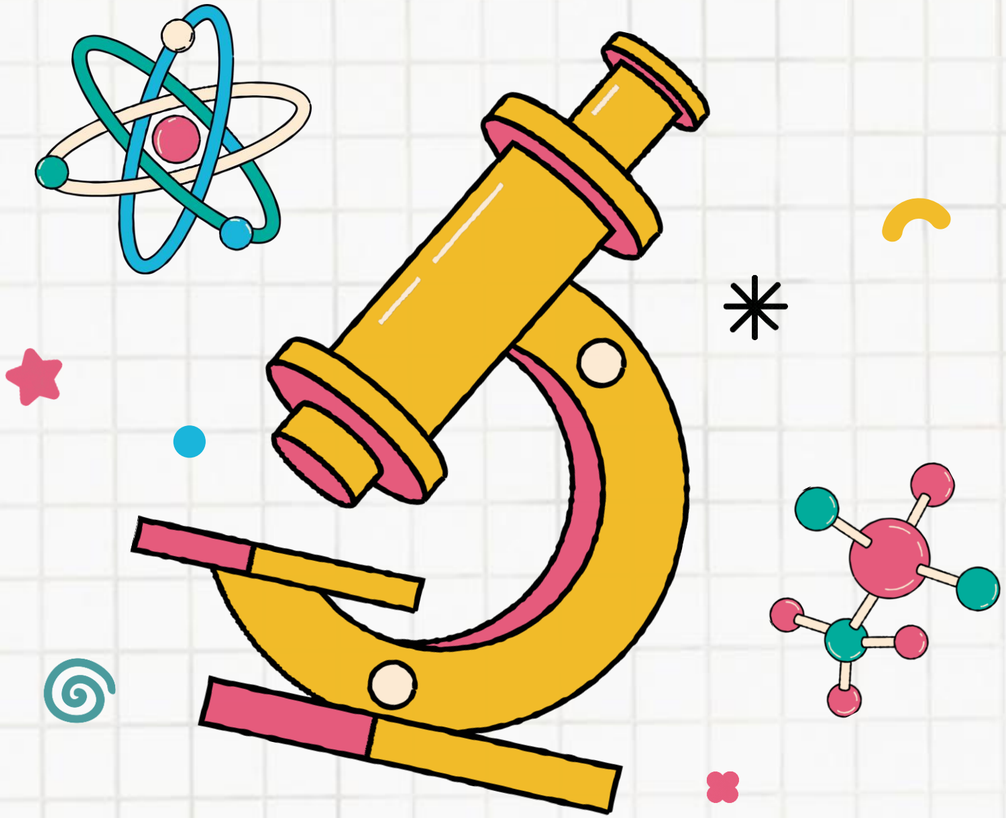


What are the benefits and risks of letting students lead investigations?

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

IMPLEMENTATION STRATEGIES



- Guided Inquiry: The teacher provides a question or problem, and students explore possible solutions.
- Structured Inquiry: Students follow teacher-designed procedures to discover answers.
- Open Inquiry: Students formulate their own questions, develop methods, and conduct investigations.
- Problem-Based Inquiry: Students work collaboratively on real-world STEM challenges with minimal teacher direction.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

Student-Led Investigation in STEM Activity

Challenge: In small groups select a classroom-relevant scenario (e.g., “How much waste does our school produce in a week?”) and design a student investigation (Guiding question; variables and data collection methods; role of teacher (as a coach))

Document:

- Tools needed, assessment strategies, students' responsibilities
- Plan on how students will present their finding.

How can inquiry shift student motivation?”

“What supports do students need to take charge of their learning?”

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

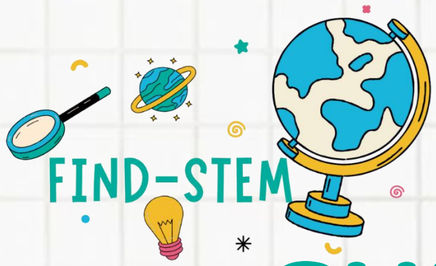
Additional Resources

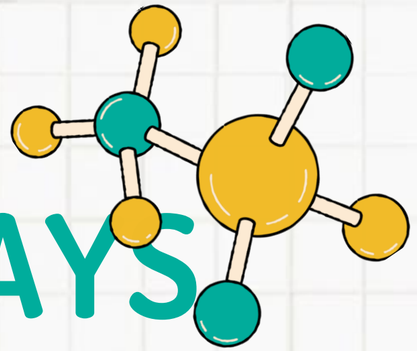
- Hmelo-Silver, C. E. (2004). Problem-Based Learning:

  What and How Do Students Learn?

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907





SUMMARY OF KEY TAKEWAYS

1. Hands-on learning connects theoretical STEM concepts with real-world applications.

2. Inquiry-based strategies empower students to ask questions, experiment, and discover.

3. Real-world challenges enhance motivation, creativity, and problem-solving skills.

4. Teachers should focus on student-led exploration and provide reflection opportunities.

5. Effective assessment includes observation, peer review, journaling, and presentations.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

References

Bransford, J. (2000). *How People Learn: Brain, Mind, Experience, and School*. National Academy Press.

Jolly, A. (2016). STEM by Design: *Strategies and Activities for Grades* 4-8. Routledge.

Hmelo-Silver, C. E. (2004). Problem-Based Learning: What and How Do Students Learn? Educational Psychology Review, 16(3), 235-266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Thomas, J. W. (2000). *A Review of Research on Project-Based Learning*. Buck Institute for Education.

Bell, S. (2010). *Project-Based Learning for the 21st Century: Skills for the Future*. The Clearing House, 83(2), 39-43. https://doi.org/10.1080/00098650903505415

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907

THANK YOU!

Any questions? Don't hesitate to ask for our help

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the National Agency. Neither the European Union nor the National Agency can be held responsible for them. Ref. no. 2024-1-EL01-KA210-SCH-000249907