Future Classroom Lab

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SCIENTIX®
The community for science education in Europe

From STEM Learning to Sustainable Action

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Learning Scenario ID

Title

From STEM Learning to Sustainable Action

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Summary

In this learning scenario, students explore how lead-acid batteries work and the main types of car batteries (SLI, EFB, AGM). Through practical tasks, including research, spreadsheet work, and creating promotional materials, they apply theoretical knowledge to real-world situations while developing digital, analytical, and teamwork skills. The lesson also emphasizes the importance of responsible battery recycling and sustainable waste management for environmental protection.

Keywords

Battery recycling, circular economy, STEM project, environmental responsibility, student collaboration

Aim of the lesson

By the end of the lesson, students will be able to explain how lead-acid car batteries work, distinguish between different battery types (SLI, EFB, AGM), and use digital tools to collect, analyze, and present technical data. They will also be able to argue the importance of responsible battery recycling for environmental protection and sustainability.

License

Overview

Subject(s)	• Chemistry • Environmental science • Information and Communication Technology (ICT) • STEM education • Road Vehicles
Topic(s)	Responsible battery disposal and recycling; Circular economy; Sustainable STEM projects; environmental awareness through technology; data analysis and spreadsheet skills; battery technology and chemistry.
Age of the learners	13–16 years old
Preparation time	Approximately 1 to 2 hours for teacher preparation, including organizing materials, setting up digital tools, and planning activities.
Total implementation time	2 × 45 minutes (+ optional – approx. 90 minutes, school project)

Teaching material	Online materials and resources:
	• Digital platform for sharing resources and collaboration
	  ○ Microsoft Teams, https://www.microsoft.com/en-us/microsoft-teams/group-chat-software or
	  ○ Google Classroom, https://classroom.google.com/
	• Tools for creating a word cloud:
	  ○ Mentimeter, https://www.mentimeter.com/ or
	  ○ AhaSlides, https://ahaslides.com/
	• Tools for quiz activities:
	  ○ Kahoot, https://kahoot.com/ or
	  ○ Socrative, https://www.socrative.com/ or
	  ○ Google Forms, https://forms.google.com/
	• Tools for data research and analysis:

	◦ Google Sheets, https://workspace.google.com/products/sheets/ or ◦ Microsoft Excel, https://www.microsoft.com/en/microsoft-365/excel • Visual collaboration tools: ◦ Padlet, https://padlet.com/ ◦ Miro, https://miro.com/ ◦ Google Slides, https://workspace.google.com/products/slides/ or ◦ Canva, https://www.canva.com/ Physical materials: • Computers with Internet access, • Projector or smart display • Cardboard boxes, old packaging, cans, plastic containers, computer cases, glass containers, fabric • Scissors, glue, tape, markers, colored paper, stickers, old magazines and newspapers, recycled decorations Project resources: • VARTA Automotive UK (2021, March 17). VARTA Batteries - Battery in action [Video]. YouTube. https://www.youtube.com/watch?v=E9AqTw3gh-s (duration: 09:22, English) • VARTA Automotive (2025, June 10). VARTA Training Academy - Battery Technologies - B-R-03 Part 1 (V1.0.0) [Video]. YouTube. https://www.youtube.com/watch?v=opSeEog2HJk (duration: 03:24, English) • VARTA Automotive (2025, June 10). VARTA Training Academy - Battery Technologies - B-R-03 Part 2 (V1.0.0) [Video]. YouTube. https://www.youtube.com/watch?v=negxBkYXqgs (duration: 01:46, English) • VARTA Automotive (2025, June 10). VARTA Training Academy - Battery Technologies - B-R-03 Part 3 (V1.0.1) [Video]. YouTube.

	https://www.youtube.com/watch?v=1xWrZnrffPg (duration: 04:49, English) • VARTA Automotive. Battery Finder tool – for battery selection task [Website]. https://www.varta-automotive.com/en-gb/battery-finder • Clarios. Circular Economy – Global Responsibility [Website]. https://www.clarios.com/global-responsibility/circular-economy

The Learning Scenario activities

Activity Plan

Fill in the table with the activity name, a brief description of the procedure, and the time needed to complete it. If an activity relates to a STEM Strategy Criterion add the code in the corresponding column. Refer to the STEM Strategy Criterion section of the template for more details.

Name	Procedure	Duration	STEM criteria codes
Introductory Activity: Why can't cars work without a battery?	The session starts with a reflective activity to activate and examine students' previous knowledge on the topic of car batteries. Students are asked to write down in a word cloud everything they know or assume about the purpose of a car batteries. Some digital tools could be used for creating a word cloud (e.g., Mentimeter, AhaSlides). The teacher then plays the video, VARTA Batteries - Battery in Action, link: https://www.youtube.com/watch?v=E9AqTw3gh-s (up to 4:29 min). The video explains how a car battery works, how it powers different components and devices in the car, and how it to properly maintain and charge the battery to keep it healthy. After the video, the teacher leads a class discussion using the following questions: • What terms did you include in your word cloud? Were any of them mentioned in the video? • Which important battery function did you perhaps not include in your word cloud, but was mentioned in the video? • What did you learn about the battery that was new or surprising to you? • What happens inside a battery when it discharges, and what happens when it recharges? • Why can't a car function without a battery, even when the engine is running?	20 min	B1, B3, C1, G1.

Name	Procedure	Duration	STEM criteria codes
	• What would happen if the battery suddenly failed? • What do you think happens to car batteries when they no longer work? • Why is it important to recycle or reuse batteries properly? **Note to teacher:** *Instead of using online tools to create the word cloud, students can write their ideas on post-its or on the blackboard, and then the teacher can group similar terms together.* *Instead of showing the video, the teacher can prepare a factsheet with the main points about car battery functions and distribute it to students. The discussion questions can then be used in the same way. As an alternative, the activity could also be implemented using the flipped classroom method: students read the factsheets and watch the videos at home and the class time is dedicated to group discussion and reflection.*		
Battery Types and Sustainability	The teacher distributes the worksheet on battery types (see **Annex 1. Worksheet Sample Questions)** with prepared questions, either in printed or digital form. In addition, the teacher shares links to the following videos with students via a digital platform (e.g., Microsoft Teams, Google Classroom) or as QR codes: • **Battery Technologies – Part 1**, link: https://www.youtube.com/watch?v=opSeEog2HJk This video introduces the main types of lead-acid batteries used in vehicles today (SLI, AGM, and EFB). It explains why the traditional term “starter battery” is no longer accurate, as modern batteries support many functions beyond starting the engine.	30 min	A2, A3, B1, B2. B3, C1, C2, G1, G2.

Name	Procedure	Duration	STEM criteria codes
	• **Battery Construction – Part 2**, link: https://www.youtube.com/watch?v=negxBkYXqqs This video explains the internal construction of a 12-volt lead-acid battery, which consists of six cells connected in series. It describes the role of electrodes, separators, and electrolyte in storing and releasing electrical energy. • **Battery Comparison – Part 3**, link: https://www.youtube.com/watch?v=1xWrZnrffPg This video compares SLI, EFB, and AGM lead-acid battery technologies. It highlights that EFB is an improved version of the flooded SLI battery for modern vehicles, while AGM differs with its absorbent glass mat separator and sealed design, making it the most robust and reliable technology. • **Circular economy**, link: https://www.clarios.com/global-responsibility/circular-economy The Clarios website explains how used batteries are collected, recycled, and reused within a circular economy, reducing waste and supporting sustainability. Students are split into pairs or groups of up to 4 students, and work together to: • Watch the videos (in English, with subtitles if needed). • Explore the Clarios website on the circular economy. • Complete the worksheet by identifying key information about different battery types, their characteristics and applications, and the importance of proper battery recycling. After completing the worksheet, pairs/groups share their answers in small groups/ with the whole class. The teacher moderates the discussion, asks follow-up questions, and provides feedback to clarify		

Name	Procedure	Duration	STEM criteria codes
	any misunderstandings, while emphasizing differences between battery types and the role of sustainability. **Note to teacher (alternative implementation):** *To increase engagement and make the activity more student-centered, the following adaptations can be considered:* • *Jigsaw method: Assign one video (or the website) per pair/group. Each group becomes the "experts" on their assigned material, summarizes its key features, and then teaches the others in a short peer-to-peer presentation or poster. This approach fosters collaborative learning and strengthens students' communication skills.* • *Collaborative board: Instead of individual worksheets, turn the task into a shared digital board (Padlet, Jamboard, Miro, etc.) where students visually map the differences between battery types together.*		
Quiz	Homework: For homework students should complete a quiz (see Assessment section). The quiz could be created using digital tools such as Kahoot, Socrative, Google Forms, or distributed on paper. The goal of the quiz is to review and consolidate key concepts about battery types (SLI, EFB, AGM), their construction, and their functions. Sample or optional quiz questions are available in the Assessment section and can be used on any digital platform of your choice.	10 min	A1, B1, C1, C2, G1.
Battery Selection and Data Entry in a Worksheet	The aim of this activity is to help students develop digital and analytical skills by applying spreadsheet tools to organize, analyze, and visualize technical data about car batteries. At the same time, students strengthen their ability to connect theoretical knowledge of battery types with practical,	40 min	A2, A3, B1, B3, C1, G1.

Name	Procedure	Duration	STEM criteria codes
	real-world applications such as battery selection for different car models. Activity should start with a brief discussion on the topic: • What information about a battery do you need to know when purchasing one? The teacher shares a link to the website, https://www.varta-automotive.com/en-gb/battery-finder. Along with the link, students receive task instructions and an Assessment Rubric. Students independently choose at least five different car models and use the Battery Finder portal to research the recommended batteries. For each car, they record the following information in an Excel or Google Sheets file: • Car make and model • Recommended battery model • Technology (AGM / EFB / SLI) • Voltage (V) • Capacity (Ah) Students format the table according to the instructions: for example, align text to center, add table borders, and format cells to improve clarity. They apply functions in the spreadsheet (e.g., calculate the average battery capacity, count the number of batteries by technology) and present the data using charts (e.g., comparing battery capacities, technology distribution, etc.). **Note to teacher:** *It is recommended to implement and enhance this activity in collaboration with the ICT teacher, as it involves the use of digital tools (Excel/Google Sheets) and data visualization.*		
School project: Batteries for the Future – Let's Recycle Responsibly (optional)		90 min	

<table>
<tr><th>Name</th><th>Procedure</th><th>Duration</th><th>STEM criteria codes</th></tr>
<tr><td>Inspiration and Challenge Framing</td><td>To develop an understanding of the importance of proper battery disposal and recycling, students need to apply their knowledge creatively to engage the school community. The lesson fosters teamwork, creativity, communication skills, and interdisciplinary learning across technology, art, and environmental education.

Students are divided into teams of up to 4 members. The teacher introduces the task with a short “problem story”:

“Every year, millions of batteries end up in landfills, leaking chemicals that harm our environment. Our school can be part of the solution. Your mission is to design and launch a battery collection campaign that works here.”

To spark ideas, the teacher shows 2-3 real-world examples of awareness campaigns or battery collection initiatives (posters, collection boxes, digital ads).

Each group is assigned to create one type of campaign product:
Promotional campaign that includes one of the formats below:
Poster (digital or physical)
Video,
Infographic,
QR code linking to additional information
Battery collection box made from recycled materials</td><td>10 min</td><td>A1, A2, A3,
B1, B2, B3,
E2, E3,
F1, F5,
G1, G2</td></tr>
<tr><td>Guided Brainstorming and Campaign Planning</td><td>Using a collaborative tool (e.g., Padlet, Miro) or paper mind maps, each team generates ideas for their product.

The teacher facilitates the process with guiding questions in three key areas:
Understanding the audience – Who produces the most battery waste in our school? What do they already know, and what would motivate them to change? Do we want the</td><td>20 min</td><td>A1, A2, A3,
B1, B2, B3,
C1,
F5,
G1.</td></tr>
</table>

Name	Procedure	Duration	STEM criteria codes
	campaign to reach people outside of the school (e.g., parents)? • Crafting the message – What is the most important idea to communicate? Should the message be informative, persuasive, fun, or urgent? • Selecting the format – Which format (poster, video, infographic, QR code, collection box) will best reach and engage the chosen audience, and where will it be displayed? Which format allows our team's strengths (art design, tech skills, video editing, communication) to shine? What materials can we reuse or recycle to build the collection box? Should the design match the theme of our poster/video/infographic to keep the campaign consistent? Where is the best location in school to place the box so people will use it? Students discuss, justify their decisions, and outline how their campaign materials will effectively promote responsible battery disposal. **Note to teacher:** *This activity can be implemented collaboratively with art, ICT or social studies teachers. Collaboration enriches students' perspectives and fosters media literacy, teamwork, and cross-curricular connections.*		
Product Development and Presentation	Students work in teams to develop their promotional product (poster, video, infographic, QR code, or battery collection box) using the knowledge acquired in previous activities. During the process, the teacher provides support and encourages creativity, teamwork, and responsible use of materials. After completing their products, each team presents their work to the class or online (Teams, Meet, Zoom). If the activity is carried out in collaboration with other	60 min	A1, A2, A3, B1, B2, B3, C1, D1, E2, E3, F5, G1, G2.

Name	Procedure	Duration	STEM criteria codes
	subject teachers (ICT, Art, Social Studies), presentations can be organized as a joint lesson or a mini-exhibition in school. Online implementation can include digital presentation tools such as Padlet, Google Slides, Canva, or Miro. Following the presentations, students use a peer feedback rubric to highlight strengths and suggest improvements. Finally, each student completes a short reflection (written or digital) addressing questions such as: • What new knowledge have I gained about batteries and recycling? • How did my team contribute to understanding the problem and its solutions? • How do I connect knowledge about batteries and recycling to my future profession and community? • What is my personal contribution to responsible handling of waste batteries? **Note to teacher:** *If students work on the projects at home, they can bring their finished products to school, send digital files, or share them on a digital platform like Canva, Google Slides or Padlet. This way, all students can present their work, whether in class or online.* *The project Batteries for the Future – Let's Recycle Responsibly can be implemented as a stand-alone school initiative or linked to broader sustainability events such as the European Sustainable Development Week (ESDW), European Week for Waste Reduction (EWWR), EU Green Week, or international days like World Environment Day. Connecting the project to these events increases its impact and visibility while highlighting the importance of responsible battery recycling within the global sustainability agenda.*		

Assessment

Describe here the assessment method of the activity, if any. For example, if you plan on assessing the learners with a quiz, include here questions and answer options with color-coding the correct answers.

Quiz questions:

1. What is considered the "heart" of a lead-acid battery?

    a) Grid
    b) Electrolyte
    c) Separator
    d) Electrodes *(correct answer)*

2. Approximately how many volts does each cell have in a standard 12V battery?

    a) 6 volts
    b) 2.14 volts *(correct answer)*
    c) 1.5 volts
    d) 12.8 volts

3. What is the function of the separator in a lead-acid battery?

    a) Increases battery voltage
    b) Connects the positive and negative plates
    c) Prevents short circuits by keeping electrodes apart *(correct answer)*
    d) Stores electrical energy

4. What is the key difference between SLI and EFB batteries in terms of function?

    a) EFB batteries are used only for engine starting, while SLI batteries support additional vehicle features.
    b) Both types serve the same purpose in all vehicle applications.
    c) SLI batteries are more advanced and used in complex systems, while EFB are basic.
    d) SLI batteries are designed only for engine starting, while EFB batteries meet broader demands of modern vehicles. (*correct answer)*

5. EFB batteries are completely sealed and do not contain liquid electrolyte.

    a) True
    b) False *(correct answer)*

6. What are the advantages of AGM batteries compared to SLI batteries? (Choose 2)

    a) Better vibration resistance *(correct answer)*
    b) Support for start-stop systems *(correct answer)*
    c) Cheaper to produce
    d) Shorter lifespan

7. Why shouldn't AGM batteries be opened or have their caps removed?

    a) Because the liquid electrolyte may leak
    b) Because they are sealed and designed for maintenance-free operation

(correct answer)
c) Because they contain dangerous gases
d) Because they need to be charged before opening

8. Why is it important to recycle automotive batteries?

a) **Because it reduces waste and prevents environmental pollution** (correct answer)

b) Because recycling makes batteries last forever

c) Because new raw materials are no longer available

d) Because it lowers the car's fuel consumption

Assessment Rubric:

Criterion	Fully Meets Expectations Points:	Partially Meets Expectations Points:	Does Not Meet Expectations Points:
Accuracy and Completeness of Data	All required data is included (e.g., for at least 5 entries); the data is accurate, meaningful, and relevant.	Some required data is missing, or certain entries are not fully accurate or clearly presented.	Data is incomplete, incorrect, or appears random.
Table Layout and Formatting	The table is clearly structured; text is aligned, borders, colors, or other formatting elements are applied for better readability.	Some formatting is applied, but overall clarity is reduced.	No formatting is applied; the table is difficult to read and disorganized.
Use of Functions	All relevant functions are correctly applied.	Functions are partially or incorrectly used; only a few are applied or not logically connected to the data.	No functions are used, or they are entirely incorrect.
Graphical Data Presentation	Data is clearly and appropriately presented using well-labeled charts that enhance understanding.	A chart is present, but it is partially unclear, lacks labels, or does not fully match the data.	No chart is created, or the chart is incorrect (e.g., does not reflect the data, unreadable).

Peer Feedback Rubric

Reflection on practice

STEM Strategy Criteria

Please indicate which Criteria correspond to the specific Learning Scenario, contributing on a broader scale to the development of a STEM School strategy, and briefly explain how you applied the specific Criterion: https://www.stemschoollabel.eu/criteria.

Examples:

Connections with industry: a school visit to a research centre will be scheduled, either physically or virtually, so learners can directly discuss with professionals the recent developments in the field.

Interdisciplinary instruction: we will examine and implement a variety of activities in a spectrum of subjects, ranging from ethics and philosophy (non-STEM) to biology and chemistry (STEM).

Click the arrow on the left of each category heading to see and select the corresponding criteria.

A. Instruction

B. Curriculum implementation

C. Assessment

D. Professionalisation of staff

E. School leadership and culture

F. Connections

G. School infrastructure

Promoted Competence areas

GreenComp: The European sustainability competence framework. For more information about this competence framework refer to this summary document.

About Scientix

Scientix® is the community for science education in Europe. An initiative of European Schoolnet (EUN). that aims to promote and support a Europe-wide collaboration among STEM teachers, education researchers, policymakers and other educational stakeholders to inspire students to pursue careers in the field of Science, Technology, Engineering and Mathematics (STEM).

Annex(es)

Annex 1. Worksheet Sample Questions

Worksheet: Battery Types and Their Characteristics

1) Why is the term “starter battery” no longer accurate for modern vehicles? (Choose the correct reason)
   a. Because modern vehicles no longer require batteries at all.
   b. Because the battery performs multiple functions beyond starting the engine.
   c. Because the term was only used in the 1990s and is outdated.

2) List at least two additional functions that the battery performs besides starting the engine.

   Function 1: ______________________________

   Function 2: ______________________________

3) What are the three main types of lead-acid batteries?

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4) What are the three main types of lead-acid batteries? Compare AGM, EFB, and SLI batteries. Fill in the table.

Battery type	Main characteristics	Typical applications	Key difference
AGM (Absorbent Glass Mat)			
EFB (Enhanced Flooded Battery)			
SLI (Starting, Lighting, Ignition)			

5) How is a voltage of 12.8 V achieved in a battery?

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6) What are battery cells and what is their role?

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7) Explain the function of a separator in a battery. Why is it important for proper battery operation?

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8) Why should the caps on AGM batteries not be opened? Explain using an example related to their design.

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9) What does the term circular economy mean?

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10) Why is the proper disposal and recycling of car batteries important for the environment and society?
