

R4.1. DataScEd4CiEn STEAM Scenario Template

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Introduction

Title

Our Sustainable School – Making a Social Contribution Through Waste Reduction

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Summary of the scenario

The goal of this lesson series is to raise students' awareness of why it is important to reduce waste and recycle. Students should recognize the importance of waste separation and waste reduction and learn strategies for doing so. They will examine their own waste generation at school and at home using statistical data they have collected themselves, analyze statistical data on waste generation in German households, and compare this with their own waste generation. In addition, they will work on their own project to inform the school community about waste generation and waste separation and build their own compost pile in the schoolyard, which can be used by the entire school community after the lessons are completed.

Age of the students

The lesson unit is intended for a 4th-grade class. To successfully complete the lesson unit, students should already have basic knowledge of statistics and be familiar with bar charts and pie charts. The students should already be familiar with digital tools, should have worked with iPads frequently in class, and should already be familiar with digital research notebooks and the BookCreator app. Additionally, they should have already worked with CODAP with their teacher and know its basic functions.

The students should already be familiar with the different types of waste. The class should have been sorting waste (general waste, plastic waste, organic waste, paper waste) up to this point.

Students should already have some experience with giving presentations. They should have worked in various group settings, such as group projects.

‘Data Science Content in STEAM for Civic Engagement and Social Justice from the Early Years’

Subjects and topics

The topics that define the lesson unit are waste separation, waste reduction, recycling, and composting.

The problem addresses civic engagement and social justice, as waste production is highly relevant to everyday life, since everyone produces waste. That is why it is important to avoid waste and sort it correctly. High levels of waste production have far-reaching global consequences and burden the environment. Through sustainable actions, students can help reduce the environmental impacts of waste production. Therefore, through this lesson unit, they should learn to act responsibly and adopt mindful consumption habits regarding waste reduction and waste separation.

The various disciplines of the STEAM approach are relevant to solving the problem. For example, the discipline of science is important when students examine the processing of different types of waste and learn about the biological processes in a compost pile.

The technology aspect is relevant to solving the problem, as students work with digital tools (BookCreator, TaskCards, CODAP). For example, they use CODAP to process their own real-world data. These tools help students identify their own impact on the problem.

The Engineering aspect is particularly prominent in the activity of building a compost pile. To do this, students must work with a given construction plan and consider why the structure must be built in a specific way to achieve a specific function. The discipline of engineering enables students to build their own compost pile, through which they can learn how waste (in this case, organic waste turning into soil) can be processed and reused.

In this lesson series, the “Arts” component is primarily addressed through social aspects that fall under the “Arts” component of the STEAM acronym. These social aspects include the global consequences of waste production and the associated importance of waste reduction and recycling. However, the Arts in the traditional sense are also relevant in this lesson unit, as students will artistically design informational posters that should be presented as attractively as possible. These posters should be designed in a three-dimensional manner, incorporating waste as an art object and thereby recycling it.

The mathematics component contributes to solving the problem, as students collect their own data during the lesson series, represent it in various formats, and analyze it. Additionally, existing datasets are to be analyzed, and a comparison is to be made between the students’ own data and existing datasets. This incorporates the aspects of reading the data, reading between the data, and reading beyond the data. The comparison is intended to prompt reflection on (one’s own) waste production. This serves as the starting point for encouraging a more reflective approach to waste production and consumption habits, as well as for improving waste management and recycling practices at the school.

Real-life questions

Main question: How can we make our school more sustainable in terms of waste?

- *Why is waste separation and waste reduction important? (Lesson 1)*
- *How much waste does our class produce? (Lesson 2)*
- *How much waste do we produce in Germany? (Lesson 3)*
- *How can we produce less waste? What can we do at home and at school to reduce waste? (Lesson 4)*
- *How can we produce less waste ourselves in our daily lives and at school? (Lesson 5+c)*

Objectives for the scenario

Overall goal of the series: Students will become aware of why it is important to reduce and sort waste.

Lesson 1:

- Students gather information from a video and connect their prior knowledge to the video's topic.
- Students identify different types of waste and sort items into the appropriate waste categories.
- Students research and describe what happens to different types of waste after they are disposed of by first independently extracting information from a text and then discussing it in a group before recording their findings in writing in a research notebook.
- Students present their group findings and explain why waste separation is important for the environment and nature.

Lesson 2:

- Students measure and collect data in and from their immediate surroundings, which is then documented as part of their homework and later transferred to CODAP.
- Students create charts with their own data in CODAP.
- Students read, analyze, and interpret the charts in terms of their message and significance in the context of their own waste consumption.
- Students formulate hypotheses and test them using the data they collected and the charts they created.

Lesson 3:

- Students extract information about waste consumption from diagrams.
- The students compare data they have collected themselves with provided statistical data.
- Students interpret data with regard to waste reduction and waste separation.
- The Students reflect the significance of different data sets.

Lesson 4:

- Students apply insights from a fictional story to real-world strategies for waste prevention.
- Students are familiar with the 6R strategies and provide examples for each strategy.
- Students explain each of the 6R strategies in their own words.

Lesson 5:

- Students identify and gather relevant information on the topic of waste reduction and waste separation.
- Students design creative informational posters on the topic of waste reduction and waste separation for their classmates and present them.

Lesson 6:

- Students plan the construction of a compost bin on the school grounds using a set of instructions.
- The students explain why the compost bin must be built in a certain way to serve a specific purpose.
- Students select a suitable location for the compost bin and justify their decision based on criteria (space, sun/shade, etc.).
- Students explain how the compost bin needs to be maintained in the future.
- Students use tools properly and safely to build the planned compost bin.

Skills and competencies

Mathematics Curriculum

Data, frequencies, and probabilities

The students...

- Collect data from their immediate surroundings and examine individual consumption needs (homework from Lesson 1 and analysis using CODAP in Lesson 2)
- Present data and frequencies in diagrams and tables, including using digital math tools (Lesson 2)
- Extract data from calendars, diagrams, and tables and interpret it to answer math-related and consumer-relevant questions (Lesson 3)
- Organize data (taking consumer-related topics into account) using tables, including digital math tools (Lesson 2)

Problem Solving

Students...

- Select appropriate tools and (digital) resources for working on tasks (CODAP, Lesson 2)
- Work on tasks independently and in collaboration with others (group work, Lesson 3; CODAP, Lesson 2)
- Check results for plausibility in order to identify and correct errors if necessary (Reflection, Lesson 3)

Modeling

The students...

- Extract information relevant to the task from real or simulated situations (homework, Lesson 1; history, Lesson 4)
- Translate problems from real or simulated situations into a mathematical model (homework, Lesson 1; Lesson 2)
- Use appropriate representations (e.g., expressions, tables, sketches, diagrams), including digital math tools (Lesson 2)
- Relate the result back to the real-world or simulated situation and interpret it as an answer to the problem (reflection phases, Lessons 2 and 3)
- Check the results for plausibility and modify their approach if necessary (Lesson 2 + Lesson 3)

Communicate

The students...

- Explain their own approaches and ideas clearly (Lesson 2 during the presentation of the statistics)
- Record their work results, procedures, and learning experiences (continuously from Lesson 1-c in the research notebook)
- Present solutions, ideas, and results using appropriate presentation formats and (digital) media (Lesson 2)
- Work on tasks collaboratively while adhering to agreed-upon arrangements or rules (e.g., Lesson 1 group work and Lessons 5 and c in the project work)

Argue

The students...

- Identify examples of suspected relationships (Lesson 3)
- Compare mathematical patterns and structures in with a focus to connections, similarities, and patterns (Lesson 3)
- Confirm or refute their assumptions using examples (Lesson 3)

Present

The students...

- Use mathematical symbols, tables, and diagrams appropriately (Lessons 2 and 3)
- Use (their own) analog and digital representations to work on assignments (Lesson 2)
- Use (their own) analog and digital representations to present information clearly (Lesson 2)

Compare and evaluate representations (Lesson 3)

Curriculum: Social Studies

Life in the Media and Consumer Society Students...

- Describe factors influencing purchasing behavior and assess their own susceptibility to influence (including gender aspects in marketing, dimensions of sustainability)

(Lesson 4)

Nature and the Environment Students...

- Explain human impacts on the habitats of animals and plants (Lesson 1)
- Evaluate the importance of nature and environmental protection for preserving the living conditions of animals, plants, and humans, and identify possible courses of action (Lesson 1, Lesson 4, Lesson 5, Lesson 6)

Using and Protecting Spaces Students...

- Develop strategies for using and protecting spaces (Lesson 1, Lesson 4, Lesson 5, Lesson 6)

Building and Designing Students...

- evaluate and optimize models they have constructed themselves (including efficient use of materials) (Lesson 6)

Art Curriculum: Sculpting and Assembly Students...

- Collect various everyday and natural materials and describe material properties (in terms of texture, appearance, and use) (Lesson 5+6)
- Experiment with ways to process and join (shaping, cutting, removing; wiring, gluing, assembling) different materials and evaluate the results as well as the suitability of tools (scissors, pliers, saw) (Lesson 6)
- Create theme-based sculptures and assemblages (using everyday materials) and evaluate the use of materials, tools, and material connections (Lesson 5+6)
- Purposefully alter everyday objects—through reinterpretation, disruption, and reinvention—(Lesson 5)

Teaching approaches and learning strategies/theories

The lesson series is problem-oriented, as a real-world environmental problem (waste pollution and waste reduction) serves as the starting point and structures the learning process across all lessons. At the same time, it follows the principles of project-based learning by having students apply the knowledge they have acquired in a concrete, collaborative final project (creating a poster and building a compost pile). The project thus represents an action-oriented response to the problem previously addressed.

Interdisciplinary & relevant competencies:

This lesson series fosters problem-solving skills by having students analyze a real-world environmental problem and gradually develop their own strategies for waste reduction. Planning and implementing the final project together encourages collaborative learning, as decisions are made cooperatively and tasks are divided among the group. At the same time, it fosters ethical awareness and a sense of responsibility by having students reflect on the

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consequences of human actions for the environment and society and take responsibility for sustainable practices in their daily school life.

Educational Scenario planification

Lesson plan

	Lesson Description	Description of the activity	Material	Social form	Time
Lesson 1	Introduction to the topic of waste pollution, waste reduction and waste separation	A video clip is shown to the whole class (the video is watched from 0:00 to 3:36) The teacher asks a prompt question about the video: Where does all this waste come from? (Students' prior knowledge on the topic is elicited and gathered	Video from "Sendung mit der Maus": "Plastic Mountains on the beach—where does all this trash come from?" (See appendix for link)	Plenary session	
	Review of types of trash	- Students should plenary match different cards with objects to the corresponding trash cans, in the they belong	Cards featuring different garbage cans, cards with different objects, magnets	Plenary session	

	Work phase: Group work with division of labor on the individual types of waste (What happens to the different types of waste after they are disposed of?)	The students use various informational texts in which they identify what happens a types of waste happens disposal they summarize the most important information by writing it down or recording it in their research notebook: What happens to plastic, paper, general waste,	iPads with research notebook, informational texts (see appendix)	Group work	
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		and organic waste after we throw them away?			
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Discussion in a group discussion	The students present their findings from the research notebook on the different types of waste by projecting them onto the wall using Apple TV After presenting their findings, the students may, where a brief summary of what happens to the different types of waste after we throw them away The discussion focuses on why we sort waste (e.g., recycling is sometimes possible, incineration is harmful, and waste in nature is also harmful) HA Explain: On a Friday, the students are given the assignment to weigh the trash generated on each day of the week starting the following week. They are to sort the trash by type. They are told that they can use a kitchen scale for smaller amounts of trash. For larger amounts of trash, they should use a bathroom scale. The children should step on the scale once with their trash and once without it, and record the difference. The teacher demonstrates to the children, using an example, how the weighing process	iPads with research booklet, Apple TV Homework: Worksheet ("How much waste do we produce in a week?") (see attachment)	Group discussion	
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		works, which units are used, and how to record their results in the table. The slips of paper are distributed by the teacher and entered into the CODAP app, where the students can during class			
Lesson 2	Introduction (whole class)	- The teacher asks thought-provoking questions to review the content of the last lesson: What types of waste are there? What happens to the waste (the different types of trash) after we throw it away? What are the consequences of this? What should be taken into account with data/what is important?			
	Introduction to the research question of the lesson sequence	- The teacher guides the children to collect their own data on waste production at home as researchers collect, leads derives the lesson's research question and writes it on the board ("How much trash do our class?")			
	Reflection of the homework (plenary session)	The teacher asks reflective questions, which the Students are expected to answer (What is well worked well? Where were any difficulties? What is noticed?)			

	Work phase	The students formulate hypotheses about waste production, which they document in the research notebook document The students open CODAP (there the teacher has the data the students' already entered) The students first freely explore the data entered in CODAP in research notebook the students enter two statistics that relevant and answer questions about them ("What exactly does this statistic tell us? Why did you choose this statistic? Why does this statistic look exactly the same?") Quick task: The students can complete the task in the research notebook as well Edit: Calculate the per capita consumption of your household. To do this, use the total amount of waste generated by your household and divide it by the number of people in your household. If necessary, use the calculator in CODAP.	Projector, technical device	partner work	
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	Backup Reflection	C	The students' results are presented by displaying them a r e displayed on the wall	Whiteboard iPad (CODAP, research notebook) Apple TV		
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		are projected and the students explain them To can be recorded the students adjust their work adjust and, if necessary, to their research notebook During the teaching phase, discuss where difficulties arose the tasks and why some diagram are not useful (informativeness, etc.) didactic reserve:Key finding in the research notebook, quick round of sharing.			
	Verification of the hypotheses + Discussion in class	The students analyze the collected data (if possible) their to at the beginning the lesson sequence (if it is not possible, a reflection should take place: Why can the hypothesesnot be tested? What information is missing? How could data be collected for this?) the results will be discussed orally in the plenary session		Individual work, plenary session	
Lesson 3	Greeting Warm-up + Review Lesson 2	The The teacher projects a Classroom lesson featuring a graphic created with CODAP, which providing an overview of the in the class collected in a the murmuring phase, the students discuss various prompt questions discuss What kinds of trash did the students collect in class?	CODAP file from the last class	Teacher presentation + partner work	

		How much trash was collected in the students' households in a week? What did you notice about our own data?			
	Transition + Class overview	The teacher transitions to the research question: Using the data collected so far, we have found out how much and what kind of waste we generate at home. In this lesson, we want to address the question: How much waste do we generate in Germany, and how does that compare to the waste in our class? The teacher writes the research question clearly on the board.	Blackboard + chalk	teacher presentati on	

Collaborative group work with different datasets (group work with about 4 children per group, there every group several times per class)	Each group works with a dataset from our document: Group A: Household Waste 2023, kg per Kof (Germany) Group B: Types of waste in households 2020 The research notebook should be used to answer various questions about the data Which units are used? For example, kilograms (kg), grams (g), year, week,... What important observations can you make? What do you need to compare the data with data we've collected ourselves?			
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		How does the data differ from our data we collected ourselves?			
	Discussion of the results	The Students present their results by using the guiding questions from the research booklet In doing so, the work results are projected onto the wall, so that the results are visible to all children.	A class set iPads with the BookCreator app Apple TV	plenary session	
	Recording results as a class discussion	The learning group compares together with the teacher, the data from their own survey with the findings from the given diagrams. It is discussed, which is why it can be difficult to compare the data (e.g., work with different units). The teacher works with the children at the blackboard to convert the values so that the values from the class can be compared with the values from the diagrams. The resulting board image is uploaded by the students to BookCreator	Chalkboard+ chalk Class set iPads with the BookCreator app		

	Reflection (Class discussion)	The teacher asks reflective questions: Why are such large datasets important, even if they don't exactly match our class? Where do you see room for improvement in waste consumption and waste separation?			
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		What can we do at our school to reduce waste and improve waste separation?			
Lesson 4	Introduction in a whole-class discussion	Welcome and explain the lesson plan: "We've already learned a lot about how much trash we all produce, where that trash ends up, and why it's actually really stupid to make so much trash. That's why today we want to think about how we can all produce less." Transition to the story of Leon and Basti, who have learned a lot about this at and learned			
	Work phase	Assignment: Read and/or listen the History in the research booklet Differentiation for fast students in the research notebook: Think about how Leon and Basti tried to produce less waste	iPads, research notebook, headphones if needed	single work	
	Development phase	The teacher presents the task card and goes through the six columns with the children The teacher explains the 6-R strategies using the " " prompt questions, which are below the strategies The teacher asks the children where Leon and Basti avoided waste and which column that belongs to	iPad, research notebook, smartboard	group setting	

		The teacher adds the appropriate example in each column Discussion question: Where else could we all produce even less waste? The teacher asks 2–3 children to share some ideas			
	Work phase	Assignment: Add more ideas to the task card Differentiation: natural Differentiation and provided tip cards	iPads, research notebook, printed tip cards	Group phase	
	Discussion	The teacher and students review all entries together Are there any entries in the wrong column? Do some entries perhaps belong in more than one column? What did the students come up with easily? What was more difficult?		Group discussion	
	Save	Assignment: Describe the 6-R strategies in your own words (using examples) explain. (Notes or audio recording)	iPads, research notebook	Single work	

Lesson 5	Introduction + development the research question	The teacher asks questions to assess from the previous lesson: Do you remember Leon and Basti? What happened again in story? How did Leon manage to avoid creating trash , and was he able to help Basti produce less waste too? In the last few lessons, you've learned a lot of important things about waste—could you help the other classes the way Leon did? through the questions the students discussed, we can lead to the research question, which is written on the board in chalk (How can we do produce trash ?)	iPads, research notebook, chalk + blackboard	plenary	
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Assignment	The Teacher leads to Assignment: To help you and our school reduce waste in our daily lives, you should create posters about the different types of trash that will help the children and teachers from other classes why it is important to produce less waste and to sort it. The teacher points out that important information from the research booklet to help create the posters It is also noted that the poster should be designed artistically . In doing so, trash should be used as design element and thus serve a different purpose (in the sense of recycling)			
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Work phase	The teacher divides the class into groups; each group is to work on a different type of waste The students receive the following assignment: Write down what you think most important aspects the Based on what you learned in the previous lessons, create a poster (generation, separation, reduction, recycling strategies, etc.). Design the poster using (Waste as artistic design element on the posters)	Trash (class) Posters (possibly the backs of old posters) Pens Craft supplies (scissors, glue, etc.)		
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	Backup, Reflection	The students present their posters The posters are displayed in the classroom/school (e.g., lobby, auditorium) Photos of all posters should be included in the research notebook	iPads, research notebook, posters, pushpins or similar for hanging		
Lesson 6	Introduction	The teacher initiates the to the students by showing them a prompt image related to compost and students the following question: What can we do our organic waste at at school do, instead of throwing it away? the Students describe the composting cycle in their own words The teacher then introduces the idea of building a compost bin	Compost image Review on the Research notebook or the group puzzle from the first lesson (What happens to organic waste? The compost cycle) (B.) Informational text on composting, printed and digital		
	Work phase I	The students read an informational text on building a compost bin (this can be taken out to the schoolyard afterward)		Singöe work	

	Phase II	The students and the teacher meet in the schoolyard The teacher assigns the task of the students use the information from the informational text create suitable Find a location for a compost bin → after that the study group agrees on a location it takes place a collaborative work phase takes place, in during which the students take on different tasks: some students help the teacher wooden stakes into the ground and securing the wire around them; other students collect materials for the compost (e.g., branches, leaves, organic waste from the school, and grass for covering (or a felt blanket) all materials will be the instructions stacked	chicken wire and wooden stakes to build the compost bin, gloves, measuring tape, nails/staples for a hand tacker, shovels, a hammer, possibly a felt blanket for covering, printed instructions for building a compost bin		
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	Safety, Reflection	The teacher discusses the next steps with the students: every now and then, the compost be “turned” by the students “turned over” The teacher asks a question that provides a outlook to the What are the benefits of the project? What can we do with the soil produced in the compost in the future? (For example, we can use the new soil to grow new, less waste in the school, or the waste is used for the school	Note the students’ own learning progress in the research notebook.		
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Timing

The first class period focuses on the STEAM topic of Science, as the first hour primarily examines waste separation with regard to the individual materials. The focus is on which materials should be separated, how, and why (for the entire class period). The sixth period also addresses the biological decomposition processes of compost and thus the “Science” aspect (the entire sixth class period, though the Engineering aspect also plays a major role).

The “Technology” aspect is addressed primarily through work with CODAP and the research notebook. While CODAP is used and emphasized mainly during the second and third class periods (particularly during the activity phases of the lessons), the research notebook is consistently used throughout all class periods (used in every class period, with the amount of time varying depending on the task).

Engineering takes center stage in the sixth lesson, as students work together to build a compost pile using construction instructions and also examine its function (an entire lesson on engineering, though combined with science).

The “Arts” aspect is addressed in the fifth period in the classical sense of art, as the informational posters are creatively designed (an entire class period). Arts in the sense of social sciences (which fall under the “Arts” aspect in the STEAM approach) are partially focused on in the first period, but primarily in the fourth period (the entire fourth class period and the last 5–10 minutes of the first period).

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Mathematics is the main focus during the second and third periods, as data is processed during these sessions using (including digital) tools (two full class periods, combined with technology). During the sixth period, mathematics is briefly covered in relation to measuring and calculating during compost bin construction (5–10 minutes, as the focus is on engineering and science).

Assessment

A test with various questions could be used for the learning objective assessment.

To determine whether the students have acquired the necessary knowledge about the different types of waste, they should provide examples (from their daily lives) of these types and then identify what happens to the waste after disposal (recycling, shredding, melting down, etc.).

In another task, students should use images of diagrams from CODAP to determine whether certain statements, such as “We produced a total of 70 kg of waste” or “Our class’s residual waste consumption is higher than our organic waste consumption,” are correct in relation to a representation from CODAP.

In the next task, students are to independently select the two appropriate statistics from a pool of four, which they can use to answer the question: “How has the total amount of waste produced and recycled in Germany changed in recent years?”

Next, students must describe the 6R strategies (provided) in their own words and with the help of visual representations, and then explain how these strategies can have a positive impact on the environment.

In the final task, students should first describe how their homemade compost bin works, select one of three images as a suitable location, and explain their choice.

Annex