Greenhouse

Summary

Age category
9 - 12 years
Topic
Algebra
Total duration
455 minutes

Students plan to create a greenhouse. They draw a design and they build their greenhouse. They explore the concept of photosynthesis and the necessary conditions to grow plants.

Problems to be tackled:

- Create your own greenhouse
- Depending on what size your plant is... you can create a small straw-model, or if the class is aiming for a bigger one, create a wooden-model.
- The costs for the greenhouses should be as low as possible, especially if the wooden models are being built.

Real context

Real world motivation

“A friend of mine has given me these plants since he had to move to Australia. He will be coming back in the summer and I am extremely worried about the plants. Can you help me take care of them, so that they will survive all through the long winter?”

Goals

Skills

Domain-general:

- Formulating and solving problems.
- Describing approaches for solving problems.
- Creating simple tables and diagrams to categorize and report results.
- Identifying and working out proposals for solutions.
- Comparing the own results with those of others and applying simple reasoning about similarities and differences and what these may be related to, and also contributing to making proposals that can improve the study.
- Documenting their studies using different forms of expression (text and pictures) and using their documentation from discussions and dialogues.
- Contributing to formulating and choosing action alternatives that lead to improvements.
- Drawing up simple documentation of work using sketches, models or texts.

Mathematics:

- Choosing and using appropriate mathematical methods.
- Measuring temperature.

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- Using scale.
- Using statistics.

Technology - Engineering:

- Creating a greenhouse which matches some necessary criteria.
- Carrying out simple work on technology and design by testing possible ideas for solutions, as well as designing simple physical models.

Knowledge

Mathematics:

- Statistics. Diagrams and tables.
- Temperature.
- Scale.

Science:

- Photosynthesis. What plants need in order to survive and grow (e.g. understanding the importance of the sun)

Technology - Engineering:

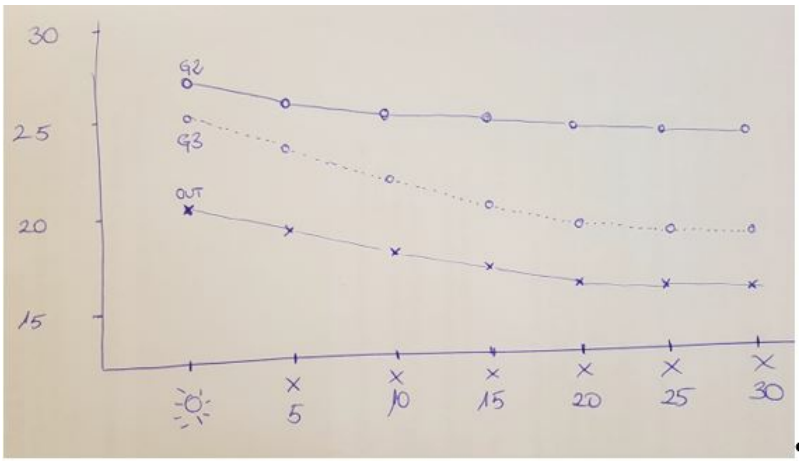
- Greenhouse. The link between building a greenhouse and the process of photosynthesis. Criteria for a good greenhouse.

Methodology

Part	Description	Timing
1	**Living plants: introducing why we need living plants: group discussion** *The teacher introduces the context of the activity: greenhouse.* After introducing the students to the plants that should be taken care of, let the students think about what living plants/vegetables need to survive. Let them compare their thoughts in pairs. Discuss and come to a conclusion with the whole class making sure that, at least, *air, soil, water, light and temperature* have appeared. Let the students write down their answers on the worksheets. Talk about the photosynthesis with your students paying special attention and discussing the importance of temperature.	45'

2	**Design your own greenhouse: group work** *The teacher introduces the design of the greenhouse.* Divide the class in small groups of 3 to 4 students. The students will be challenged to design and create their own greenhouse. The costs to build the greenhouse need to be as low as possible without compromising its functionality. Let the students start sketching and discussing on the key elements of their greenhouse. Guide them using questions such as: How will you water your plant? Will you be able to move it, once it is built? Will it make a good use of light? Will the plant fit in when it grows? Will it be exposed to wind or rain? On this level, focus and concentrate only on the shapes and measurements. Materials need to be discussed later.	120'
3	**Transform your greenhouse drawings: group work** ***The teacher helps the students to transform their drawings using different scales.*** Help students transform the drawings into the different 2D structures that together will make the walls, roof and floor (if any). Measure the plants to make scaled drawings with the appropriate ratio (for simplicity, try to use only 10:1, 5:1, or 2:1) in order to make each structure fit on a piece of paper. ***The teacher helps the students with the calculations.*** Compute the lengths of the sticks and the areas of all surfaces from your drawings.	80'

4	**Build your greenhouse: groupwork** ***The students decides on Version A, B or C*** **Version A: "the strawmodel"** Build a prototype of the greenhouse by using your own sketch. • Write a letter to your teacher indicating how many straws and how much kitchen film you need to build your greenhouse. Justify your data (and don't forget to de-scale!) • Build the prototype using adhesive tape for the junctions, straws to hold the structure, and kitchen film for the surfaces and place your plant inside. • The plant's size should be max. 7cm (height) x 4cm (width) for a small straw-model **Version B: "the real greenhouse"** Build the real greenhouse within a certain budget. • Estimate the costs of your greenhouse using different materials (remember to add adequate pieces and/or materials to build the junctions). Recycling should be encouraged but not enforced as long as the project stays within budget. • Write a letter to your headmaster/mistress justifying the budget and the needs for the expenses. • Build the greenhouse and place the plant inside. **Version C** Use the Printable; Description how to make a greenhouse with straws	120'
5	**Measuring temperature: instruction, group work, group discussion** ***The teacher introduces how to measure the temperature*** *(see tips&tricks)* The children need to do research about the efficiency of their greenhouse. Therefore they need to c heck how the greenhouse works measuring its inside temperature, and compare this with the outside temperature. Therefore the greenhouses will be put on a place on the schoolyard where the sun will shine on them for about 30 min.. and after this the greenhouses will be in the shadow. Students will measure the temperature at different times during a period of about 2 hours. (*see worksheet for children*) Send a pair of students each 10/15 minutes to fill in the table while the following discussion happens in the classroom: Can we grow plants in the North Pole/Moon/Mars? (There are documentaries on YouTube under "Lunar greenhouse", "Tundra greenhouse" or "Potatoes on mars".) Discussion among students should be encouraged, finishing with a personal summary of the discussion in their preferred format (mind-map/ paragraph/ visual...).	20'

6	**Collection of all data: group work** ***All data in a shared spreadsheet (if possible)*** Put all data in a shared spreadsheet (if possible) and make a graph of each team's data or a graph overlapping all the data, See example below: (Example with fictional data) Below there is an example of a table with 5-minute measurements. Note the sun/shade mark by each measurement. Since the first measurement in the graph should be the last measurement under the sun, it has been underlined for each thermometer.  From that temperature on, all measurements are shown in a graph were we can compare the maximum temperature for each thermometer, as well as the speed in which greenhouses loose temperature. If the experiment goes well, all greenhouses should cool down more slowly than the outside and at different rates depending on the materials.  	40'
7	**Evaluation: groupdiscussion** ***The teacher decides which way to evaluate*** The students reflect on what they have learnt. Use the report part in the worksheet.	30'

Organization

Materials

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- Writing material
- Rulers
- Version A – straws, tape, glue gun, kitchen film
- Version B – depends on their design
- Description How to make a greenhouse
- Worksheet Greenhouse

Grouping

- Groups consist of three or four students.
- Attitudes needed in a group:
  - Creativity
  - Accuracy

Printables

- Description How to make a greenhouse
- Worksheet greenhouse

Coaching

Useful questions

- What do plants need to survive?
- Why do we need plants?
- What happens in the plant when the sun shines on it?
- Is it possible for plants to stand close next to each other?
- How can a greenhouse look like?
- Why is it that greenhouses are more needed in some countries than in others?
- What different shapes are there in a house?
- Why do we use scales when we draw sketches?
- What were the biggest difficulties that your group faced?
- How did the group overcome the difficulties?

Adaptations

- In earlier ages and classes with more difficulties the teacher can be more explicit and work only on the prototype. For the measurements, they might also need help and thus, the discussion on the lunar/mars/pole greenhouse should be conducted by the side of the experiments. If the debate were not rich enough, students may be encouraged to write or draw a fictional story “Growing vegetables in Mars”.
- In older or more advanced groups we can build the real greenhouses and ask them to view the videos prior to the discussion in the classroom for task 6.
  - Native (or bilingual) English speakers can work simultaneously in their English class on the College Edition of the book “The Martian”, by Andy Weir, which will also be encouraged for advanced readers.

Assessment

Teacher’s assessment:

Assessment takes place in a formative way, especially regarding:

- Schedule and chronogram

- Students motivation and participation
- Group collaboration
- Development of the activity as planned from both the technical and the scientific viewpoints.
- Pupils understanding of the mathematical and scientific concepts involved.
- Cooperation and respect in the classroom

Student's assessment:

At the end of the activity:

- Group work
- Individual contribution to the work
- All the tasks have been completed on time
- Identify the biggest difficulties
- Ways to overcome the difficulties
- Comprehension of the process and the concepts