SCIENCE ON THE MOVE 2023

BEYOND OUR FOOD

Experimental Task

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Beyond our Food

What is it all about?

Photo credit: Ruth Hartnup, Flickr

Food is essential for all living organisms and delivers building blocks as well as energy. During photosynthesis, plants reduce carbon dioxide to carbohydrates. By breathing, organisms oxidize nutrition and thereby mobilize stored energy (reduced molecules) to 'feed' their metabolism. Beside carbohydrates, food delivers all kind of elements creatures depend on to build their own essential molecules.

For centuries, humans have had to struggle to get enough food to survive. Even today, food is an ongoing issue in many aspects. Hunger still exists and kills thousands of children and adults. Today, almost 700 million people suffer from hunger.

The fight against hunger is one of the greatest challenges faced by people. Beside political issues and distribution problems, food production was and still is crucial. How can we feed huge populations worldwide with healthy, tasty food in a sustainable way? How can we avoid loss of biodiversity and contamination of our water resources while enhancing the productivity of the cultivated soils? How can we improve transportation of food into big cities? Can technology help us to overcome some of the mentioned problems?

The task of SOTM 2023: Choose an autotrophic organism and find the best way to produce a maximum amount of biomass in a defined space and timeframe without sunlight while consuming as little electricity as possible.

In this competition, you will learn to optimize all relevant variables in this complicated process to find the best approach to solve the task. In real life, it would be all about producing useful nutrients (food). However, in this competition your autotrophic organism does not have to be edible for humans but may still have an application in food production.

The Task

Your task consists of three subtasks:

1. **The Experimental Setup**
2. **The Poster**
3. **The Video Clip**

Please read all instructions until the very end! It is crucial for you to know which criteria will be evaluated and how many points you can get for each subtask! See also page 8.

The Experimental Setup

What you have to do…

Choose your autotrophic organism. Think about possible setups for your experiments. You may also carry out some pre-tests. Then choose the parameters you want to optimize in order to receive a maximum amount of biomass in a given time and space without sunlight.

Your entire experimental setup including the light source should fit in a space of 0.5 m^3. You should run several different experimental approaches and provide a statistical analysis.

Find the best photosynthetically active organism for the purpose of this task. How you invest your money and which organism, which cultivation system or which light sources you choose is up to you. There are no restrictions considering the material.

Please consider the following evaluation criteria when you plan your experimental setup (20P):

1. **Efficiency:** The inhouse biomass producing site should deliver a maximum of biomass in a given time (rate of growth). The result of your optimized efforts should be provided as: **delta fresh weight / day*volume*Wh**. (8P)

   In other words, the finally presented number depends on:

   1. biomass growth (fresh weight, fw)
   2. time (day)
   3. experimental space (max. 0.5 m^3)
   4. energy investment (watt hours, Wh)

2. **Creativity:** How smart and creative have you been in finding the best way to fulfill the task? How big was your own contribution? We will assess this point based on your progress report / lab journal (see below). (5P)

3. **Optimization process:** You have to find a smart way to measure the gain in biomass. To what extent was the theoretical knowledge (literature, knowledge from professionals, internet searches) transferred into an optimized, functioning growing system? Which steps did you take into consideration to optimize your system? Could you statistically verify your success? We will assess this point based on your progress report / lab journal (see below). (7P)

Tips

- **Experts:** Before you start thinking of the setup of your biomass growing system, get inspired by talking with different people about your project. Discuss the task with your biology or chemistry teacher. Take your time to ask experts (outside school). It is not forbidden to ask for tips or inspirations. As soon as you have made your final decision for a particular system, your teacher is only allowed to act as a coach in the background.
- **Criteria:** Check carefully the criteria we will use to assess your project and decide which aspects of the scoring list should be taken into your considerations establishing the first approaches. Please consider that not all aspects might have the same weight in your approach.
- Furthermore, it is very important not to spend too much time discussing, but to settle on an organism and to start with pre-tests as soon as possible.

Expected documentation

1. Progress Report (max. 1 A4 page)

You are expected to describe and explain precisely **what happened between your team's initial discussions and the final system you present**. Track your first ideas and discussions as you go along. For us it is crucial to **understand the process** you went through during this part of the task. Mention **three suggestions** that were made and give a short **explanation** why you decided to choose the particular setup or parameters. Give arguments for and against choosing a certain solution including the one you finally selected as the most promising one.

2. Activity List (max. 1 A4 page)

Organizing yourself as a team with defined tasks will be crucial to be successful. You are expected to document the contribution of every student in the competition. **Who was or is responsible for which portion or aspect of the work?** Every student must have participated at least once during the experimental task (no matter what kind of work she or he did).

Take **one picture** showing the class involvement. Place it next to the activity list.

3. Lab Journal (max. 5 A4 pages)

Please provide a lab journal to **prove or document all important thinking and experimental steps in your final setup**. This may include notes, measurements, raw data, calculations, sketches, pictures, etc. that are not shown on the poster but are crucial to understand your workflow. Please think about everything that is important to see for the correction team.

Combine those documents in **one** PDF file (**max. 7 A4 pages**) and name it, strictly following these conventions. **Please use underlines instead of spaces.**

- ▶ Name of School
- ▶ Name of Class (same as on application form or on simplyscience.ch)
- ▶ Name of file (ProgressActivityJournal)
- ▶ Date (year/month/day)

Here is an example: **Gymnasium_Muster_Class3b_ProgressActivityJournal_20230331.pdf**

Please note! If you do not submit the ProgressActivityJournal file or if it is incomplete, points will be deducted from your score!

The Poster

What you have to do…

The poster should explain your growing system. Start with a short text on the theoretical background of your system and the pros and cons of inhouse vertical farming in general.
Your optimal "delta fresh weight / day*volume*Wh" should be visible.
Include a sketch of the growing system, showing and describing the materials used and how the system functions.
Display the results including the statistical analysis.
Give an insight in problems you had to overcome.
Finally, add a self-critical assessment of your system.
What is the vision behind? Are there possible applications of your system in the food production in real life?

The poster should also be attractive, comprehensible and make people want to read it. Add a meaningful title, name of school and name of class.

For evaluating your poster, the following aspects will be taken into consideration (20P):

1. **Layout:** Readability, quality, labelling and numbering of the tables, graphics and pictures (2P)
2. **Attractiveness:** Is the poster eye-catching? (1P)
3. **Density of information:** Too much or not enough information may be an issue (2P)
4. **Theoretical background of the topic:** What is the main question? Is the complex theoretical background of the topic successfully explained? Is it correct? Is it obvious which aspect of the theory is illustrated by the growing system? Are the pros and cons of this cultivation technique described? Under which circumstances producing food in a controlled environment without direct sunlight could be beneficial for humanity? (5P)
5. **Function / Construction sketch:** Is the sketch informative and accurately drawn and labelled? Is the function explained in a comprehensible way? Do outsiders understand it? (5P)
6. **Materials & Methods:** How was the increase of the biomass measured? (1P)
7. **Results:** What are the results and how are they presented on the poster? (2P)
8. **Discussion:** Is a self-critical assessment of your system included? (2P)

Additional information

- To create the poster, use our PowerPoint template which will be available on our website next to the experimental task. **Feel free to adapt the whole layout** according to your taste but **do not change** the format (A0, **portrait** format). Save your poster as a **PDF file.**
  The size of the PDF file must not exceed **6 MB** (if you need to compress your file you can use online tools such as https://pdfcompressor.com/de/)

- Use **at least font size 24 for the main text**.
  You are free to choose the font, but it should be easily readable (e.g. Arial, Calibri).

- Name the PDF file strictly following these conventions.
  Please use underlines instead of spaces.
  ▶ Name of School
  ▶ Name of Class (same as on application form or on simplyscience.ch)
  ▶ Name of file (Poster)
  ▶ Date (year/month/day)

Here is an example: **Gymnasium_Muster_Class3b_Poster_20230331.pdf**

The Video Clip

What you have to do…

Make a short entertaining video clip (max. 2 minutes) which explains your growing system and all aspects you considered in the process of establishing it. How does your system work? What considerations led to entering the race with the chosen organism? What problems did you face, how did you react? Use time lapse technology to visualize your success.

During a discussion between members of your class (which might happen simultaneously or following the explanations), you should try to ask meaningful questions and to provide well thought-out answers leading to a deeper understanding of your growing system.

Consider the following questions

- What are the highlights of your system?
- Which considerations did you make to enhance and optimize the speed of gain in fresh weight?
- What difficulties did you have to overcome?

By asking meaningful questions and giving precise answers you will prove that you are able to critically review your growing system and maybe even suggest what could be done better.

For judging your video clip, we will take into consideration (10P):

1. **Content:** How well does the video clip explain the system in action in its full complexity? (2.5P)
2. **Questions and answers:** Are the questions and answers meaningful? Do they help to embed the growing system in a broader context? (2.5P)
3. **Technical aspects:** How sophisticated are the script, the camera work and the sound quality? Is there a time lapse sequence of your growing organisms? (2.5P)
4. **Entertainment value:** Is the video clip interesting, entertaining and engaging? (2.5P)

The filename extension should be .mp4 or .mov. If your original file has a different extension, you can use freeware such as VLC (http://www.videolan.org/vlc/) to convert your video.
The size of the video file must not exceed 500 MB and it must not be longer than 2 minutes.

Name the video file strictly following these conventions. **Please use underlines instead of spaces!**

▶ Name of School
▶ Name of Class (same as on application form or on simplyscience.ch)
▶ Name of file (VideoClip)
▶ Date (year/month/day)

Here is an example: **Gymnasium_Muster_Class3b_VideoClip_20230331.mp4**

Please note that your final growing system will be evaluated based only on the poster and the video clip. The construction itself will not be available to the evaluation team!

Scoring List*

Subtask	Judging criterion	Score (P)
Experimental Setup		**20**
1	**Efficiency** The inhouse biomass producing site should deliver a maximum of biomass in a given time (rate of growth). The result of your optimized efforts should be provided as: **delta fresh weight (g) / day (d)*volume (m^3)*Wh**.	**8**
2	**Creativity** How smart and creative have you been in finding the best way to fulfill the task? How big was your own contribution?	**5**
3	**Optimization Process** To what extent was the theoretical knowledge (literature, knowledge from professionals, internet searches) transferred into an optimized, functioning growing system? Which steps did you take into consideration to optimize your system? Could you statistically verify your success?	**7**
Poster		**20**
1	**Appearance** **Layout:** Readability, quality, labelling and numbering of the tables, graphics and pictures **Attractiveness:** Is the poster eye-catching? **Density of information:** Too much or not enough information may be an issue	**5**
2	**Content** **Theoretical background of the topic:** What is the main question? Is the complex theoretical background of the topic successfully explained? Is it correct? Is it obvious which aspect of the theory is illustrated by the growing system? Are the pros and cons of this cultivation technique described? Under which circumstances producing food in a controlled environment without direct sunlight could be beneficial for humanity? **Function / Construction sketch:** Is the sketch informative and accurately drawn and labelled? Is the function explained in a comprehensible way? Do outsiders understand it? **Materials & Methods:** How was the increase of the biomass measured? **Results:** What are the results and how are they presented on the poster? **Discussion:** Is a self-critical assessment of your system included?	**15**
Video clip		**10**
1	**Content** How well does the video clip explain the system in action in its full complexity?	**2.5**
2	**Questions and answers** Are the questions and answers meaningful? Do they help to embed the growing system in a broader context?	**2.5**
3	**Technical aspects** How sophisticated are the script, the camera work and the sound quality? Is there a time lapse sequence of your growing organisms?	**2.5**
4	**Entertainment value** Is the video clip interesting, entertaining and engaging?	**2.5**
Total		**50**

To submit

1. ProgressActivityJournal file: .pdf, max. 6 MB
2. Poster: .pdf, max. 6 MB
3. Video clip: .mp4 or .mov, max. 2 minutes, max. 500 MB

Tip:
If you need to compress your file you can use online tools such as https://pdfcompressor.com/de/.

Send all 3 files together
via **Wetransfer.com** or **Swisstransfer.com** to:

scienceonthemove@simplyscience.ch

Don't forget to add the name of your school and class
in the message field!

Closing Date of the experimental task:

Friday, 31.03.2023, 13:00

Questions?	E-Mail: **scienceonthemove@simplyscience.ch**	
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*The top 10 classes who will proceed to phase 2 will retain their score from this first, practical part: For their final rank, the score from phase 1 will count 50% and the live performance on stage (phase 2) another 50%.