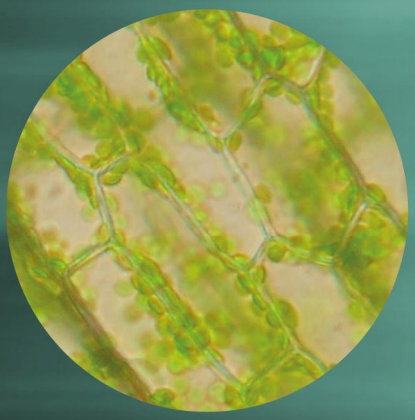
Science on the Move 2017

This year it is all about motion!



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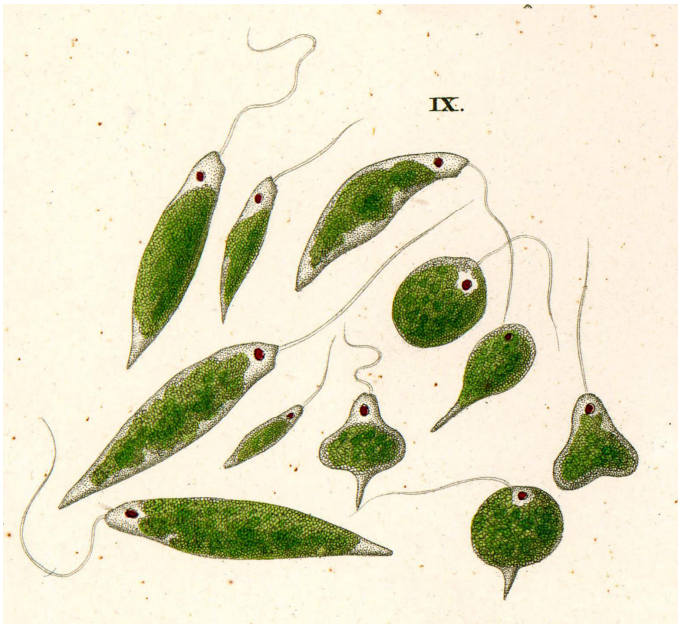
No Life without Motion



Portrait of *Euglena viridis*, from CG Ehrenberg, Die Infusionstierchen, 1838.

What is it all about?

Movements happen on all levels of organization like in proteins, organelles, cells, tissues, organs, organ systems, organisms, populations and in all domains like Archaea, Bacteria and Eukarya. All processes in a living organism happen in aqueous solutions. Biochemical processes may finally result in a movement of proteins that are again interacting with organelles. Unicellular organisms can use cilia or flagella to move, which allow cells to change their position. Invisible structures in plant cells drive chloroplasts forward. Muscles allow organisms to get food, expel residues, find a mate or avoid capture by a predator.

Some of these omnipresent movements are well known and we all see them every day. However, some of them take place very slowly and we cannot perceive them easily. If we notice that a plant orientated its leaves to the light, we can conclude that a movement happened. However, the low speed of the plant's movement prevents detection by eye. Other movements happen so quickly that we are unable to see in detail what causes the movement (e.g. flies starting and landing on a table or the movement of the wings of a hummingbird). Some movements are barely visible even using a microscope, such as the circulation of chloroplasts under light in a plant called *Elodea* or the quick movements of single cell organisms like *Euglena*. The growth of mycelia or cultures of bacteria on an agar plate happens very slowly, but can be detected by eye. Quite a lot of movements nevertheless stay undetected by us humans.

Movements can be passive or active; very often motion is initiated by a detector via a receptor. A plant for example must 'see' where the sun is in order to turn the leaves to a certain position. Sperms must detect a chemical gradient in order to enable fertilization. A cat has to 'feel' or measure how far she is from the house where she lives in order not to get lost. To investigate such kind of movements you would tag a cat to follow her trips and tours.

All manifestations of life are strictly related to any kind of movement – no life without motion!

The Task – Overview

You will investigate a type of movement in a biological system of your interest in order to understand it more in detail.

- What causes the movement?
- On which factors does it depend?
- What can you change in your experimental setup to get more information about the involved receptors?

The results of your research must be presented in three different ways. Each one is explained on the following pages.

1. **The Paper:** In a short paper you have to define the question you are interested in and describe and discuss the process of your investigation. Your paper should include the following components: introduction, design of the experiment, progress report, data collection / processing / presenting, and conclusion / discussion / evaluation.

2. **The Poster:** On a poster (DIN A0) you have to present your results with the processed data, tables, graphics and pictures. (Note: In case you reach a place among the top 10 classes, this poster will also be evaluated by a jury of scientists from academia and industry and will support the discussion with the jury members during the poster session at the final presentation).

3. **The Movie:** A short movie (max. 1 minute) helps to explain the main outcome of your investigation and shall attract interested people to go further into detail by studying your paper. To achieve these objectives you may use different techniques like slow-motion or time lapse movies. This movie will also be evaluated by the other classes (student voting).

Please read all instructions until the very end! It is crucial for you to know what will be judged and how many points you may get for each subtask! See page 13.

The Paper

1. Introduction

Search for information about movements in nature in general. Try to find out secret, hidden movements, movements that are not evident. **The goal is to trigger astonishment and amazement by uncovering unexpected movements.**
Before you go into detail, write a short introduction. Explain why movements are of central importance for all living systems. Keep in mind that you are ultimately interested in amazing the spectators by describing and explaining an unexpected movement that most of the audience never thought or knew about. The text should show how seriously you looked into this subject.
Please note that the text must **be between half and one DIN A4 page long**. The best rated article is not necessarily the longest one!

An important aspect in the introduction will be the citation of your sources and the compilation of a bibliography (reference list).
Please read carefully the following instructions on how to cite and use the examples as a model for your own list.

„In-text" citations: Numerical markers
To let the reader know where you have used a piece of information in your work, please use the numerical marker. Here is an example:
"Monkeys(1) prefer ripe bananas to unripe bananas(2). This is due to the extra sugars present in ripe bananas(3), and scientists think that monkeys may have a similar range of tastes to humans."

Bibliography (reference list)
Supply complete details of the source you have used – so that the reader could easily find it to check it or to learn more. You must list your sources in the order in which they appear in your paper. The very first source you cite in your text is listed in position 1 in your bibliography, the second in position 2 and so on. If you use a source again later on, cite it in the text with the same number as the first time you used it. You don't need to write the same source twice in your bibliography. Here an example referring to the "in-text" citations above:

1) Monkey; http://en.wikipedia.org/wiki/Monkey, retrieved March 7, 2015
2) Taylor, S. 2006. *Monkey Nutrition Handbook*. 2nd edition. pp 198-199. Primate Press, Bandung.
3) Triandafillou, A. 2011. *Livestrong* – Article: "Nutritional difference in ripe bananas". Retrieved February 22, 2013 from www.livestrong.com.

2. Design of your experiment

The main goal of your research is to find out more about the motion / movements you are investigating.
An experimental design is not limited to describing an experiment by words, but includes sketches and tables.

Aspect 1: Defining the problem and selecting variables

Based on the knowledge of the background information you acquired, you should now identify a specific research question. You may use this question as the title of your poster.

Define and write down the following three types of **variables** (we would like to see them!). Variables are factors that can be measured and controlled.
Independent variables are those that are manipulated, and the result of this manipulation leads to the measurement of the dependent variable.
A controlled variable is one that should be held constant so as not to obscure the effects of the independent variable on the dependent variable.

Example of a specific scientific research question: Imagine you'd like to measure how high a soccer ball bounces back after being dropped down from different heights. The independent variable is the height you let the soccer ball drop down; the dependent variable is the height the soccer ball will bounce back. Relevant controlled variables would include pressure of the soccer ball, the meteorological conditions, the property and texture of the ground surface**.**

Aspect 2: Materials & Methods

Describe carefully how the experiment was performed. Another person should be able to repeat your experiment using your descriptions.

Take **two** meaningful pictures. These pictures, supported by sketches, should help the reader of your paper to understand the setup of your experiment.

Aspect 3: Reasonable data collection

The planned investigation should provide sufficient data so that the research question can be suitably addressed and an evaluation of the reliability of the data can be made.

Be sure to collect enough data in part 4 to enable an error analysis that involves the calculation of a **mean value** and a **standard deviation**.

3. Progress Report on the initial phase

You will get points for describing and explaining precisely **what happened between your team's initial idea and the well-defined main experiments** you carried out. Without being forced to carry out a set of pretests make sure that your idea is realizable.

Track your discussions and first observations as you go along.

For us it is crucial to ***understand the process*** you went through during this part of the task.

Is there a strategy that was finally helpful and successful leading to an interesting experiment or have decisions been made rather randomly? What did you take into consideration? Asking an expert? Checking different books in your school library?

Take your time to share your ideas with your biology teacher. Your teacher may support you in establishing an interesting research question for your investigations. As soon as you have decided on what to investigate, your teacher is not allowed to support you anymore.
During the following investigations you are allowed to contact other persons that could be supportive in any kind of process. **We want you to learn to network, to organize yourself in your class and to communicate with experts from outside your school.**

Research cycle
Always keep in mind that the ideal approach of any scientific investigation involves the same steps. To be honest, in reality things develop rather unpredictably. Nevertheless, try to follow the rules!

4. Data collection, processing and presenting

Until now, you have collected a lot of information about movements, decided on an exciting research question and designed the experiment(s) you are going to conduct. Now it is time to actually perform your challenging experiment and test your hypothesis. You may feel what it means to be a scientist ☺.
It is absolutely crucial to collect enough and reliable data!

Aspect 1: Recording raw data

Raw data are the actual data measured and the video clips recorded during the experiment. Video clips can document the experiment or be themselves a source for collecting raw data.

Aspect 2: Processing raw data

Data processing involves combining and manipulating raw data to determine the value of a physical quantity (such as adding, subtracting, squaring, dividing), or taking the average of several measurements and transforming data into a form suitable for graphical representation. It might be that the data are already in a form suitable for graphical presentation. If the raw data are represented in this way and a best-fit line graph is drawn, the raw data have been processed. Plotting raw data (without a graph line) does not constitute data processing.
In this particular task editing and assembling different movie-elements (clips) may play a major role.

Aspect 3: Presenting processed data

You are expected to decide upon a suitable presentation format yourself (for example spreadsheet, table, graph, chart, flow diagram and of course a short movie). **Calculations, tables or graphs should be clearly labeled. Graphs need to have appropriate scales, labeled axes with units, and accurately plotted data-points with a suitable best-fit line or curve (not a scatter graph with data-point to data-point connecting lines).** You should present the data in a way that all the steps to the final result can be followed. The way you present your data is not only a matter of design. It should be meaningful and prove that you didn't choose the type of diagram by chance.

You should include a treatment of uncertainties and errors with your processed data, wherever relevant.

5. Conclusion, discussion and evaluation

You have now acquired your data. How to proceed? It is up to you to find an interpretation. Although your results may seemingly fit your hypothesis, be prudent in concluding and try to reconsider premature deductions. Nevertheless – this part may be very satisfactory ☺.

Aspect 1: Conclusion & Discussion

First of all, neutrally describe the results without any interpretation. What do you see? This may include comparisons of different graphs or descriptions of trends shown in graphs. The explanations should contain observations, trends or patterns revealed by the data.

As a second step, an interpretation of the results follows. Think about possible explanations of your results. You may even take the literature into consideration.

Aspect 2: Evaluation

The design and method of the investigation must be analyzed as well as the quality of the data. You must not only list the weaknesses but must also appreciate how significant the weaknesses are. Comments about the precision and accuracy of the measurements are relevant here. When evaluating the applied procedure, you should especially look at the processes, use of equipment and time management.

Aspect 3: Improving the investigation

Suggestions for improvements that could be made in a future experiment should be based on the weaknesses and limitations identified in aspect 2. Modifications to the experimental techniques and the data range can be addressed here. The modifications proposed should be realistic and clearly specified. It is not sufficient to state generally that more precise equipment should be used.

Expected documentation and further information

Activity List

Each class needs to report which member was or is responsible for which portion or aspect of the work. Each person in the class must have participated at least once during the experimental task (no matter what kind of work she/he did).
Take **two pictures** showing the class involvement. Place them next to the activity list. The activity list is part of the paper.

Content of the paper

- Create **one single** PDF file. The size of the PDF file must not exceed **6 MB** containing all your answers, solutions, pictures, other documenting material and the activity list. Use page numbers and use a new page at the beginning of each part:

Front page:	Name of school, name of class and number of task
Page 1:	Table of Contents
Page 2:	Introduction
Page 3-4:	Design of your experiment
Page 5:	Progress report
Page 6-8:	Data collection, processing and presenting
Page 9:	Conclusion, discussion and evaluation
Page 10:	Reference list (List your most important references according to the guidelines explained in “Introduction”)
Page 11:	Activity list including two pictures showing the class involvement

- Use font size 11.
  You are free to choose the font, but it should be easily readable.

- Name the file following strictly these conventions:
  - Name of School
  - Name of Class (same as on application form or on simplyscience.ch)
  - Name of file (Paper)
  - Date (year/month/day)

  → Please use underlines instead of spaces!

Here is an example: **Gymnasium_Muster_Class3b_Paper_20170408.pdf**

The Poster

What you have to do…

The paper you write should contain all relevant data, whereas the poster should help to convey and explain your intentions, your findings (results) as well as your interpretation of the data in a more compact way.
The poster should be attractive and serve as a basis for discussion with people interested in your project.

For judging your poster, the following aspects will be taken into consideration:

1. **Layout (Readability, quality of the tables, graphics and pictures) 2P**
2. **Eye-catcher (Is the poster attractive?) 1P**
3. **Density of information (to much or not enough information may be an issue…) 1P**
4. **Correctness (are there mistakes in form and content?) 1P**

Some 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) and the font size for the main text. Save your poster as a **PDF file.**
  The size of the PDF file must not exceed **6 MB**.

- Your poster should include:
  - Title, name of school, name of class
  - Results (Text, Tables, Graphs, Pictures)
  - Discussion

- 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:

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

  → **Please use underlines instead of spaces!**

  Here is an example:
  Gymnasium_Muster_Class3b_Poster_20170408.pdf

The Movie

What you have to do…

We all like movies. Our eyes and our brain deal with moving elements all day long. Investigating movements is strongly connected with making them visible by taking videos.
These days it has become easy to make a time lapse or a slow-motion film. **The intention of this part of the contest is to fascinate the audience, the viewers.**
The movie is more than a documentation of a process. Especially by slow-motion and time lapse sequences, processes which are normally not detectable by the naked eye become visible.
The final film sequence you produce should not be longer than **one** minute. Don't forget that the jury consists of scientists working at universities and in the industry. Rather than funny effects they prefer to see meaningful, fascinating insights.

For judging your film we (and you!) will take into consideration:

1. **Attractiveness and arrangements of the sequences, expressiveness and significance of the movie (8P)**
2. **Technical skills used to produce the film (2P)**

The filename extension should be .mp4. If your original file has a different extension, you can use freeware such as VLC (http://www.videolan.org/vlc/) to convert your video.

Name the movie file strictly following these conventions:

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

→ **Please use underlines instead of spaces!**

Here is an example:
Gymnasium_Muster_Class3b_Movie_20170408.mp4

Scoring List

Part	Subject	Score (P)
1	**Introduction:** Searching the literature, background information (For your short text and the correct references to the literature you can get 4P of the total score).	4
2	**Design:** (If you fulfill all 3 aspects perfectly you can get up to 4P of the total score).	4
3	**Progress Report:** Describing the complex process from a bunch of ideas to one promising experiment (Provide us with information about the process that finally led to your investigations. What was your strategy, where did you struggle, how did you organize yourself? You can get up to 4P of the total score).	4
4	**Data collection, processing and presenting:** (If you fulfill all 3 aspects perfectly you can get up to 4P of the total score).	4
5	**Conclusion, discussion and evaluation:** (If you fulfill all 3 aspects perfectly you can get up to 4P of the total score).	4
Poster	**Quality of your poster:** The following aspects are crucial for judging the quality of a poster: **Layout** (Readability, quality of the tables, graphics and pictures); **Eye-catcher** (Is the poster attractive?); **Density of information** (too much or not enough information may be an issue…); **Correctness** (are there mistakes?) (If you consider these aspects and if all pictures and tables are labeled and numbered correctly and the quality of your pictures, charts and diagrams is convincing, you will get up to 5P of the total score).	5
Movie	**Attractiveness** and **arrangements** of the sequences, **expressiveness** and **significance** of the movie. **Technical skills** used to produce the film (If you fulfill these aspects, you will get up to 10P of the total score)	10
Total		**35**

Who will be judging what with how many points?

	Paper	Poster	Movie	Final Presentation-Top 10 classes
SimplyScience	20P	5P	10P	
Students			10P	
Jury		5P		30P
weighting factor	*2/8*	*1/8*	*2/8*	*3/8*

To submit

- Paper: .pdf, max. 6 MB
- Poster: .pdf, max. 6 MB
- Film: .mp4, max. 1 minute, max. 50 MB

Send all three files together
via **WeTransfer** (https://wetransfer.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:

Thursday, 13.4.2017, 23.59h

Please note that on this date the helpline will be available only until 14.00h!