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Science on the Move
SimplyScience School Class Competition

PROJECT SUMMARY

Introduction

Modern biology is developing at a breathtaking pace.
SimplyScience, the website for natural sciences and technology, is therefore launching a national school class competition, "Science on the Move".

All competition activities will be in **English** - the language in which scientists communicate and publish around the globe.

Objective

This competition by SimplyScience provides an entire public school class at Secondary Level (Gymnasium) the opportunity to demonstrate their interest and commitment in the field of biology as a team and to pit themselves against other classes in Switzerland. The 1st prize to be won is a day in Basel and a fascinating science week for the entire class in California.

Target audience

School classes at Secondary Level (Gymnasium). Teachers are permitted to provide logistic support to their students. Assistance by teachers in solving the tasks is not permitted.

Structure

Phase 1: Challenge - Over the course of nine weeks, a total of 3 different scientific experiments will be issued; one every three weeks. Each one will include a practical segment. Usually, the pupils' own hypotheses are examined by means of tasks they perform by themselves, the results of which are then discussed. Their results and input are returned by email.

Phase 2: Final - Each of the top 10 ranked classes will be given 5 minutes for a live presentation.

The objective of the presentation will be to convey and link their own experiences during the first part of the competition as imaginatively and convincingly as possible on the subject of "Science on the Move".
A jury consisting of established experts from science, industry and teaching will judge the Final presentation and select the winners.

Timeline

Competition invitation posted at www.simplyscience.ch November 18, 2010

Application deadline:	January 14, 2011
Selection of participating classes	January 17 – 21, 2011
Publication Experiments 1-3:	February 28 – April 11, 2011
Announcement of the top 10 classes	May 16, 2011
Final presentation and selection of winners	June 10, 2011
Trip to California (pupils + 1 teacher)	September 17 -24, 2011

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Additional Terms & Conditions

Eligible for the competition are Swiss residents. Application to the competition is only possible together with fellow students as whole class. Only classes enrolled in the 10th or 11th schoolyear at a swiss public school are eligible for the competition. Employees of SimplyScience, members of the jury or the project team, as well as their relatives, are not eligible for the competition. If a non-eligible person is affiliated with an applicant school, this will lead to the non-eligibility of the whole school.

Any recourse to courts of law is excluded.

There will be no correspondence concerning the competition. Winning classes will be informed directly by SimplyScience.

The exchange of prizes for cash or any other prize is not possible.

SimplyScience is allowed to publish the names and pictures of all participating classes in print media or on the internet.

By applying for this competition, each applying person agrees to the terms and conditions stated above.

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PROJECT DESCRIPTION

Introduction

SimplyScience proudly introduces a special nation-wide science competition intended for school classes at Secondary Level (Gymnasium). The project, intended to inspire interest in life sciences for a broad spectrum of pupils is noteworthy for its extraordinary top prize for the winning class to spend a science day in Basel and one week in California, with their teacher. The concept and content for this competition have been developed by a special project team as part of SimplyScience.

SimplyScience is an internet platform www.simplyscience.ch. It offers a lot of interesting and astounding information on natural sciences and consolidates a range of other commitments to motivate young people for science and technology.

Objective

The objective of this competition is to identify the class with the greatest dedication and greatest commitment in the subjects of Biology / Science (e.g. basic science subject Biology, special subject Biology-Chemistry, complementary option Biology etc.) through a two phase competition.

In the first, practical phase, the goal is to conduct classical biological **experiments** and to discuss the results**.** In contrast, the second phase of the competition calls for different capabilities. In a brief five-minute live **presentation**, the top 10 classes will illustrate the experiences they had while conducting the experiments. What highs and lows did they go through? What made them satisfied or glad? What stressed or baffled them? How did they experience teamwork while experimenting? How did they organize themselves? How did their parents, their teachers and the school administration react to their activities? How were they able to motivate the whole class? How can they correlate these experiences with the title of the competition "Science on the Move"?

Target audience

For once, this is not a competition that seeks individual pupils with distinct strengths in natural sciences (for example: the Science Olympics)**.** Instead the **entire class shall compete**. Good organisation, clever division of tasks, strong communication in the group and mutual support are all indispensable aspects in order to do well in this competition. People with different strengths should be able to contribute. Apart from performing the experiments, other skills such as preparing layouts, translating, and doing research, for example, are also expected.

This competition is intended for public school classes at Secondary Level (Gymnasium) in all regions of Switzerland. All competition activities will be in **English** - the language in which scientists communicate and publish around the globe.

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Teacher Involvement Participants in this competition are exclusively pupils in the participating classes but not their teachers. Teachers can, of course, provide logistical support to their classes; this is even desirable, especially for Phase 2. It is, however, explicitly forbidden for teachers *themselves* to get involved in solving the experiments in Phase 1. In order to enforce this requirement of the competition, a signed statement by the respective teacher and the class team leader must be submitted. Their signatures will confirm that they will comply with these rules.

With the number of participating classes limited to 40, the goal is also to have classes from all linguistic regions of Switzerland participate.

Organization Each class will select its **team leader** from among the pupils and a substitute. These individuals will be the contacts for the "Science on the Move" organizers. Contact information for the attending teachers is also requested in order to offer assistance in case of any competition questions or problems (see registration form attached).

Phase 1: *Challenge* In the first phase, three different experiments will be issued for the participating classes; one experiment assignment will be published every three weeks on www.simplyscience.ch beginning in February 2011.

Each of the three experiments contains **5 questions or tasks** to be solved or answered. Based on this particular section, multiple hypotheses should be considered, examined and discussed, and smaller problems must also be solved. The expected scope of the solutions will be provided for each experiment. In general, short answers are preferred rather than lengthy essays. The solutions and documenting material must be mailed as a single PDF according to a time schedule of *3 weeks for eligibility*.

Please note, there is an assumption that each school can take photographs through the microscope. It is advised that teachers support the pupils, as required, in handling these instruments.

On the designated form (**Activity List**) each class needs to report which member was or is responsible for which portion or aspect of the work. Each pupil should be assigned a number on the table provided. Each person in the class must have participated at least *once* (during the entire competition) in the experimental portion.

The PDF of the solutions and documentations should include:
- Responses to the 5 tasks
- Activity List
- Photo documentation (10 digital photos showing the full class involvement)

Phase 1 Scoring All eligible submissions received on time will be reviewed and scored quickly by the Project Team. It is the Project Team's task to determine the top 10 classes.
A maximum of 10 points is awarded for each experiment. Each question/task (1-5) is rated with a maximum of 2 points each.

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All participating classes will be **notified on 16th May** whether they are among the **10 top-rated.** At this point, the best ten classes will be expected to compete again in the final (second) round, in order to achieve the maximum number of points needed to win.

Phase 2: *Final*

Only the 10 top-rated classes will proceed to the second part of the competition which is organized very differently. For this, the individual classes will each have **5 minutes** assigned for presentation on **10th June 2011**. How this time is used is up to the individual class. The objective is for pupils to link their experiences during the first phase of the competition as imaginatively and convincingly as possible with the subject of the competition "Science on the Move".

Teams will be encouraged to be creative!
Music, literature, poetry slam, a discussion theatre, show, or straight forward presentation… anything goes. However, personal delivery is required. Homemade videos are welcome, but may only be a *part* of the presentation. It is up to the class to determine how many people from their class will participate on stage during Phase 2. The presentations will be judged by a specially assembled **expert jury** consisting of **5 people representing science, industry and teaching**. They will judge the presentations according to the aspects outlined below.

Phase 2 criteria

Content, relevance to the issue (Is the presentation directly connected with the issue? Are the aspects addressed relevant?)

Creativity, depth, level (Did the presentation engage? Is it ingenious? Is it thoughtful? Was it thought-provoking?)

Persuasive power, enthusiasm, dedication (How convincing was the presentation? How much passion and dedication is exhibited? How strong a will to win this competition **as a team** is apparent?)

Prizes

The first prize is a science day in Basel and a week**-long trip to the Bay Area, California** with a varied and exciting program reflecting the subject of **science**. The winning class will visit state-of-the-art businesses and colleges, famous science museums and of course get to see the city of San Francisco. Each day, the class will write a brief **blog** to be published via **SimplyScience.ch**.

2nd to 10th prizes are also attractive. Classes winning second and third place will enjoy a one-day visit for the entire class to Roche in Basel. Further, all pupils in 2nd through 10th ranked classes will win an attractive iPod device as well as their teacher and classroom entitled to receive the well-known Genetics Education Experimental suitcase and enrol in the complementary Teacher Workshop.
All participants in the final phase will also receive a certificate to affirm their participation in "Science on the Move".

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Reminder

All participants entering this competition should recognize that it presents a certain amount of additional effort, on top of everyday school work. However, this experience is primarily intended to enrich learning and be fun! **A hotline is available for support in case of ambiguities or questions.**

We are looking forward to an interesting encounter with pupils and hope they have success in answering the questions.

Timeline

Competition invitation posted on SimplyScience	November 18, 2010
Application deadline	January 14, 2011
Phase 1 - Challenge	
Publication Experiment 1:	Feb 28, 2011
Publication Experiment 2:	March 21, 2011
Publication Experiment 3:	April 11, 2011
Closing date (submission of experiment 3 results):	April 29, 2011
Selection of the top 10 classes	May 13, 2011
Phase 2 - Final	
Announcement of the top 10 classes	May 16, 2011
Final presentation and winner selection	June 10, 2011
Publication of winners (web and e-mail)	June 13, 2011
Trip to California	Sept 17-24, 2011

Questions?

If you have any questions, please contact:

Hotline SimplyScience:
Tel: +41 44 368 17 46 (Mo-FR 9 am - 5 pm)
Mail: scienceonthemove@simplyscience.ch

Thomas Flüeler

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There will be no correspondence concerning the competition. Winning classes will be informed directly by SimplyScience.

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SimplyScience is allowed to publish the names and pictures of all participating classes in print media or on the internet.

By applying for this competition, each applying person agrees to the terms and conditions stated above.

PARTICIPANTS

33 classes from all over Switzerland are participating in the class competition "Science on the Move".

Good luck and have fun!!!

Here are pictures and some information about these classes...

> 01 Academia Engiadina Samedan - Class 4G2
> 02 Alte Kantonsschule Aarau - Class G1D
> 03 Gymnasium Bäumlihof Basel - Class 4c
> 04 Gymnasium Burgdorf - Class Sekunda c
> 05 Gymnasium Burgdorf - Class Sekunda d
> 06 Gymnasium Interlaken/Gstaad - Class Sekunda s
> 07 Gymnasium Kirchenfeld Bern - Class M2012c
> 08 Gymnasium Kirschgarten Basel - Class 4D
> 09 Gymnasium Laufental-Thierstein - Class 2B
> 10 Gymnasium Leonhard - Class 3b
> 11 Gymnasium Liestal - Class 2B
> 12 Gymnasium Münchenstein - Class BE-1-EarlyBirds
> 13 Gymnasium Münchenstein - Class Last Minute to San Francisco - WAMS
> 14 Gymnasium Oberwil BL - Class 1E
> 15 Kantonsschule am Burggraben - Class 3dNP
> 16 Kantonsschule Chur - Class 5Gabcdfghm
> 17 Kantonsschule im Lee Winterthur - Class 3h
> 18 Kantonsschule Rychenberg Winterthur - Class EF Bio
> 19 Kantonsschule Solothurn - Class L09c
> 20 Kantonsschule Solothurn - Class N09b
> 21 Kantonsschule Sursee - Class 5a
> 22 Kantonsschule Wohlen - Class 2E
> 23 Lycée Jean-Piaget Neuchâtel - Class 2M11
> 24 Lycée-Collège de l'Abbaye de St.-Maurice - Class 2E sci
> 25 Lycée-Collège des Creusets Sion - Class 3B
> 26 Neue Kantonsschule Aarau - Class G1B
> 27 Neue Kantonsschule Aarau - Class G1D
> 28 Neue Kantonsschule Aarau - Class G1E
> 29 Neue Kantonsschule Aarau - Class G1F
> 30 Neue Kantonsschule Aarau - Class G2B
> 31 Neue Kantonsschule Aarau - Class G3E
> 32 Seeland Gymnasium Biel - Class 13d
> 33 Seeland Gymnasium Biel - Class Sekunda d

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Science on the Move - Laborwettbewerb mit 33 Gymnasialklassen

Bild: SimplyScience

Wie extrahiert man DNA aus Tomaten? Mit dieser spannenden Frage setzen sich seit Anfang März schweizweit gegen 600 Schülerinnen und Schüler aus 33 Gymnasialklassen auseinander. Zwei weitere Laborexperimente folgen im April und Mai. Lehrpersonen dürfen coachen – mehr nicht! Tolle Preise winken den zehn besten Klassen.

Der Wettbewerb "Science on the Move" motiviert 16- bis 18-jährige Gymnasiastinnen und Gymnasiasten als Team im Klassenverband naturwissenschaftliche Experimente durchzuführen und auszuwerten. Die zehn besten Klassen werden im Juni nach Basel zu einer Schlusspräsentation eingeladen. Dabei erhalten die Jungforscherinnen und Jungforscher die einmalige Gelegenheit, ihren gemachten Erfahrungen in einer selber inszenierten Kurzpräsentation Ausdruck zu verleihen. Eine hochdotierte Jury wird die Darbietungen beurteilen, und zwar sowohl ihren Inhalt als auch das mit der Präsentation zum Ausdruck gebrachte Bekenntnis für Naturwissenschaft und Technik.

"Ich habe meine Klasse noch nie mit soviel Elan in der Biologie gesehen"

Der Wettbewerb ist Anfang März erfolgreich angelaufen. Die Schülerinnen und Schüler schätzen die Arbeit im Team und haben Spass an den Experimenten. Gemäss Wettbewerbsbedingungen dürfen Lehrpersonen den Lernenden keine direkte Hilfe anbieten – die Experimente und deren Auswertung müssen von den Lernenden selbständig durchgeführt werden. Dabei sind Fähigkeiten aller Klassenmitglieder gefragt und werden sinnvollerweise eingebunden. Kaspar Schwarzenbach (Lehrer an der Kantonsschule Oberwil BL): "Ich habe die Klasse noch nie mit soviel Elan in der Biologie gesehen – und selber noch nie so wenig zu tun gehabt während eines Praktikums ...".

Tolle Preise winken den besten Klassen: die Schülerinnen und Schüler der 10 besten Klassen erhalten ein kleines Gerät aus dem Hause Apple und dürfen bei Roche einen Science Tag verbringen. Für die Siegerklasse organisiert die SimplyScience Stiftung mit Unterstützung der Firma Roche eine „Scienceweek“ in San Francisco, Kalifornien.

Breite Nachwuchsförderung

Der Laborwettbewerb "Science on the Move" verfolgt die Idee einer breiten Nachwuchsförderung in Naturwissenschaft und Technik. Im Fokus stehen Aktivitäten, welche die Begeisterung junger Leute für diese Themen wecken und sie dazu motivieren, sich aktiv mit naturwissenschaftlich-technischen Fragen auseinanderzusetzen. Interessierte und wissbegierige Jugendliche eignen sich dadurch die besten Voraussetzungen an, später einmal zu innovativen Berufsleuten in naturwissenschaftlichen Bereichen zu werden, auf welche die chemisch-pharmazeutische Industrie als bedeutendste Exportbranche der Schweiz dringend angewiesen ist

Über die SimplyScience Stiftung

Die Organisatoren des Laborwettbewerbs „Science on the Move“ betreiben die Online-Plattform www.simplycience.ch. Die SimplyScience Stiftung richtet sich an Schweizer Jugendliche zwischen 12 und 18 Jahren. Texte, Bilder, Videos, Experimente und Wettbewerbe bringen naturwissenschaftlich-technische Themen auf verständliche Weise in einen Bezug zum Alltag.

Ziel der SimplyScience Stiftung ist, die Motivation und das Verständnis von Jugendlichen für naturwissenschaftlich-technische Fragen zu fördern und sie dabei für Ausbildungs- und Laufbahnmöglichkeiten in Wissenschaft und Wirtschaft zu begeistern. Ansprechend aufbereitete Informationen sollen auch in der breiten Bevölkerung zu einer erhöhten Akzeptanz von Wissenschaft und Technik führen.

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1. DNA Extraction from a tomato

Fig. 1: Tomato

Introduction:

As you know all living organisms consist of cells. In almost every cell information is stored as DNA. Scientists routinely investigate and manipulate DNA in their laboratories. For many years it was unclear if a person's heritage was due to DNA or proteins.

Goal:

In this experiment you will isolate the DNA from a piece of tomato to see what DNA actually looks like. It will also give you an idea of the amount of DNA you eat and of some of its physical properties. The procedure is very simple and does not require any special chemicals or highly sophisticated machines. All you need you can find around the house.

Task 1: Please open the file "Protocol_DNA_Extraction_from_a_tomato.pdf" and follow the protocol carefully. You'll find this protocol on the website just next to this file.

Expected answer: Take a picture of each important step during the experiment. Make sure that you take a picture of the DNA you extracted. Chose 3 pictures (including the picture of the extracted DNA) and describe each of them carefully in your documentation.

Task 2: For the best results, use freezing cold alcohol (-20°C).
Explain why this is true.
Expected answer: 1-3 sentences.

Task 3: A skeptical person could argue that you extracted protein instead of DNA. How would you proceed
a) to prove that your extract contains DNA?
b) to test that proteins are present in your DNA extract as a contaminant?
Expected answer: 2-4 sentences each for task 3a and 3b.

Task 4: One of the first genetically manipulated fruits was a tomato called *'Flavr savr'*. What was the intention of the scientists who developed this special tomato? Find the answer by searching the web.
Expected answer: 3-5 sentences.

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Task 5: You buy a tomato in a supermarket in Switzerland today. How can you know if this fruit is genetically modified?
Expected answer: 2-3 sentences

List the references used according to the guidelines of SCHWEIZER JUGEND FORSCHT, http://www.sjf.ch.

Do not forget to add the activity list to your documentation! 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 entire competition) in the experimental portion.
Therefore, **take 3 digital photos per experiment showing the class involvement.** Place them next to the activity list in your documentation file.

Expected documentation and further information

- Create **a single** PDF file containing all your solutions, pictures, other documenting material and the activity list and name it, following strictly these conventions:

  1. Number of class
     (find your class number in "Participant" where all the participating classes are presented).
  2. Name of School
  3. Name of class (same as on application form)
  4. Number of experiment
  5. Date (year/month/day)

  → Please use underlines instead of spaces!
  Here is an example: **08_Kantonsschule_Muster_3b_Experiment1_20110222.pdf**

  → The size of the PDF file must not exceed 3 MB (6 pictures: about 400-500 KB per picture)!

- Scores

  A maximum of 10 points is awarded for each experiment. Each question/task (1-5) is rated with a maximum of 2 points.
  If the **references** are listed correctly (according to the guidelines of SCHWEIZER JUGEND FORSCHT) and the **layout** of the whole PDF file is satisfactory, there won't be a penalty on scores. If one of these two aspects is not solved sufficiently, you will receive one point less (for each aspect).

  Example: If you solve the task 1-5 satisfactory (10 points), the layout is good, but the references are not listed correctly, you will only receive 9 points in the end (for one experiment).

Closing date of experiment 1:	**28.03.2011, 18:00**

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Protocol: DNA extraction from a tomato

"It's all about DNA!" This is the answer to the question why a tomato is a tomato. In the TV series CSI, criminals got caught due to the identification of their DNA. DNA is the genetic material which is present in the nucleus of all our cells. But how do we isolate the DNA from the nucleus? An experiment with a tomato shows: there is nothing easier than that!

Material

- Tomatoes
- Table salt
- Lemon juice, filtrated
- Washing-up liquid (colorless)
- Kitchen knife
- Mortar
- Coffee filter
- Alcohol (ethanol, 96%, **-20°C**)
- Test tube with cork plug
- Toothpick

Performance

1. Cut half of a tomato into small pieces with the kitchen knife. Put them into the mortar.

2. Prepare an extraction buffer:
   - 0.5 g table salt
   - 25 ml filtrated lemon juice
   - 5 ml washing-up liquid (colorless)
   - 20 ml water

3. Pour the extraction buffer into the mortar and mash the tomato pieces thoroughly for about a minute .

4. Take the content of the mortar and let it drop through the coffee filter into a clean glass.

5. Take 1.5 ml of the filtrated liquid and pour it into a test tube.

6. Add 1.5 ml water and cover gently with a layer of 6 ml **freezing cold** alcohol (**-20°C**, ethanol 96 %).

7. Hold the test tube quiet for a short time. Alcohol is less dense than water, so it floats on top of the water layer.

8. The DNA is now visible as a „white ball" between ethanol and water. Look for clumps of white stringy stuff where the water and alcohol layers meet. If you want, you can try to grab the DNA ball with the toothpick and take it out of the test tube.

Proper disposal of waste: the reagents do not require special disposal.

Competition 'Science on the Move'
Class 4c of the Gymnasium Bäumlihof, Basel

Experiment 1: DNA Extraction from a tomato

Task 1: How can I extract the DNA of a tomato (experiment)?

1.1 Materials:

- Tomatoes
- Table salt
- Lemon juice, filtrated
- Washing-up liquid (colorless)
- Kitchen knife
- Mortar
- Coffee filter
- Alcohol (ethanol, 96%, -20°C)
- Test tube
- Eppendorf tube
- Crochet hook

1.2 Goal:

The goal of the experiment is to isolate the DNA of a tomato.

1.3 Methods:

First, we cut half of a tomato into little pieces with the kitchen knife and mash them with a mortar. Then, we prepare the extraction buffer by mixing 0.5g table salt, 25ml filtrated lemon juice, 5ml washing-up liquid with 20ml distilled water. The mixture has to be put into the mortar and then tomato pieces have to be mashed with the buffer. On figure 1 you can see all the material being used for the preparation of the extraction buffer, a person mixing the extraction buffer and another person mashing the tomato pieces with a mortar.

Fig.1: Materials used for the DNA-extraction

After those steps, we filter the tomato-buffer-mixture through a coffee filter until we have enough of the filtrated liquid to put 1.5ml into a test tube. Now, we are adding 1.5 ml distilled water and covering it with 6ml ethanol (-20°C, 96%). You can see Seraina on figure 2 pipetting 6 ml ethanol gently into the test tube.

Fig.2: Seraina pipetting ethanol

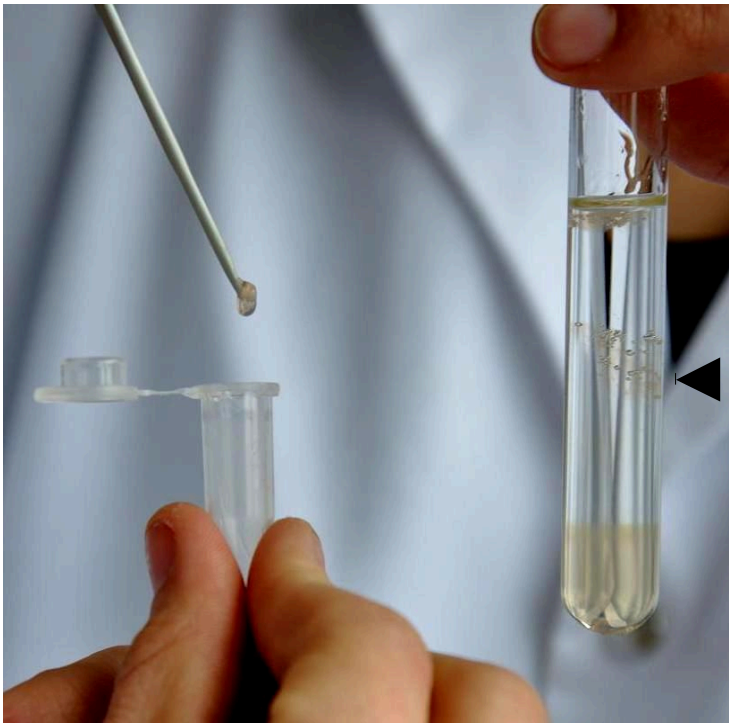

Fig.3: The extracted DNA being transferred with a crochet hook into an Eppendorf tube. Arrowhead points to DNA floating in the ethanol phase.

Ethanol floats on the top of the water layer because it is less dens than water.
After waiting and shaking gently, we see the DNA as a “white ball” between the extract and ethanol phases. We look for clumps of white stringy stuff where the water and alcohol layers meet. This is the DNA!
On figure 3 you see Adélaïde who grabs the DNA with a crochet hook to transfer it into an Eppendorf tube. The arrowhead shows a rest of DNA in the test tube floating in the ethanol phase. This rest comes into existence because it is difficult to grab the whole DNA at once (1).

Task 2: Why is it best to use freezing cold alcohol?

It is best to use ice cold alcohol because the salt in the extraction process destroys parts of the hydration shell and the freezing cold alcohol destroys the remaining parts of the hydration shell and hence the DNA precipitates (2).

In addition, the coldness of ethanol helps to prevent the possibility of the breaking apart of the DNA, because it strongly slows down DNA digestive enzymes (DNAses) (3, 4).

However, the temperature of the alcohol is subordinate because even if cold temperatures help to precipitate more DNA out of a highly diluted DNA-solution, more salt is precipitating out as well. DNA could as well be precipitated with ethanol or isopropanol at room temperature, but at lower efficiency (5).

Task 3:

a) How can I prove that the extract contains DNA?

I can prove the presence of DNA in my extract with agarose gel electrophoresis, after the digestion with restriction enzymes (e.g. *Eco*RI) and agarose gel electrophoresis you can see a smear on the gel under UV-light instead of a discrete band. The smear is because millions of DNA-fragments of different lengths were produced and this would prove the isolation of DNA (6).

Another method to prove that it is DNA is the UV-spectroscopic determination of the DNA-concentration. If you irradiate the extract with 260nm and 280nm UV-light and read the extinction, you can calculate the concentration and purity (7).

b) How can I test proteins are present in my DNA-extract as a contaminant?

I can test the presence of proteins in my DNA extract by UV-Spectroscopy; by measuring the extinction of the extract at the wavelength of 260 and 280 nm and comparison of the proportion of the extinction. With this information it is possible to find out which molecule you have and in which purity (7).
If the ratio of the UV-Spectroscopy at 260 nm to 280 nm equals 1.8, the DNA is pure, if the ratio is smaller, the DNA contains proteins and is not pure (8).

Another possibility to prove the existence of proteins is to digest the DNA with DNAse and use a SDS PAGE (**s**odium **d**odecyl **s**ulfate **p**oly**a**crylamide **g**el **e**lectrophoresis) for the detection of proteins (9,10).

Task 4: What was the intention of the scientists who developed flavr savr?

Flavr Savr is a genetically manipulated tomato that was developed in the early 1990's. It was submitted to the U.S. Food and Drug Administration (FDA) in 1992 and was approved two years later (11, 12, 13). The aim of the genetic modification was to improve the consistency and the appearance of an older fruit. The manipulated fruits appeared like fresh fruits with a healthy look. The flavr savr didn’t establish itself because of the reduced harvest and the resulting costs; furthermore the tomatoes were often not large enough to be sold premium-priced (14).

Task 5: How can I see if a supermarket tomato is genetically modified?

The tomato must be identified as a *genetically modified organism* (GMO) (15), however biological tomatoes are trustily not genetically modified. In general, GMO-products must have an etiquette with the modified ingredients. In Switzerland there are hardly GMOs and they are all imported, because the Swiss law prohibits producing GMOs (16).

Sources:

1) SimplyScience Stiftung (2011). DNA Extraction from a Tomato. http://www.simplyscience.ch/PortalData/1/Resources/scienceonthemove/Protocol_DNA_Extraction_from_a_tomato.pdf (03.03.2011)

2) Grahmann, Marc (2007). Praxisworkshop DNA Extraktion und DNA Färbung. http://www.uni-frankfurt.de/fb/fb15/institute/didaktik-biowiss/_dokumente/Molekularbiologie.pdf (01.03.2011)

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Activity List

All members of the class participated in the experiment. Always two pupils accomplished together. After the experiment the groups compared their results.

In addition to the experiment we also tested the DNA extraction with a banana and a kiwi. The highest yield of DNA was not achieved with the tomatoes but with the banana!

The tasks were assigned to the following persons:
Task 1: Xenia Griss, Pascale Schlienger, Selinda Ceylan, Milena Petignat
Task 2: Sarah Schnell, Seraina Meister, Leonard Bongers, Marc Felice
Task 3: Nesina Caderas, Alexandra Hrovat, Priska Zuber, Jakob Mücke, Elena Huusi
Task 4: Martin Schweighoffer, Niclas Kiss, Ivan Valli, Alvin Duong, Nicolas Zipperer
Task 5: Isabel Haas, Adélaïde Le Bloc'h, Céline Bader, Gustavo Prack

Photographer: Milena Petignat
Activity List: Gustavo Prack
Layout: Jakob Mücke

Fig.4: Nicolas cutting a tomato into halves

Fig.5: The whole class is working on the experiment.

Fig.6: Nesina pipetting 1.5 ml of DNA-containing tomato extract.

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2. Investigation of colored petals (*Viola wittrockiana)*

Fig 1: *Viola wittrockiana*

Introduction:

Perhaps you are familiar with the velvet-like impression you get by touching the petals of these well-known flowers called 'Stiefmüetterli' (Fig. 1). As well as their soft feel, these flowers have intense and vibrant colors.

Goal:

It's your task to explain these two phenomena (the feel and color of the flowers) by making very thin sections of the petals, and then looking at and photographing the cellular structures under the light microscope. Finally you should interpret and discuss your results.

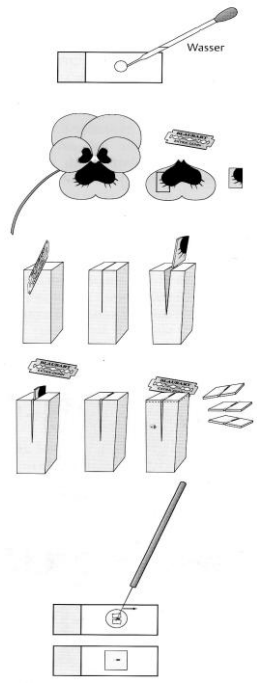

Fig 2: Scheme of the experiment

Task 1:

Find the flowers in a nursery, a flower shop or in a garden. Make sure that they are colored violet, black and yellow (Fig. 1).

Expected answer: Take 1 picture of the whole flowers you have chosen for this experiment. Take 1 picture of the samples of very thin sections you will investigate in task 2 (Fig. 2).

Task 2:

Cut the petal with a new razor blade through the area you would like to analyze (Fig. 2). Make sure that the sections you cut are as thin as possible. Do not only make one section but rather half a dozen of them in a row for further analysis.
Transfer them into a drop of tap water on a slide, cover your sample with a cover slip, and observe the sample under the microscope.

When you find what you are looking for, start to take pictures with your digital camera.

Chose the best picture, label it and describe your observations in detail.

Expected answer: For this task we want to see 1 clear and sharp picture. With this picture you should explain in 2-3 sentences where the velvet effect comes from.

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Task 3: Where in the cells of the investigated petals are the pigments stored that are responsible for the vibrant colors of these flowers? It is of special interest to show in which organelles the respective pigments are stored.

Expected answer: 3 sharp and clear pictures which show where in the cells the different colors of the investigated petal-sections are stored. Label the pictures carefully and label the structures you can recognize.
Where (in which organelles) are the yellow and the violet pigments stored? How come some regions of the petals appear black? You may use books you find in your classroom or your reference library for biology at your school to help find the answer.

Task 4: Find some flowers during the winter season in flower shops or in a nursery. Investigate petals from the flowers of 2 other species. Can you detect some obvious similarities or differences?

Expected answer: 2 pictures (one of each species) of the sections through petals of your choice, labeled as in task 3. 3-4 sentences should be added to explain your observations.

Task 5: Read some background information about colors in petals. Give a clear explanation why it is unlikely to find situations where the same pigments are stored in completely different organelles.

Expected answer: 3-5 sentences.

List the references used according to the guidelines of SCHWEIZER JUGEND FORSCHT, http://www.sjf.ch.

Do not forget to add the activity list to your documentation! 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 entire competition) in the experimental portion.
Therefore, **take 3 digital photos per experiment showing the class involvement.** Place them next to the activity list in your documentation file.

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Expected documentation and further information

- Create **a single** PDF file containing all your solutions, pictures, other documenting material and the activity list and name it, following strictly these conventions:

  1. Number of class
     (find your class number in "Participant" where all the participating classes are presented).
  2. Name of School
  3. Name of class (same as on application form)
  4. Number of experiment
  5. Date (year/month/day)

  → Please use underlines instead of spaces!
  Here is an example: **08_Kantonsschule_Muster_3b_Experiment1_20110222.pdf**

  → The size of the PDF file must not exceed 6 MB (11 pictures: about max. 500 KB per picture)!

- Scores

  A maximum of 10 points is awarded for each experiment. Each question/task (1-5) is rated with a maximum of 2 points.
  If the **references** are listed correctly (according to the guidelines of SCHWEIZER JUGEND FORSCHT) and the **layout** of the whole PDF file is satisfactory, there won't be a penalty on scores. If one of these two aspects is not solved sufficiently, you will receive one point less (for each aspect).

  Example: If you solve the task 1-5 satisfactory (10 points), the layout is good, but the references are not listed correctly, you will only receive 9 points in the end (for one experiment).

- Special Award

  Chose the best and nicest picture you took during the whole experiment 2, label it with your school name, class name and "Miss Viola" and send it as a .jpg file additionally to your documentation file of experiment 2 with the e-mail.

  The most beautiful picture will be chosen and will be awarded with the special price "Miss Viola" in the category "Science & Art".

Closing date of experiment 2:	**18.04.2011, 18:00**

Competition 'Science on the Move'
Class 4c of the Gymnasium Bäumlihof, Basel

Experiment 2: Investigation of coloured petals (*Viola wittrockiana*)

Task 1: The flowers and their sections

We have chosen three different flowers (Fig.1). Petals of these flowers were sectioned (Fig.2) for further investigation:

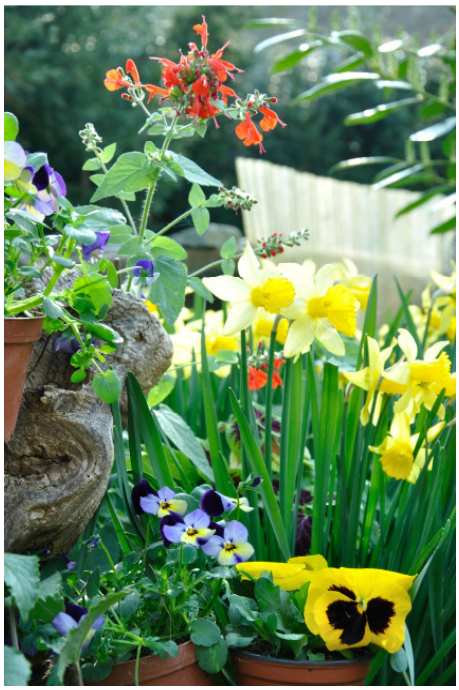

Fig.1: All the flowers used for the second experiment: The tricolored *Viola wittrockiana* at the front, the yellow *Narcissus pseudonarcissus* and the red *Salvia coccinea* in the back.

Fig.2: The very thin sections used for all of the investigations. It is visible that the soluble purple colour diffuses into the water.

Task 2: The velvet effect of *Viola wittrockiana*

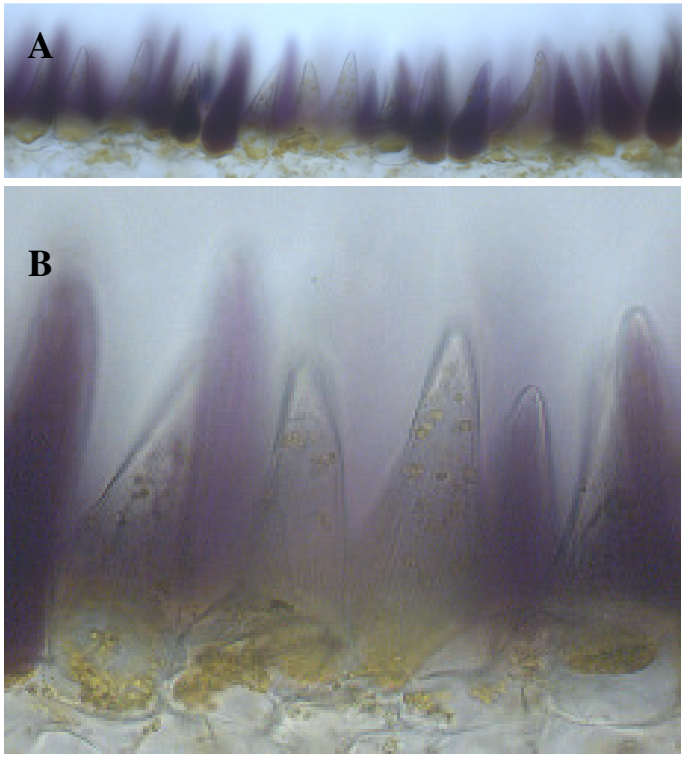

Fig.3: A Papillae on petal epidermis cause the velvet effect. **B** Cuticular folds are visible as very thin lines on the papillae.

The velvet effect is based on the structure of the petal epidermis, on which there are papillae (Fig. 3A). Furthermore, the papillae show cuticular folds which are characteristic for viola (Fig. 3B) (1,2).

In general smooth epidermal cells are the reason for gleaming colours while papillary epidermal cells are the reason for velvet like colours. White petals can also be caused by the reflexion of light through the intercellulars (2).

Task 3: Where in the cells are the pigments of *Viola wittrockiana*?

The colour of the petals arises due to soluted color pigments in the vacuoles of the cells or due to pigments in plastids (chromoplast). There are different pigments in vacuoles like Anthocyane (=blue, red, and purple), Anthoxanthine (yellow, white, UV), Betalaines (red-violet, yellow) and Chalcones/Aurones (yellow and UV). In chromoplasts carotenoid pigments are found like orange coloured carotene and yellow xanthophylls (the green colour in chloroplasts is due to chlorophyll).The visual impression of the colour of petals can change in relation to the position in the pigment holding cell layers, or the overlap of tissues of different colours or through the surface structure of the epidermis (2).
In *Viola wittrockiana* (Fig.4A) we found purple vacuoles with anthocyans (Fig.4B,E) or yellow chromoplast with plastoglobuli (Fig.4C,F). For the colour black, the absorption spectra of different pigments layers have to overlay each other (Fig.4D,G). The thicker the layers are the blacker appears the colour. In our case, the *Viola wittrockiana,* yellow and purple overlay each other. On top of the papilla is the vacuole and on the bottom of the papilla are the chromoplasts (Fig.4D,G). The chromoplasts of the yellow papilla absorb from the light the wave-length of all colours except the ones of yellow and the purple coloured vacuole absorbs all wave-length except the blue or purple ones. So, if there are two colours in a papilla that absorb all of the wavelengths except the one of their own colour, they absorb each other as well; because of that the whole visual spectrum is absorbed and the colour turns out black (2) and therefore *Viola wittrockiana* is tricoloured (yellow, violet and black). The patterns on the petals, which attract insects, come into existence because of the local arrangement of these three colours (3).

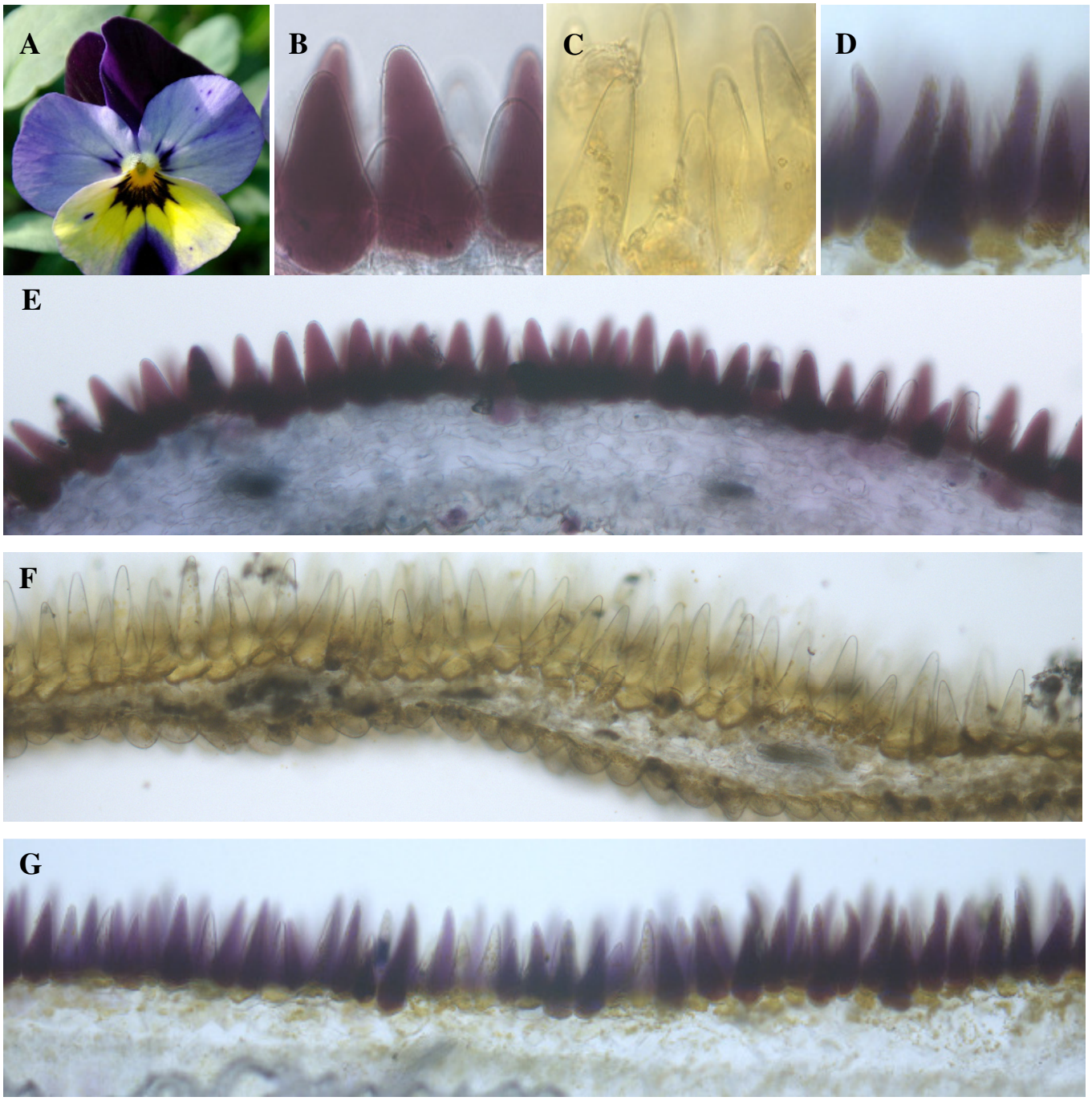

Fig.4
A: *Viola wittrockiana* bloom used for petal sectioning.
B,E: Section through the purple area of a petal. In the detail picture **B** it is clearly visible that the colour is located in the vacuole.
C,F: Section through the yellow area of a petal. In the detail picture **C** it is visible that the colour is located in the chromoplasts.
D,G: Section through the black area of a petal. In the detail picture **D** it is clearly visible that the same cell contains a purple vacuole and underlying yellow chromoplasts.

Task 4: Comparison with two other flowers

In addition to *Viola wittrockiana* we investigated two other phanerogams: *Narcissus pseudonarcissus* and *Salvia coccinea* (4).

Similarities:
The granular structures (plastoglobuli) are placed in the chromoplast of the yellow *Narcissus pseudonarcissus* (Fig.5) and the red colour of the *Salvia coccinea* (Fig.6) comes from the anthocyan in the vacuols (2,3). In the human eye both flowers are unicoloured but it is possible that there are some colours which are only visible for insects as ultraviolet light (3).

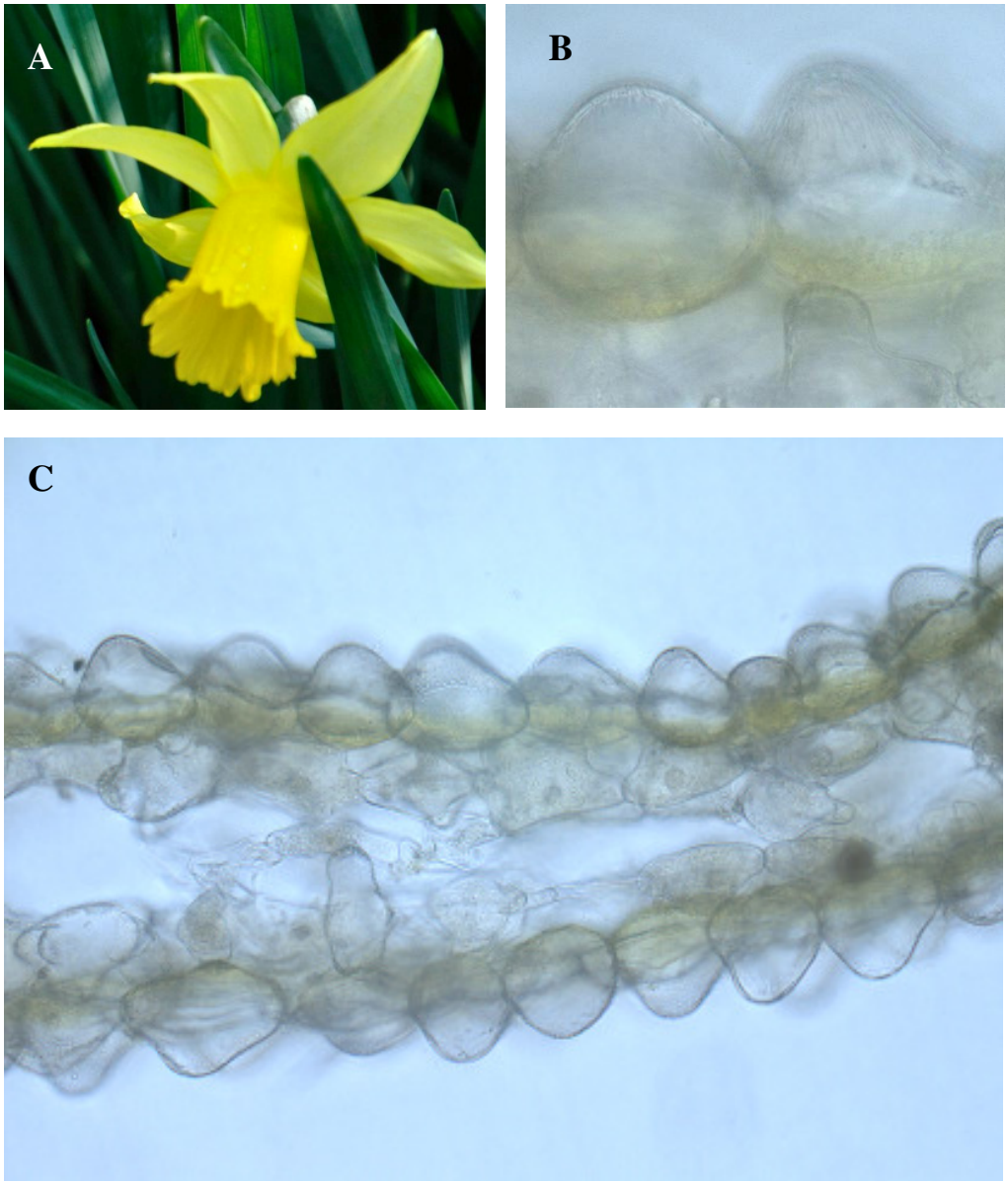

Fig.5:
A: *Narcissus pseudonarcissus* bloom, used to perform cross section.
B: Part of the cross section in detail with two papillae in a higher magnification. These papillae are responsible for the velvet effect from *Narcissus pseudonarcissus* (similar to the velvet effect from *Viola wittrockiana*, but the papillae in *Narcissus* are smaller). The yellow chromoplasts are visible at the bottom of the epidermal cells. Cuticular folds are visible as lines on the papillae.
C: Overview on a cross section through a petal of *Narcissus pseudonarcissus.*

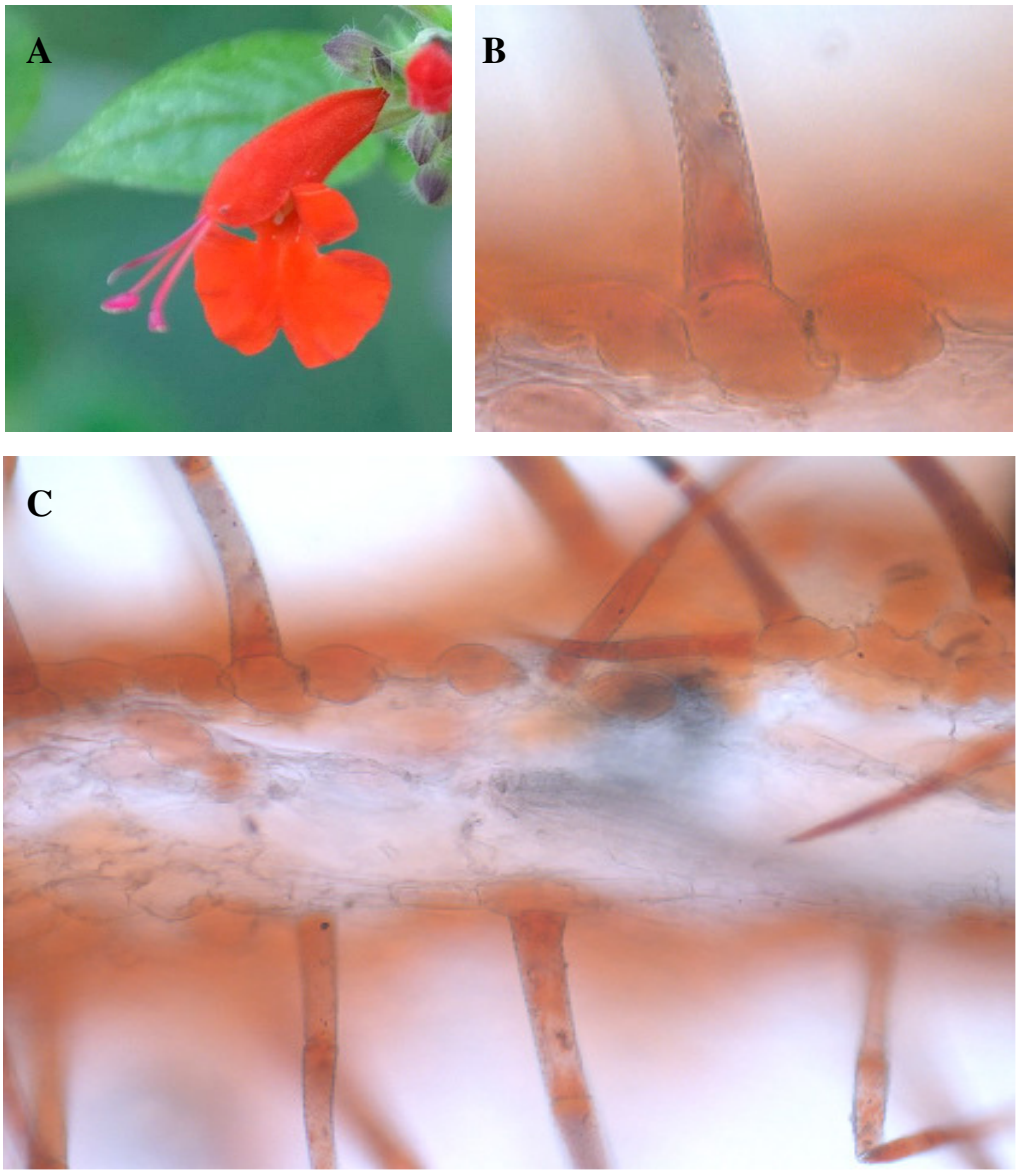

Fig.6:
A: *Salvia coccinea* bloom, used to perform cross section
B: Part of the cross section in detail at a higher magnification. The colour is located in the vacuoles.
C: Overview on a cross section through a petal of *Salvia coccinea.* We found this flower very interesting because of the petal structure. It has many long and tinged hairs.

Task 5: Why is it unlikely that the same pigments are in different organells?

Plant cells synthesize their pigments in organells with the help of complex biochemical pathways involving a lot of steps and enzymes.
The pigments in the organelles evolved through biochemical modifications which base upon already existing biochemical pathways used for other purposes. Because every single organelle had its particular set of chemical substances and biochemical pathways it is highly unlikely that the same pigment evolves independently in two different organelles by the modification of different biochemical pathways (5,6,7).
In addition some pigments are watersoluble and others hydrophobic and membran bound. Different compartments (organelles) give the appropriate surrounding for the different chemical substances and it is unlikely for the same chemical compound to be in different compartments as they exhibit different surroundings (5).

Sources:

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Activity list

The whole class participated in this experiment, everyone cut the petal with a razor blade and analysed the sections on a school microscop.

A first set of pictures was taken with the school microscopes.
To achieve better pictures, eight members of the class went twice to the Biozentrum of the University of Basel. These were Milena Petignat, Sarah Schnell, Céline Bader, Selinda Ceylan, Alvin Duong, Jakob Mücke, Nesina Caderas, Priska Zuber. We would like to thank Prof. Markus Affolter of the University of Basel who allowed us to use his microscope.

The tasks were assigned to the following persons:
Task 1: Isabel Haas, Leonard Bongers, Jakob Mücke, Marc Felice, Elena Husi,
Task 2: Adelaide Le Bloc'h, Martin Schweighoffer, Gustavo Prack, Niclas Kiss
Task 3: Selinda Ceylan, Xenia Griss, Ivan Valli, Nicolas Zipperer
Task 4: Seraina Meister, Céline Bader, Pascale Schlienger, Milena Petignat
Task 5: Martin Schweighoffer, Alvin Duong, Priska Zuber, Nesina Caderas

Photographer: Milena Petignat, Pascale Schlienger
Activity List: Gustavo Prack, Niclas Kiss, Nicolas Zipperer
Layout: Jakob Mücke

Fig.7: Part of the class is preparing and analyzing petal sections.

Fig.8: Three members of the class looking at thin sections on the microscope

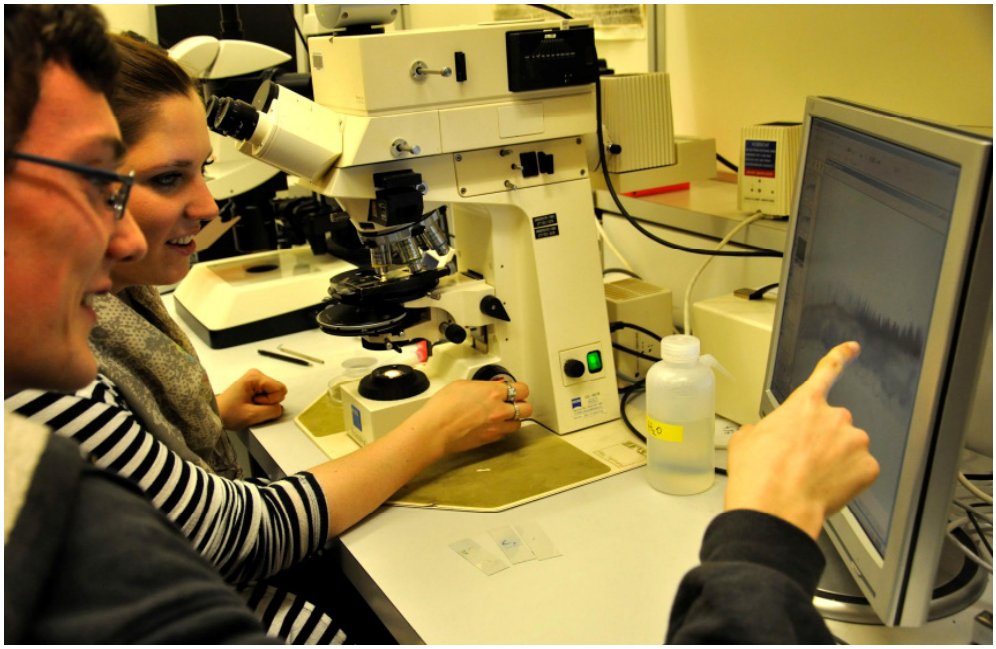
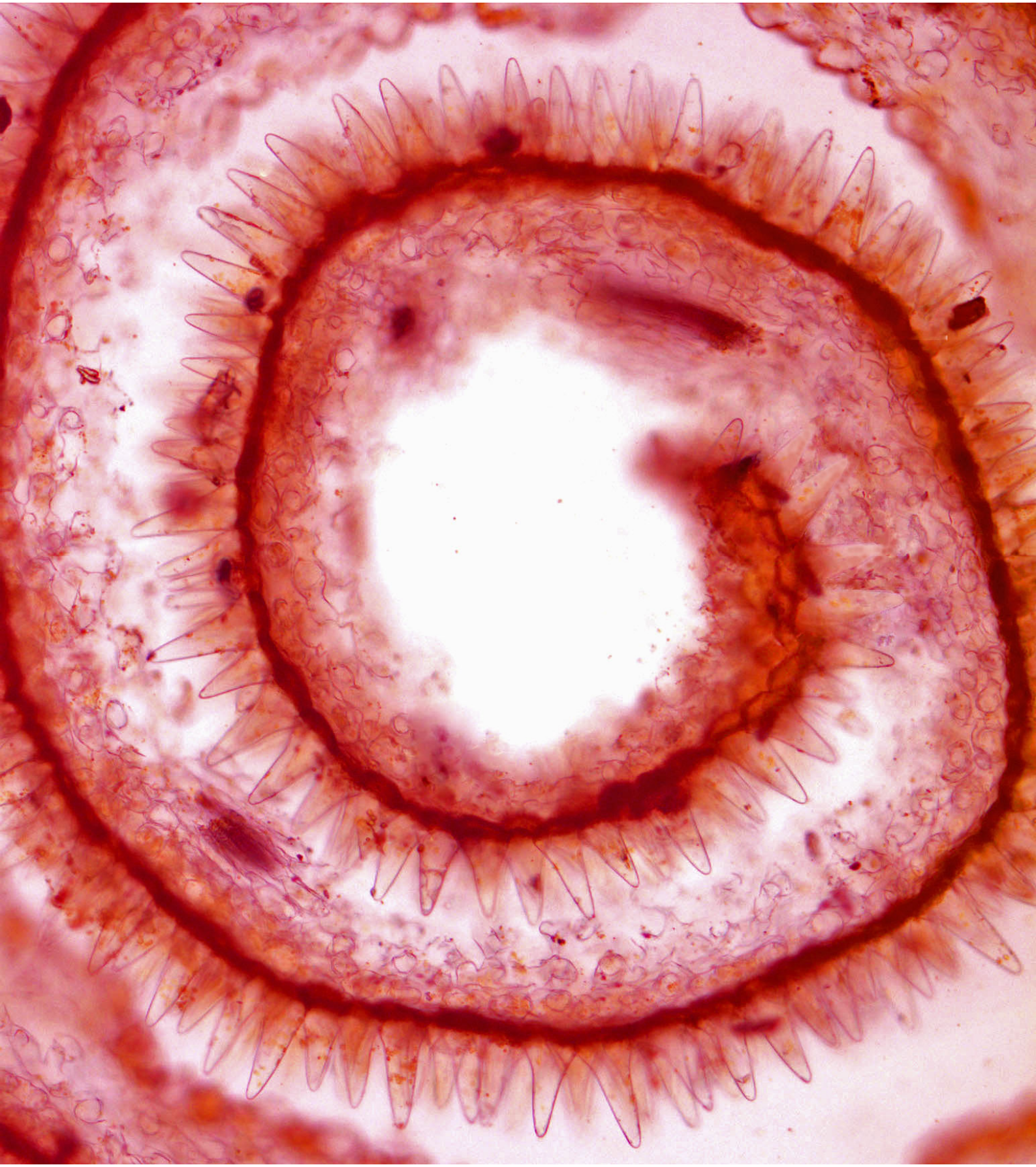


Fig.9: Jakob and Céline analysing petal sections with a Zeiss microscope in the Biozentrum of the University of Basel.



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3. Conversion of energy - with and without oxygen

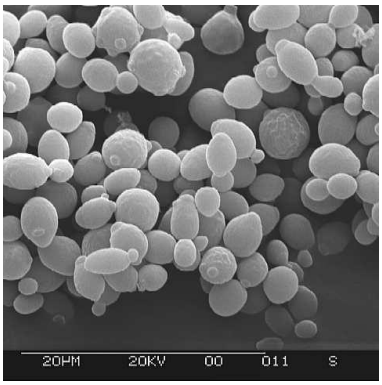


Fig. 1: Yeast Cells in the scanning electron microscope

Introduction:

Baker's yeast is a unicellular fungus, which is able to produce ATP by both, aerobic or anaerobic metabolism. The figure shows yeast cells, pictured with a scanning electron microscope.

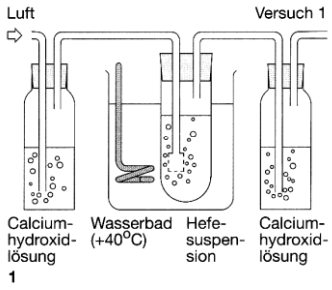
The following reactions describe the stoichiometric equations for the two processes, called respiration and alcoholic fermentation, respectively.

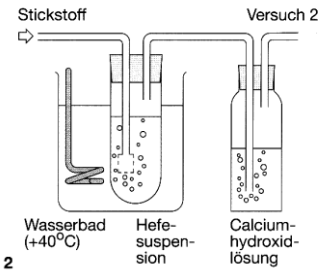
Goal:
During the following experiment you will compare the CO_2 output of cellular respiration and fermentation.

Respiration: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

Without oxygen glucose can be degraded just by fermentation. The amount of ATP gained per glucose molecule is much less compared with respiration.

Alcoholic Fermentation: $C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH$





Task 1: Study the arrangement (Fig. 2) of the two experiments. Make a hypothesis - in which one the yeast cells will produce more CO_2 during the same period of time? Explain your hypothesis.

Expected answer: 2-4 sentences.

Fig. 2: Scheme of the experiment

Translation: Calziumhydroxid-Lösung: calcium-hydroxide solution; Wasserbad: water bath; Hefesuspension: yeast suspension

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Task 2: Calcium hydroxide can bind to carbon dioxide. The product is not soluble and will precipitate.

a) How will the pH in the last wash-bottle (1 and 2) change during this experiment?

Expected answer: Explain by using the correct stoichiometric reaction and one sentence.

b) Explain the purpose of the first wash-bottle during the experiment Nr. 1. Why would it make sense to replace the calcium hydroxide solution in the first bottle with concentrated NaOH?

Expected answer: 2-3 sentences.

Task 3: Please assemble the bottles as described in Fig. 1. Both arrangements should be installed in the same water bath to avoid differences in temperature during the experiments.

1. To each of the last wash bottles containing 50ml of a saturated clear calcium hydroxide solution, add three drops of phenolphthalein.
2. Dissolve 20g of baker's yeast and 15g of glucose in 150ml water. Just before starting the experiment, transfer 50 ml of this solution to the wash bottles of both experiment 1 and 2.
3. Start both experiments (1 and 2) at the same time.
4. Measure the times it takes (in experiments 1 and 2) for the pink color in the respective wash bottles to disappear.

Expected answer: Take one picture of your experimental setup. Repeat the experiment 3 times and record the results in a table each time. Calculate the average values for each experiment.