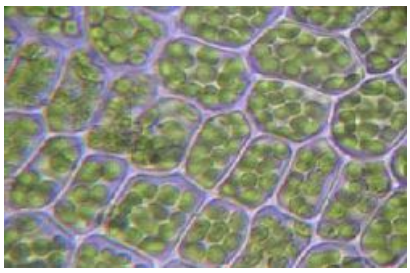
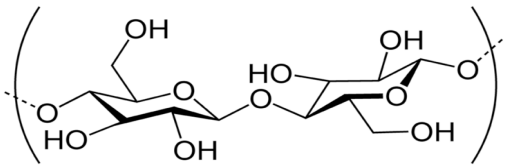
Gastronomy : Teacher Guide

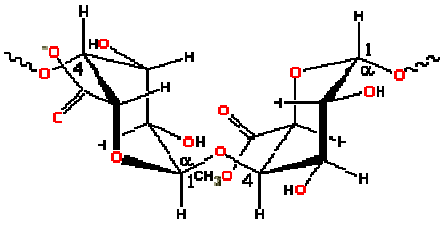
Plant cells separated by cell walls



Cell wall consists of:

Cellulose: a polymer of β-D glucose and Pectin containing substances





Ontwikkeld voor scholen binnen Bètapartners

Auteurs: Scheikundenetwerk Onderwijscentrum/VU
Bewerkt door: Lisette van Rens

Klas: 5 vwo
Vak: Scheikunde

1. Teacher Guide: Gastronomy

Teaching guide for six lessons. Study time for the students: 10 – 20 hrs

Below you find a time schedule for the inquiry project, 'Gastronomy'. The first three parts (1-3) are integrated in the chemistry lessons and the others (4-8) will be done outside the chemistry lessons. The students' first task is to become familiar with the inquiry. Therefore you will give a demonstration and the students will do a guide experiment. After this the students will analyse and judge the research done by Fels, Egnod & Bu (2008). These three researchers investigated what amount of NaCl is leached out of plant cells when heated at different temperatures in a common salt solution. Some questions arise. How 'fair' and accurate is their research? Are their research results trustworthy? Are their conclusions valid? These are questions that the students will answer by critically analysing the article written by these three researchers. Doing this we expect the students – in a team of two – to perform a better inquiry. As a team they will write a first report on their inquiry. You need to publish the first reports on a website/*elo*. In this way the students can discuss their results with peers, giving and receiving suggestions. They have to use these suggestions to improve their report, when writing their final article. All articles will compete for a research award.

Schedule for the procedure of the 'Gastronomy' inquiry project (10-20 hours):

Procedure	**Part of the project**
Start with the task	*1. Understand aim and nature of the inquiry project* *2. Understand the research of Fels, Egnod & Bu:* • Predict, observe, explain • Conduct guide experiment • Judge accuracy, reliability and validity
Conduct research	*3. Own inquiry in teams*
Write report	*4. Report*
Send first report	*5. Report* to: teacher All reports on a website/*elo*
Peer discussion	*6. Peer discussion* The peer discussion on: • Accuracy in the inquiry plan • Accuracy in performing the inquiry • Reliability of the results • Validity of the conclusions
Process comments	*7. Teamwork*: Processing the comments received, improve report
Send final article	*8. Report* to: teacher
Receive prize	All final articles on a website/*elo* Jury selects the best inquiry

Before the six lessons

1. An introduction in class of approximately 15 minutes, with:
   A. The aims of the inquiry task
   The students:
   - Gain knowledge on cell walls with cellulose, pectin and chlorophyll-*a*
   - Gain knowledge on the Mohr's method: titration
   - Judge accuracy and reliability in a research
   - Design a 'fair' inquiry, measure accurately, determine whether measurements are reliable and lead to valid conclusions
   - Are part of a *simulated research community* and gain knowledge on peer review in an Internet symposium

   How to achieve these aims?
   1. Do the inquiry task guided by the questions in the workbook
   2. Predict, observe and explain in the demonstration: fresh and cooked green beans
   3. Conduct the guide experiment: how much NaCl?
   4. Analyse/judge the Fels, Egnod & Bu (2008) article: "Sodium chloride and vegetables"
   5. Formulate own inquiry question and plan the experiments to answer this question
   6. Conduct planned experiments
   7. Write a report about this inquiry and submit the report
   8. Discuss results with peers in an Internet Gastronomy symposium
   9. Rewrite report into a final version or article
   10. Submit final article to an independent jury, e.g. other science colleagues or experts from outside; they select the best inquiry and award a prize

   B. The nature of the inquiry task
   - A scientific inquiry with measuring accurately

   Why is accurate and reliable research so important?
   - You want to acquire knowledge
   - An inquiry should be accurate, reliable and repeatable in order to convince other researchers of the (tentative) reliability of the results

   Why is the inquiry interesting?
   The students can, in teams:
   - Acquire chemical knowledge and knowledge about empirical evidence
   - Critically discuss empirical evidence in their peers' inquiry
   - Win a research award
   - Publish their results on the Internet/*elo* or in the school magazine

   What should be handed in for a mark?
   - The filled student workbook
   - The inquiry plan
   - The participation in the Internet discussion
   - The final article
2. Distribute the printed student materials (workbook) and the article of Fels, Egnod & Bu, 2008.
3. Focus the students' attention on the 'Study Guide' (**workbook p. 25**) and the planning of the project (**workbook p. 5**)
4. Ask the students to make teams of two or three

Lesson 1: Understand what Fels, Egnod & Bu (2008) investigated

Introduction

1. Introduce the workbook and the 'Planning', see Student **workbook p. 5**.
   Introduce what the students have to do in the first lesson. Refer to the **workbook 'Study guide'**, **p. 25**.
2. Let the students read the introduction in the workbook, **p. 3-4**.
   Refer to the list of concepts on **p. 26.** The students can fill out this list bit by bit as the project proceeds.

Demonstration: fresh and cooked beans

3. Let the students *individually* predict and write down what they expect about the texture of the uncooked and cooked green beans.
   Ask them to answer the questions in **2.1, p. 6**.
4. Discuss the predictions (what they expect) and explanations (why they expect this).

Materials needed for the demonstration:	*Procedure:*
- Fresh and cooked beans - 0.1 mol/L NaCl solution - Large beaker to cook the beans in - Sieve to filter off the beans - Large beaker for the recovered solution	- Bring enough green beans in a 0.1 mol/L NaCl solution to the cooking temperature and keep the beans for five minutes at that temperature. - **!!Recover the cooking water. This is needed for the guide experiment in the next lesson. Each team then needs 10.00 mL of the recovered cooking water!!** - Give each student a few fresh beans - Give each student a few cooked beans
Safety and remarks: N.B: no eating allowed in the lab	

5. Follow the procedure for the demonstration and ask the students – in their teams – to write down their observations, conclusion and explanation in **2.2., p. 6 and 7.**
6. Discuss the explanations in terms of the plant cell walls. Cellulose or the fibres are insoluble, but the hemicellulose and the pectin related substances in the cell walls dissolve. This dissolving process makes the beans softer.

Homework

7. Ask the students to browse the Internet for information on cooking vegetables. Ask them to write down their findings.
8. **Students should read the article of Fels, Egnod & Bu (2008) on "Sodium chloride and vegetables"**

Lesson 2 and 3: Guide experiment and judgement of Fels, Egnod & Bu's research

Introduction

1. Introduce what the students need to do in these lessons. Refer **"Study guide" p. 25**.

Guide experiment: how much NaCl?

2. In teams the students titrate 10.00 mL of the recovered solution from the demonstration.

Materials needed for the guide experiment:
Each team needs:
- Burette stand, boss and clamp
- 50.00 mL burette
- 10.00 mL pipette
- 250 mL conical flask
- Wash bottle containing deionised water
- 0.05mol/L silver nitrate solution
- Potassium chromate indicator (5 g potassium chromate dissolved in 100 mL water) in a dropping bottle

Procedure:
- Let the teams titrate 10.00 mL of the recovered solution with 0.05 mol/L silver nitrate solution using about 10 drops of potassium chromate solution as indicator
- Each team will do one titration
- The outcomes of all teams are compared and the best titre is determined

Safety and remarks:
N.B: Student need to wear eye protection
Silver nitrate is dangerous to the eyes and blackens the skin
Potassium Chromate is toxic

In the Mohr's method a white precipitate of silver chloride will form as the silver nitrate is added. The end point is when the white precipitate acquires an off-white colour. A permanent red colour shows that the end point is overshot. In the 10.00 mL titration a titre close to 22.70 mL silver nitrate solution were obtained.

3. Follow the procedure for the guide experiment and ask the students – in their teams – to write down their prediction (**3.1**), observations (**3.2**), results, conclusion and discussion (**3.3**).

Judging the research of Fels, Egnod & Bu, 2008

4. Let the students, as teams, work on the questions in **4.1 (i) (ii) and (iii)**, **p. 9-10**.
   After that ***discuss accurate measurement*** **[(4.1 (i)]**, depends on:
   - Use of the same amount of recovered solutions in the titration
   - Use of the same number of drops of indicator in each titration
   - How the burette is read off e.g. can independently be done by two persons

   Discuss what to do to find out if a measurement is reliable **[4.1 (ii)]**:
   - Repeat the titration
   - How many times to repeat, depends on the deviation between the measurements.

   Discuss reliability of a series of measurements **[4.1 (iii)]**, depends on:
   - The experiment should be set-up in a 'fair' way
   - All experiments should be conducted in exactly the same way
   - The deviation between measurement should not exceed 0.1%

5. Let the students, in teams, work on the rest of the questions in **chapter 4; p. 9 - 18**.
   Be sure that they get to know and understand the meaning of accuracy, reliability and validity in an inquiry.

Lesson 4: Students' own inquiry project: question and plan

Introduction:

1. Introduce what the students need to do: formulate inquiry question and design an inquiry plan (see **workbook "Study guide" p. 25**).
   As indicated on **p. 18** in the workbook the students are free to choose a certain inquiry, as long as it is related to gastronomy.

NB: possible inquiry projects are: relation between temperature and amount of NaCl leaching out of plant cells, replacement of magnesium ions in chlorophyll, alkaline environment en the loss of vitamin C. For references see:
Lister. T. (2005). Kitchen Chemistry. RSC publication ISBN: 0-85404-389-6.
McGee, H. (2004). On Food and Cooking. The Science and Lore of the Kitchen.

Inquiry in teams:

2. Let the students work out the "inquiry in teams" (**chapter 5, p. 18-21**)
   The students' inquiry questions should be:
   a. Unambiguous: contains one problem
   b. Relevant: related to the topic 'gastronomy'
   c. Concrete: the question should contain the dependent variable and independent variable
   The student's inquiry plan should be handed in and checked on:
   d. Is it related to the inquiry question?
   e. Are the experiments not dangerous?
   f. Is it too time consuming?
   g. Students can vary a lot e.g. use different vegetables, change the cooking time instead of the temperature, use various salts, use acidic or alkaline environments in relation to vitamin C. repeat the experiment of Fels et al. (2008), etc.
3. Give the students feedback on their inquiry plans and a go!
4. Remind the students to keep a record of the inquiry (**workbook p. 22**).

Lesson 5 and 6: Conduction of the planned inquiry

Introduction:

1. Introduce what the students need to do:
   -discuss the teacher's comments on their plans,
   -execute the experiments, and
   -write down their observations.

Conduction of the experiments:

2. Let the students discuss the comments on their inquiry plan
3. Let the students execute their experiments
4. When the teams conduct their experiments, walk around and pay attention to:
   (i) Do they always measure in the same way?
   (ii) Do they accurately read the measurements?
   (iii) Do they repeat measurements?
   (iv) Do they write down their observations and measurements?

Further approach in the project

5. Discuss with the students the part in the project "Outside the chemistry lessons", so that all students know what still needs to be done

Outside the chemistry lessons

Check, now and then, whether the teams do the following:

1. Write a first version of their report with the following guidelines (**workbook p. 23**):
   - **Snappy** but relevant title
   - Names of the authors and submission date
   - **Summary** of the inquiry
   - **Introduction** with the reason of or problem in the inquiry guided by theory on the problem, with the **inquiry question** and with a **hypothesis** and the **theoretical assumptions** concerning the answer on the inquiry question.

- **Experimental design** with a description of the method of investigation, of the way of handling the different **variables** and of the way of handling the **accuracy** in the experimental set-up and the measuring itself.
- **Results** with a description of the **relevant observations**/ **measurements** that are correctly put into **tables and graphs**.
- **Discussion and conclusion** with a critical interpretation of your results and with a valid answer to your inquiry question.
- **Evaluation** with a critical description of the experimental set-up, with suggestions for improvements and further inquiry questions.
- **Bibliography** with relevant resources like textbooks, websites, magazines, articles.

Further guidelines:

- Use correct **English** and use a layout in **2 columns**.
- Enclose a **picture** or **drawing** of the experimental set-up (max. **100 kb**).
- The report should not exceed **1500 words** (max. **500 kb**).
- **Label** your document with **teamnumber_first name_first name**.
- Add **separately the email addresses of all team members.**

2. **Submit** the **first version** of the report on a website / elo

3. **Discuss** the published report of at least another team in the Internet 'Gastronomy' symposium
   Use the following questions (**workbook p. 24**):

- Are the dependent and independent variable visible in their inquiry question?
- Are their assumptions and theory about their hypothesis relevant?
- Did they manage the control variables well?
- Did they measure accurately?
- Are their results well presented?
- Did they track the reliability of their results?
- Can you approve of their discussion and conclusions?
- Did they write a critical evaluation?
- Did they come up with a relevant bibliography?

4. **Use comments from the peer discussion to improve their first report**

5. **Rewrite their report into a final version: article**
   Again use the guidelines on **p. 23** of the workbook

6. **Submit their final version**.

7. Ask the jury to find the best inquiry.