



TEACHING IDEAS SHARED FROM SAILS TEACHER EDUCATION PROGRAMME

Proof of the pudding - Irish version



This resource has been developed through the SAILS Teacher Education Programmes (2012-2015) but was not developed as a finalized SAILS Inquiry and Assessment Unit. These materials are shared to inspire further use of inquiry and assessment of inquiry skills in the science classroom.



Author[s]	Brigid Corrigan, Declan Cathcart, Jacinta Burke, Richard Moynihan, Robert Clarke, Seán Kelleher
Project Coordinator	Dr. Odilla Finlayson, Dublin City University.
Website	www.sails-project.eu
Email	info@sails-project.eu

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Inquiry Unit: “How would you make the best pudding?”

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Teacher Information

Level: (Secondary School, Junior or Senior)

Treatment can be tailored to suit the age/ability of the class group.

Duration: 3 - 6 lesson periods. Time given can be varied to suit circumstances.

Topic:

The focus of the investigation is the properties of starch. This unit offers opportunities to visit a range of key concepts in science for students at all stages of secondary school. Some of these are highlighted below, but this is by no means an exhaustive list. Depth of treatment depends of time/ability/teacher preferences. In other works, this unit is very open to change and adaptation to suit the needs of the teacher and student.

References to sub-topics (and key scientific concepts)

It would be very possible to use this starch unit as an over-arching theme under which the class could digress to other related sub-topics , and then come back to the main theme of this module. In this way, relevance of and connections between these sub-topics are much more obvious to the student. This unit can therefore be carried out as a vehicle for the introduction of a particular topic (see list below), or it can assume prior knowledge of certain key concepts, and be an opportunity to deepen understanding. It can of course be an opportunity to focus solely on (and assess) the inquiry skills of students.

The states of matter

- Gels

Changes of state

Solutions and Suspensions

- Concentration
- Saturation
- Solubility
- The relationship between solubility and temperature

Food

- Carbohydrates
- Structure of polysaccharides (polymers in general)

Nutrition

- Role of (starch) carbohydrates in living things

- Anabolic processes in plants (using products of photosynthesis)
- Structural roles vs. metabolic roles of carbohydrates (chitin, cellulose, peptidoglycan)

Food storage

- Storage organs in plants (vs in animals e.g. glycogen)
- Seed structure (endospermous and non-endospermous)
- Germination of seeds (digestion of starch during early seedling germination)

Digestion and Enzymes

- Amylase (breakdown of starch)
- Gel immobilisation of enzymes using sodium alginate (reaction with calcium chloride, ion exchange *etc.*)
- Denaturation of proteins (including enzymes)

Inquiry skills emphasised in this unit.

This list is by no means exhaustive. However, over 3-4 lesson periods, choosing no more than 2-3 inquiry skills for assessment purposes seems practical. Assessment should be carried out by the teacher while the student inquiry activity is underway, and by means of a report booklet/worksheet. Those in italics are suggested skills to be assessed and for which a rubric is provided.

Asking questions

Selecting variables

Research

Planning an investigation

Carrying out experiments

Recording and analysing results

Critiquing results

Formulating hypotheses

Teamwork

Communication

Variables that might be considered:

Temperature

Concentration of starch in mixture

Milk or water as solvent

Types of milk:

Skimmed, half fat, full fat

Soya, Rice, Nuts *etc.*

Type of starch:

Potato, maize (corn), wheat, rice,

Modified starch

Other gelling agents

Gelatin

Agar (vegetarian)

Other additives

Fruit juices

Sugars, syrups

Other flavourings (vanilla, chocolate *etc.*).

Stirring time

Setting time

Texture (viscosity /"thickness")

Variables suggested for initial investigation (and some points to note)**1. Temperature:**

- Reaching a temp of 70°C is necessary for thickening of corn starch
- A temp of 60°C is enough for potato starch to thicken.
- Raising temp to 95 doesn't affect thickening

2. Concentration:

- Ranges of 5-20% (w/v) in our hands seemed a practical range to test
- Final thickness at these concentrations depends on cooling time/setting time.
- An optimum of 15% works for a short setting time giving a warm custard consistency.
- A max concentration of 10% works well to give a cold final product.
- Even heating seemed important for concentrations lower than 15%.

Lesson Sequence

Lesson 1:

Activity 1: (Whole group) (see Student Worksheet)

Whole group discussion about “what makes a good pudding?” Likely suggestions by students are written up on the board by the teacher:

Flavour
Colour
Texture
Ease of preparation
Healthiness
etc...

It is suggested here that “texture” is taken as the starting point for the Investigation. “Healthiness” and “ease of preparation” offer great potential for further investigation.

Class agrees (under teacher guidance..) to focus on texture.

Discussion on what is meant by texture (creaminess, smoothness, thickness *etc.*)

Thickening agents introduced (how do you thicken a sauce/pudding).

The use of flour or cornstarch is likely to come from the students here as prior knowledge).

Cross-curricular link with Home Economics.

Activity 2: (Small group discussion and planning) (see Student worksheet)

Small groups of 3-4 for discussions

The students’ task is to think of **relevant factors** that would affect the thickness/texture of a pudding.

Groups **make lists** of variables.

Students are then asked to **rank** the variables in order of importance/relevance.

Groups then report back to whole class.

Groups of 2-3 (laboratory partners) are then asked to choose one important variable to test.

Each group must make predictions of the effect of that variable.

List the materials they think they might need.

Homework set for students carry out internet research (see Student Homework sheet)

- the different sources of starch
- which foods contain starch?
- what differences are there between starches from different sources?
- what causes these differences between starches?

Lesson 2: (Double Period) (see Student Lab Report)

Groups of 2-3

Materials and equipment made available, based on students requests from previous lesson.

Initial testing of chosen variables (those in italics are suggested as a good starting point)

Temperature

Concentration

Solvent

Stirring

Time

Record and analyse results.

Revise, re-test and repeat.

Towards the end of the double period, whole class discussion:

- Individual groups report back
- Comparing results with other groups
- Feedback from class to individual groups
- Critiquing results

Homework:

Students asked to make a plan for the next session

Using what they have learned about the properties of starch, can they come up with a pudding recipe to test out?

How would they go about testing their recipe?

Lesson 4:

Activity 1: Whole group discussion towards extending the investigation to look at other considerations for making a good pudding.

- Flavour
- Ease of preparation
 - How much time?
 - How simply can it be made?
 - How much heating is required, if any?
- Health aspects
 - Fruit (juices) instead of sugars
 - Different milks for vegan diets, lactose intolerance, fat quantity)
 - Skimmed, half-fat, Soya, nut milks *etc.*

Activity 2: Final design stages and preparation of pudding.

These final stages must take place in the Home Economics room if the puddings are going to be eaten by students. Students may have a final recipe in mind, or they may wish to further test certain ingredients as previously suggested (e.g. different milks, or fruit juices).

Activity 3: Consumer testing

Students share and taste each others' creations, offering constructive feedback. Scoresheets could be used to add a competitive element to the activity.

The proof is in the pudding!

What makes the best pudding?

Report Booklet

Student Name:

Planning your investigation:

Equipment: List the equipment that you will need for your experiment(s).

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Plan Outline:

Outline your plan in the space below. Use a diagram if you think this would make your plan easier to explain (and understand!)

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Diagram:

Labelled Diagram

Procedure:

In this section, try to be as and clear and specific in you language as possible, so that another student *should be able to carry out your experiment* after reading your methods.

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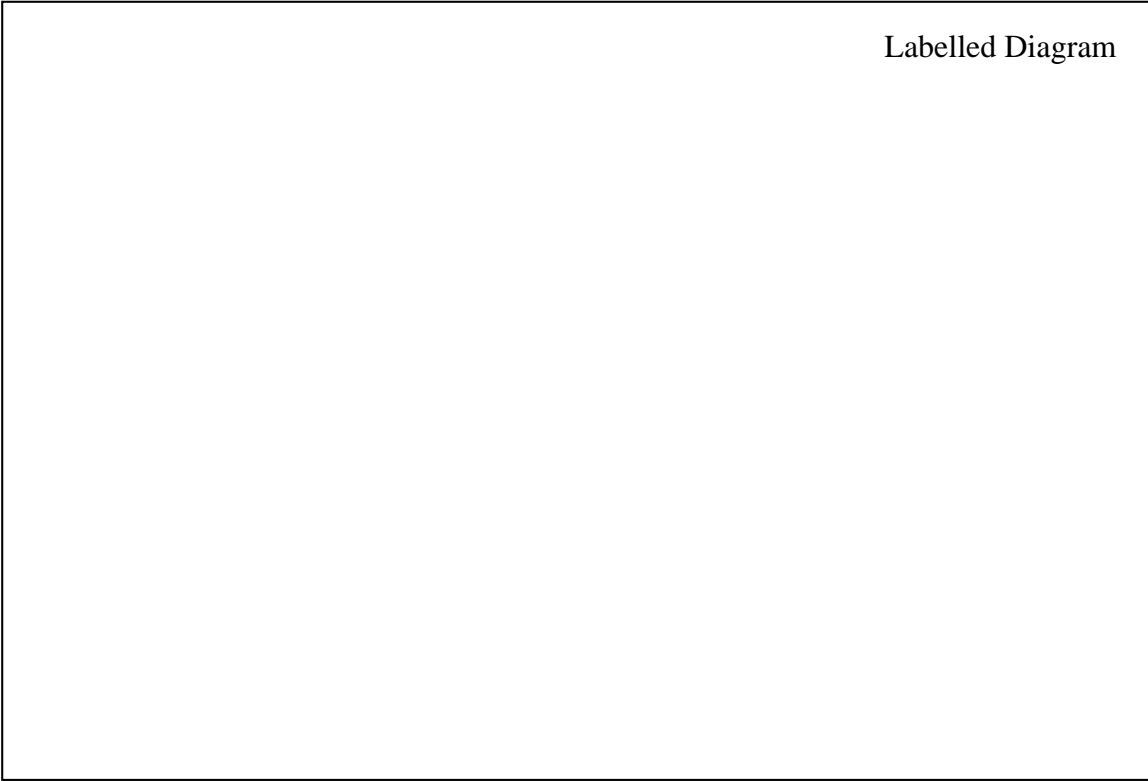
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Observations and Results: Take care in this section to present your findings in the *clearest* and most *presentable* way that you can.

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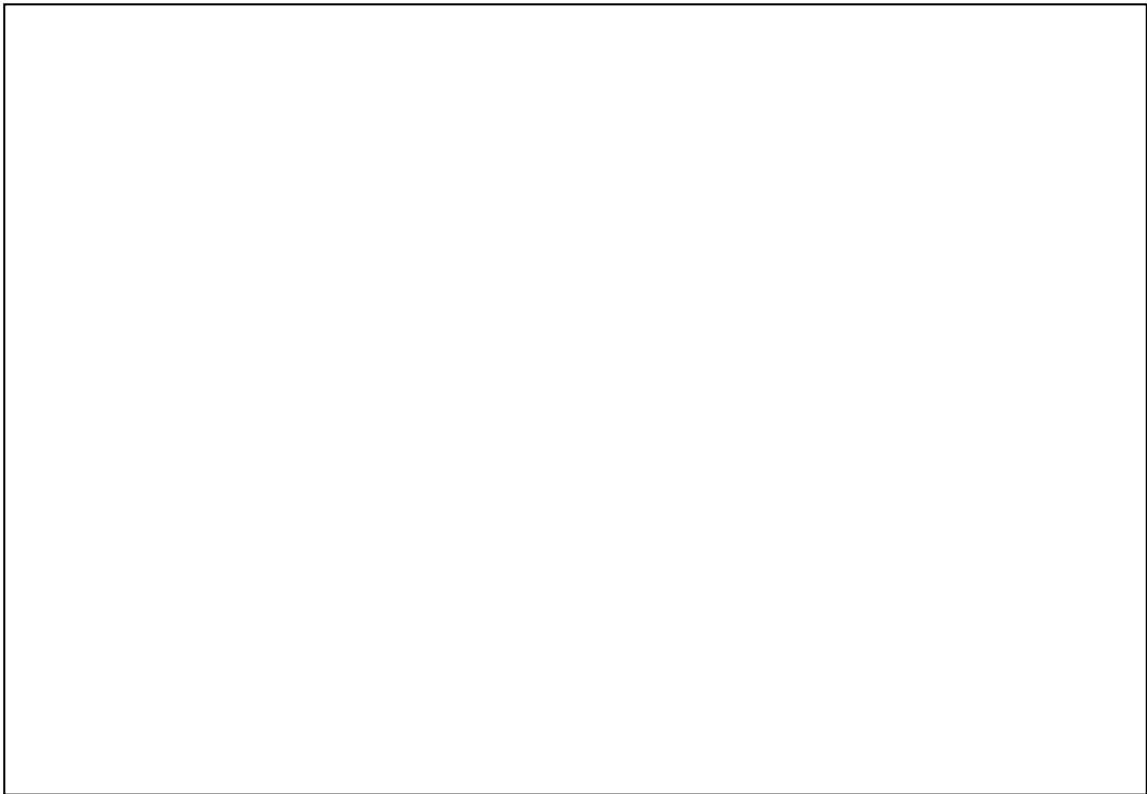
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Conclusions:

Did you identify any *patterns*? What *conclusions* can you draw from your results?

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Do your results agree with your predictions? Discuss any unexpected results or observations below.

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How do your results compare with other groups?

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If you were to do the experiment(s) again, what would you do differently?

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Were there any questions thrown up by your results? If you were to carry on with your investigation, what further experiments might you do?

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EXTRA SPACE:

EXTRA SPACE:

Student Worksheet

Investigation topic: "What makes a good pudding?"

Your task is to design a good pudding.

But before you go off mixing your favourite ingredients, let's have a think about what we should consider here.



Activity 1: (Whole group discussion)

Write down the **suggestions** or **questions** that you can think of or that come out of the class discussion.

Activity 2: (Small group discussion)

- (a) What **relevant** factors would affect the thickness/texture of a pudding?
List as many as you can.

From your list, choose one of the variables that you would like to investigate. Make sure that the question(s) you have in mind are testable.



(c) Make predictions of the results of tests that you think you would carry out during your investigation.

(d) List any materials, ingredients or equipment that you will need to do your experiments



Student Homework

How do I make the best pudding?

Student Name:

Homework

Carry out some internet research to help you with your investigation. Make some notes of any relevant information that you find in the spaces below, and write down the url or website address where you found it (not just Wikipedia!).

Where do we get starch from?

Which **foods** contain starch?

Are there any **differences** there between starches from different sources?

What can you find out about **why** there are differences between starches

Assessment of Starch Inquiry

	Emerging	Developing	Consolidating	Extending
Planning an investigation	Goes for an initial idea.	Looks at different options and decides on one, but without careful consideration regarding relevance or testability.	Looks are many different options and ranks them on scientific relevance and testability. Justifies decision through critique or by scientific explanation.	Considers the evidence from trials and others' results or ideas. Refines their plan using results from experiments.
Carrying out an investigation	In need of continuous support and instruction. Using equipment unsafely or inappropriately.	Occasional support needed. Demonstrates the ability to use equipment safely and appropriately.	Able to run experiments confidently and relatively independently, in a well organised and time efficient manner.	Demonstrates the ability to continually
Recording and analysing results	Limited recording of results, or none.	Results recorded and presented appropriately.	Recording, presenting results appropriately. Some analysis of results demonstrated.	Recording, presenting, and analysing results appropriately, using critical thinking to evaluate and draw valid conclusions.