

Deconstructing Denaturation



40 mins

MATERIALS

- 4 raw eggs per group.
- 4 clear beakers/containers.
- kettle/urn
- measuring jug
- 100 ml water.
- 100 ml boiling water.
- 100ml white vinegar.
- 100 ml methylated spirits.

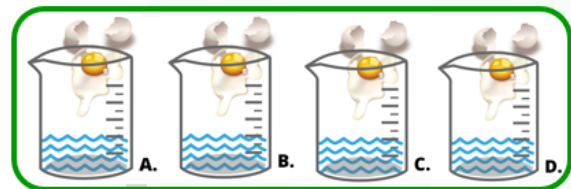
METHOD:

1. Label each container: **A.** control water (room temp), **B.** hot water, **C.** vinegar and **D.** methylated spirits.
2. Crack an egg into the control container & add 100ml of room temp water, recording your immediate observations & setting the timer for 2 mins.
3. Crack each raw egg into each beaker & fill with the labelled 100ml solution, recording any immediate observations & setting each timer for 2 mins. Repeat until all beakers are set up.



WHY?

Denaturation is a process of modifying the molecular structure of a protein by the application of an external stressor/compound such as heat, acid or organic solvent. The chemical bonds that are responsible for the highly ordered structure of the protein in its natural state break, changing their shape. Denatured proteins have a looser, more random structure, most are insoluble.



4. After the 2 mins have elapsed record your observations and set the timers for a further 3 mins.
5. At the 5 mins mark record your observations & set the timers again for another 5 mins.
6. After the 10 mins have elapsed record your observations for the final time.



Deconstructing Denaturation

Lesson Outline:

Time allocation: 40 mins

Format: Group work.

Student outcomes:

- Observe the process of protein denaturation.
- Understand that denaturation is a process by which chemical change creates physical change.
- Understand that denaturation is a process by which the molecular structure of the native protein is modified.
- Utilise science inquiry skills.
- Enhance literacy and critical evaluation skills.
- Enhance food literacy and food experience skills.

Materials:

FOR EACH GROUP

- 4 raw eggs
- 4 clear containers/ beakers
- kettle/ urn with boiling water
- measuring jug/cylinder
- 100ml water (room temp)
- 100 ml boiling water
- 100 ml white vinegar
- 100ml methylated spirit

Optional/ Extra Material:

Preparation:

Print or display experiment set up poster for the groups to follow and print student worksheets.

Setup: 2 mins

Assemble all necessary equipment for the students to access when conducting their experiment/s.

Introduction: 5 mins

Ask: Does anyone know what the term denaturation means or what it might apply to?

Denaturation is the process of modifying the molecular structure of a protein by the application of an external stressor/ compound such as heat, acid, or organic solvent. The chemical bonds that are responsible for the highly ordered structure of the protein in its natural/ native state break, changing their shape. Denatured proteins have a looser, more random structure, and most are insoluble.

Today the protein we will be investigating is egg/ egg white and we are going to test the effectiveness and rate of denaturation when we expose an egg to some different solutions.

Investigation: 20 mins

Working in groups of 2 - 4 ask the students to follow the instructional poster to conduct their experiment and fill out their worksheet.

Discussion: 8 mins

Work your way through discussing the results for each solution or alternatively ask a group to share their results/ observations for each solution tested.

Ask: Can anyone think of a process in the body that involves the denaturation of protein?

Digestion is a process that involves denaturation of proteins. Protein is broken down by our digestive system using acid (saliva and stomach acid) and enzymes so that it can be absorbed by our bodies and converted into energy.

Conclusion: 5 mins

Ask the students to pack away their experiments.

Take away messages:

Chemical reactions can create changes we can see and are involved in many familiar processes.

- Denaturation modifies the molecular structure of proteins and involves the breaking of hydrogen bonds within the proteins native structure which affects how the protein behaves.
- Denatured proteins have a looser, more random structure and most are insoluble.

Foods are comprised of vitamins, minerals and molecular compounds which means they too can undergo chemical reactions.

- The modification of the molecular structure of the protein occurs because of the application of a compound/reactant, such as heat, acid or organic solvent, which then chemically reacts with the natural protein.
- When we cook eggs their protein is denatured.

Digestion is a process that involves the denaturation of protein.

- Protein is broken down by our digestive system by the application of acid (saliva and stomach acid) and enzymes so that it can be absorbed by our bodies and converted into energy.

Further Topic Inquiry

This experiment can be further explored within the context of the Health and Physical Education Curriculum. Providing an opportunity for students to develop strategies to ensure safety and wellbeing at home and at school, such as identifying and choosing healthier foods and drinks for themselves.

Refresh.ED provides unit resources for specific year groups within their Food & Drink Choice and Food, Drink & Health focus areas. Of particular interest in relation to extending learning within this area is the unit.

- Year 9 Food Labels Exposed.
- Year 10 Alternative Nutrition Sources.

Denaturation Experiment Worksheet

A. Water (room temp)

Time	Observations
Initially	
2 mins	
5 mins	
<u>10 mins</u>	

B. Hot Water

Time	Observations
Initially	
2 mins	
5 mins	
<u>10 mins</u>	

C. White Vinegar

Time	Observations
Initially	
2 mins	
5 mins	
<u>10 mins</u>	

D. Methylated Spirit

Time	Observations
Initially	
2 mins	
5 mins	
<u>10 mins</u>	

Overview

In this experiment students explore the process of denaturation. Raw eggs are exposed to different solutions that will potentially denature the egg protein/ Albumin. Students are asked to record their observations at several time increments to assess the effectiveness of the solutions at denaturing the protein.

Some key new vocabulary students will be introduced to includes: Denaturation, Native structure, Reactant, Insoluble.

Key Messages

- Denaturation is a process that effects protein molecules.
- Denaturation occurs when a reactant/ compound is applied to the protein.
- Denaturation is a chemical process that affects physical change which can be observed.
- When we cook eggs their protein is denatured.

Learning Outcomes:

- Observe the process of protein denaturation.
- Understand that denaturation is a process by which chemical change creates observable physical change.
- Understand that denaturation is a process by which the molecular structure of the native protein is modified.
- Utilise science inquiry skills.
- Enhance literacy and critical evaluation skills.
- Enhance food literacy and food experience skills.

General capabilities:

Literacy, Critical & creative thinking, Personal & social capability.

Year 10 Australian Curriculum Links

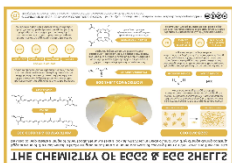
Strand/ Sub- strand	Curriculum content descriptions
SCIENCE	
<p>Science understanding. <i>Chemical sciences.</i></p> <p>Science inquiry skills. <i>Planning & conducting.</i></p> <p><i>Processing & analysing data & information.</i></p> <p><i>Communicating.</i></p>	<p>Different types of chemical reactions are used to produce a range of products and can occur at different rates. Investigating the effect of a range of factors, such as temperature and catalysts, on the rate of chemical reactions (ACSSU187).</p> <p>Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods. Identifying the potential hazards of chemicals or biological materials used in experimental investigations (ACSIS199).</p> <p>Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies. Exploring relationships between variables using spreadsheets, databases, tables, charts, graphs and statistics (ACSIS203).</p> <p>Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS208).</p>
ENGLISH	
<p>Literacy. <i>Interacting with others.</i></p>	<p>Use organisation patterns, voice and language conventions to present a point of view on a subject, speaking clearly, coherently and with effect, using logic, imagery and rhetorical devices to engage audiences. Participating in pair, group, class, school and community speaking and listening situations, including informal conversations, discussions, debates and presentations. (ACELY1813).</p>
TECHNOLOGY	
<p>Design technologies. <i>Knowledge & understanding.</i></p>	<p>Investigate and make judgements on how the principles of food safety, preservation, preparation, presentation and sensory perceptions influence the creation of food solutions for healthy eating. conducting sensory assessment testing of a range of foods to determine how these characteristics might be used to enhance food solutions, for example taste testing a variety of milks, comparing freshly squeezed juice to commercial juices (ACTDEK045).</p>

Additional Year 10 WA Curriculum Links

Strand/ Sub- strand	Curriculum content descriptions
TECHNOLOGY	
Design technologies. <i>Knowledge & understanding: Food specialisations.</i>	Healthy eating through the skills and knowledge of nutrients and the application of the principles of food safety, preservation, preparation, presentation and sensory perceptions (ACTDEK045).

External Supporting Resources for Teachers

- The chemistry of eggs & eggshells infographic.



<https://www.compoundchem.com/2016/03/26/eggs/amp/>

- Similar experiment video.



<https://www.youtube.com/watch?v=8k6D8ajTRlc>