



Prize Winner

Science Investigation

Year 7 - 8

Thavin Siow

**Norwood International High
School**



Kitchen Science

Which Common Method Produces the Easiest-to-Peel Hard-Boiled Eggs?

Oliphant Science Awards 2026 – Science Investigation

Prepared by: Thavin Patrapol Siow

Year 7, Norwood International High School

Abstract

Most people have their own advice for making hard-boiled eggs easier to peel. Some say to use older eggs, while others recommend adding vinegar or baking soda to the boiling water. This investigation will look at which method works best.

Four groups of eggs were tested: fresh eggs boiled in plain water, fresh eggs boiled with vinegar, fresh eggs boiled with baking soda and older eggs boiled in plain water. Peeling time, appearance, smoothness and weight before and after peeling were measured

The results showed that the older eggs were the easiest to peel and produced the smoothest eggs. Baking soda reduced peeling time but did not always produce smooth eggs, while vinegar made very little difference. This investigation showed that using older eggs is the most effective method for producing easy-to-peel hard-boiled eggs.

Introduction

Most science investigations begin in a laboratory. Mine began in my family's kitchen. One of my jobs at home is helping my mum peel hard-boiled eggs. One of my favourite Thai meals is Kai Palo, which is made with hard-boiled eggs cooked in a delicious soy-based gravy. Whenever Mum cooks it, I usually help prepare the eggs.

While peeling them, I noticed something strange. Sometimes the shells came off easily and the eggs looked smooth and perfect. Other times the shells stuck



tightly to the egg, making them difficult to peel and leaving deep dents in the egg white. Even though the eggs were cooked in a similar way, the results were completely different.

I became curious and wanted to know why.

When I searched online, I found lots of different answers. Some websites said older eggs peel better. Others recommended adding vinegar or baking soda to the boiling water. The advice was confusing because different people claimed different methods worked best.

Instead of guessing which advice was correct, I decided to test the ideas myself using a scientific investigation.

Background Research

Why are some eggs difficult to peel?

An egg has a hard shell with two thin membranes underneath. When an egg is cooked, the egg white becomes firm. If the membrane sticks tightly to the egg white, pieces of the egg white can come off with the shell, making the egg look rough and damaged.

Why do older eggs peel more easily?

As eggs get older, they slowly lose carbon dioxide through tiny pores in the shell. This changes the egg white and also makes the air pocket inside the egg larger. These changes weaken the bond between the membrane and the egg white, making the shell easier to remove.

Why do people add vinegar or baking soda?

Many home cooks believe vinegar or baking soda helps eggs peel more easily. Vinegar is thought to help if an egg cracks while boiling, while baking soda may make it easier for the shell to separate from the egg white by increasing the pH around the shell. This investigation aimed to test whether either method actually worked better than plain water.

Research Question

Which common kitchen method has the greatest effect on the peelability of hard-boiled eggs?

Aim

To compare four popular methods of cooking hard-boiled eggs and determine which method produces the easiest-to-peel eggs with the smoothest appearance.

Hypothesis

It is predicted that older eggs will be the easiest to peel because changes inside the egg happen naturally as it ages.

It is also predicted that fresh eggs boiled with baking soda will peel more easily than fresh eggs boiled in plain water or water containing vinegar.

Variables

Independent Variable

The cooking method used for each group:

- Group A – Fresh eggs in plain water
- Group B – Fresh eggs with vinegar
- Group C – Fresh eggs with baking soda
- Group D – Older eggs in plain water

Dependent Variables

Time taken to peel an egg

- Peeling time (seconds)
- Appearance score (/5)
- Smoothness (%)
- Weight before peeling
- Weight after peeling

Controlled Variables

To keep the experiment fair, the following variables were kept the same:

- Egg brand
- Egg size
- Saucepan
- Water volume (1 litre)
- Boiling time (10 minutes)
- Ice-water cooling time (5 minutes)
- Same person peeling every egg
- Same scoring system
- Same camera and lighting for photographs

Materials

- 20 large chicken eggs
- 1 litre of water
- Saucepan
- White vinegar
- Bicarbonate of soda
- Bowl of ice water
- Kitchen scales
- Stopwatch
- Spoon
- Camera
- Recording sheet



Risk Assessment

Hazard	Risk	Safety Precaution
Boiling Water	Burns	Adult supervision and careful handling.

Hot Saucepan	Burns	Handle carefully using oven mitts.
Eggshells	Minor Cuts	Peel carefully and dispose of shells safely.
Water Spills	Slipping	Wipe spills immediately.

Overall risk: Low

Method

- Twenty eggs were divided into four groups of five eggs.
 - Group A contained fresh eggs boiled in plain water.
 - Group B contained fresh eggs boiled with two tablespoons of vinegar.
 - Group C contained fresh eggs boiled with one teaspoon of baking soda.
 - Group D contained older eggs boiled in plain water.
- One litre of water was brought to the boil.
- Each group of eggs was boiled for exactly ten minutes.
- The eggs were immediately placed into an ice-water bath for five minutes.
- Each egg was weighed before peeling.
- The same person peeled every egg while the peeling time was recorded.
- Each peeled egg was weighed again.
- Every egg was given an appearance score and a smoothness percentage.
- Photographs were taken of every peeled egg under the same conditions.
- The results were recorded, averaged and compared using tables and graphs.

Results

- Each average was calculated from five eggs in each treatment group.

	Group Treatment	Average Peel Time (seconds)	Average Appearance (out of 5)	Average Smoothness (%)
A	Fresh eggs + water	26.2	3.0	81

B	Fresh eggs + vinegar	20.2	3.2	80
C	Fresh eggs + baking soda	19.0	3.0	68
D	Older eggs + water	11.6	5.0	100

Table 1 shows that the older eggs (Group D) achieved the best results in every main measurement, and were selected as the best overall treatment.

Key for all graphs:

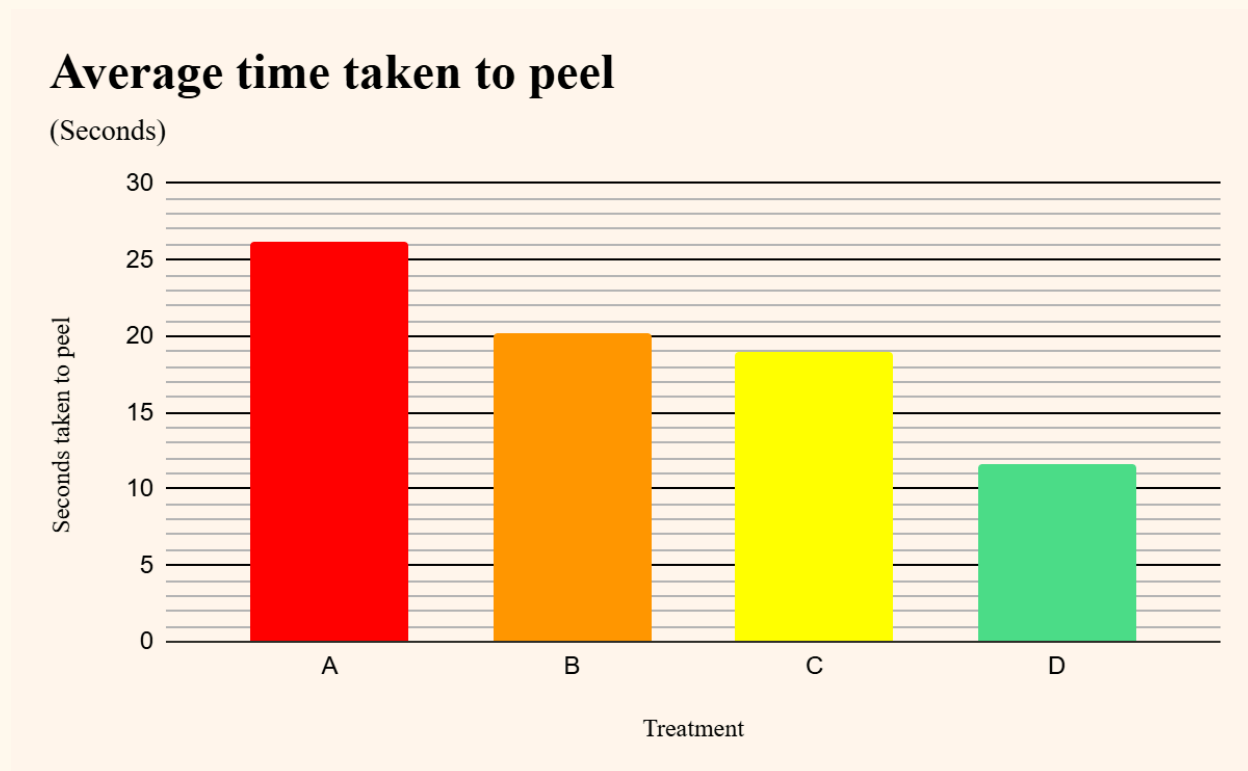
A- Fresh eggs in Water

B- Fresh eggs in Vinegar and Water

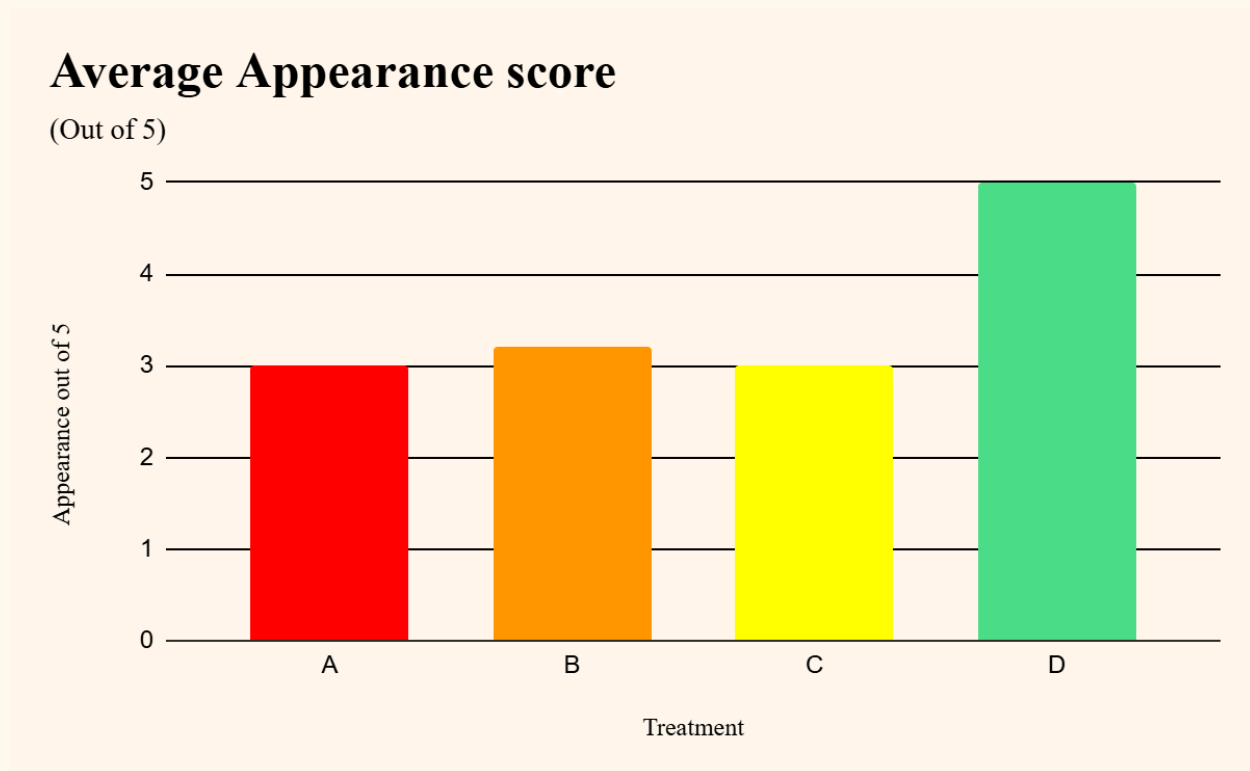
C- Fresh eggs in Bi-carb soda

D- Old eggs in Water

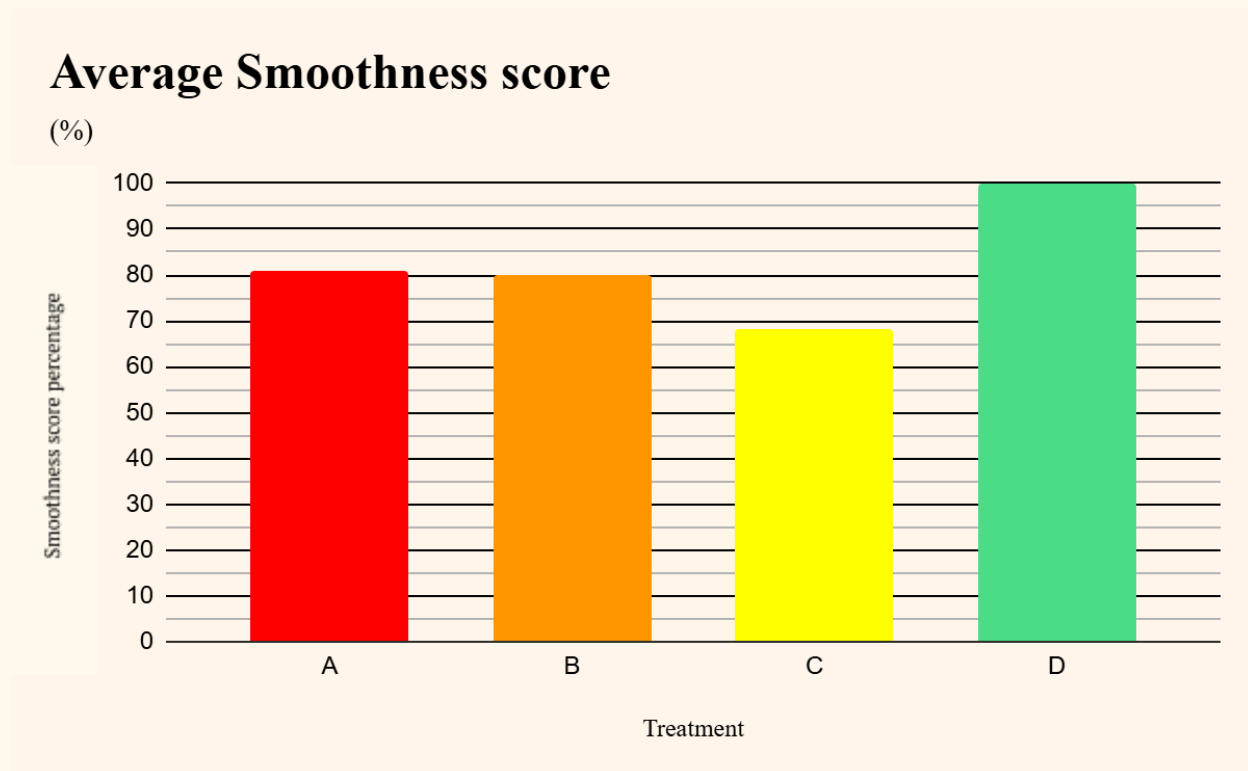
Graph 1: Average time taken to peel



Graph 2: Average Appearance Score

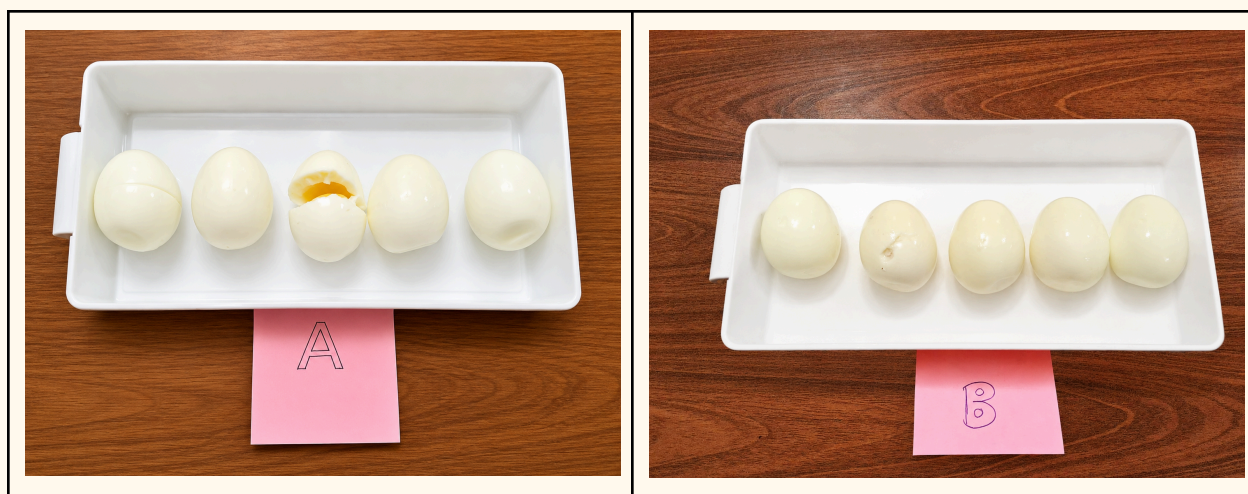


Graph 3: Average Smoothness Score



Photographic Results

Photographs were taken immediately after peeling every egg group. These photographs provided visual evidence to support the measurements and scoring.



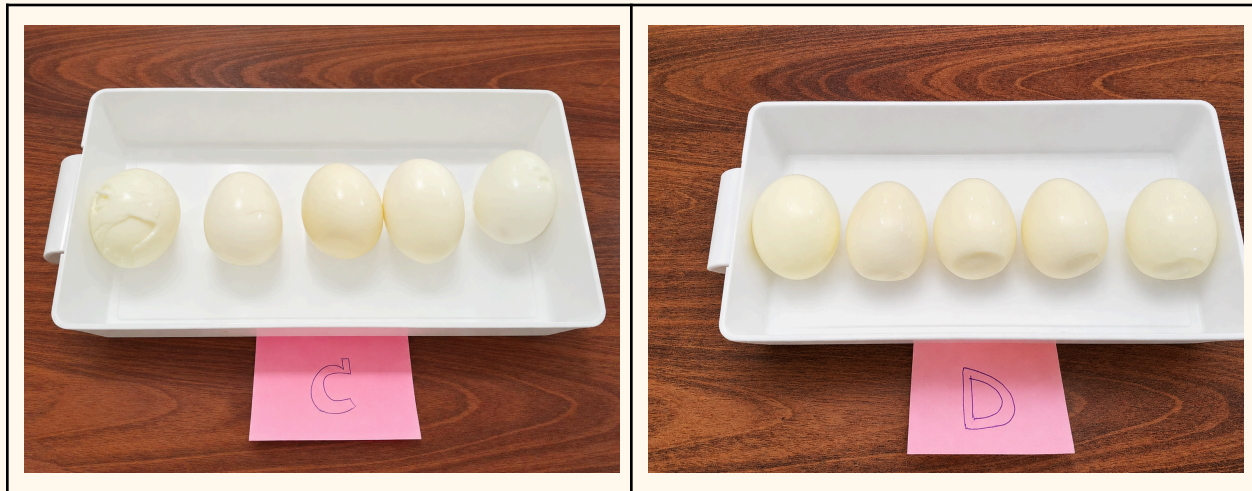


Figure 1: Photographs of eggs after peeling.

Overall, the older eggs (Group D) performed the best in every measurement. They peeled the fastest, received the highest appearance score and were the only group to achieve 100% smoothness.

Fresh eggs boiled in plain water (Group A) took the longest to peel and showed moderate damage to the egg white.

Adding vinegar (Group B) reduced the average peeling time slightly, but the eggs looked very similar to the control group.

The baking soda group (Group C) produced an interesting result. The eggs peeled faster than the control group, but one egg was badly damaged during peeling. This lowered the average smoothness score, making baking soda less consistent than expected.

The photographs supported the measurements. The older eggs looked noticeably smoother than the other three groups, while the baking soda group showed the greatest variation between individual eggs.

Discussion

In this investigation, peelability means how easily the shell can be removed while keeping the egg smooth and undamaged.

The results mostly supported the hypothesis. It was correctly predicted that the older eggs would be the easiest to peel. They had the shortest peeling time, the highest appearance score and the smoothest surface.

The research conducted explained why this happened. As eggs get older, they slowly lose carbon dioxide through tiny pores in the shell. This increases the pH of the egg white and makes the air pocket inside the egg larger. These changes weaken the bond between the shell membrane and the egg white, making the shell easier to remove.

The baking soda results were unexpected. It reduced the peeling time, but it did not always produce better-looking eggs. One egg lost a large piece of egg white during peeling, showing that peeling quickly does not always mean peeling well.

One interesting finding was that baking soda did not produce the same smooth peeling as older eggs, even though it is thought to increase pH. This suggests that changes happening naturally inside the egg as it ages may be just as important as pH in making eggs easier to peel.

The vinegar treatment made only a small difference compared with plain water. Based on the results, adding vinegar was not as effective as simply using older eggs.

One thing this investigation showed is that using only one measurement would not have told the whole story. If only the peeling time was measured, it would have been thought baking soda was almost as good as older eggs. However, by also measuring appearance, smoothness and taking photographs, it was found that the older eggs clearly gave the best overall results.

This investigation also suggested that internet advice is not always correct. Different websites recommended different methods, but conducting the experiment showed that some methods worked much better than others.

Was the Hypothesis Correct?

The hypothesis was mostly correct.

It was correctly predicted that older eggs would peel the easiest.

It was also predicted that baking soda would work better than vinegar for fresh eggs. Although baking soda reduced peeling time more than vinegar, it did not consistently produce smoother eggs. This means that part of the hypothesis was only partly supported.

Limitations

Like all scientific investigations, this experiment had some limitations.

The biggest limitation was that the exact age of the eggs was unknown. “Fresh” eggs and “older” eggs were determined from the best-before dates printed on the cartons. Although this was the best estimate available, it was not exactly known when the eggs were actually laid.

Only five eggs were tested in each group. Testing more eggs would make the results more reliable.

The appearance score and smoothness percentage were also based on observations. Another person may have scored the eggs slightly differently.

Finally, only one brand of supermarket eggs was tested. Different brands or eggs from different farms might produce different results.

Improvements

If this investigation was repeated, freshly laid eggs directly from a local farm would be collected so the exact age of the eggs will be known. Eggs that were one day old, one week old and two weeks old could be compared.

The number of eggs in each group would be increased and more cooking methods would be tested, such as steaming or different boiling times.

Another improvement would be to ask several people to score the appearance of each egg and calculate the average score. This would reduce personal opinion and make the results more reliable.

Conclusion

This investigation compared four common methods that people use to make hard-boiled eggs easier to peel.

The results showed that older eggs boiled in plain water were the easiest to peel and produced the smoothest eggs. They performed better than fresh eggs boiled in plain water, fresh eggs boiled with vinegar and fresh eggs boiled with baking soda.

Although baking soda reduced peeling time, it did not consistently produce smooth eggs. Vinegar made very little difference compared with plain water.

From the investigation, it was concluded that the age of the egg had a much greater effect on peelability than adding vinegar or baking soda to the boiling water.

This investigation showed that science can begin with something as simple as helping to prepare a family meal. A question that started while peeling eggs for Kai Palo led to a scientific investigation that tested common kitchen advice using evidence. The investigation also demonstrated that everyday observations can lead to interesting scientific discoveries.

Appendices

Appendix 1: Logbook showing the records of different stages of this experiment.

Investigation Logbook

Day 1 – Choosing the Investigation

After my original investigation needed to be changed, I looked for a new science question that could be completed safely at home within a short time.

I chose to investigate peeling hard-boiled eggs because it is a real problem I have experienced while helping my mum cook Kai Palo, one of my favourite Thai dishes.

Day 1 – Background Research

I researched why some eggs peel more easily than others.

I found many different suggestions online.

The three most common ideas were:

- Use older eggs.
- Add vinegar.
- Add baking soda.

The advice was often conflicting, so I decided to test these methods scientifically.

Day 1 – Planning the Experiment

I planned a fair test.

I decided to compare four groups:

- Fresh eggs in water.
- Fresh eggs with vinegar.
- Fresh eggs with baking soda.
- Older eggs in water.

I chose to measure:

- Peeling time.
- Appearance.
- Smoothness.
- Weight before and after peeling.

I also decided to photograph every egg.

Day 2 – Conducting the Experiment

Twenty eggs were tested.

Each group was boiled for ten minutes.

The eggs were immediately cooled in ice water for five minutes.

Each egg was peeled by the same person.

All measurements were recorded carefully.

Photographs were taken throughout the experiment.

Day 2 – Recording Results

The results were entered into tables.

Average values were calculated for each treatment group.

Graphs were prepared to compare the groups more easily.

Day 3 – Analysing the Results

The older eggs clearly performed best.

Baking soda reduced peeling time but did not consistently improve appearance.

Vinegar produced only a small improvement compared with plain water.

The photographs supported the numerical results.

Day 3 – Reflection

This investigation showed me that scientific evidence is more reliable than opinions or internet advice.

I also learned that simple questions from everyday life can become interesting scientific investigations when they are tested fairly.

If I repeated this investigation, I would like to obtain eggs directly from a local farm so I know exactly when they were laid. This would make the investigation even more accurate.

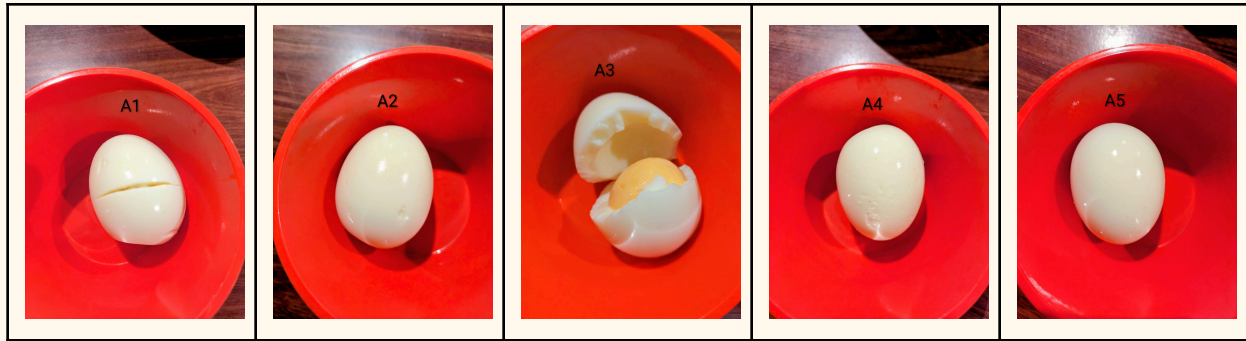
Data Sheet

Group	No.	Weight before peel (Grams)	Weight After Peel (G)	Peel Time (second)	Peel Quality Score (1-5)	Percentage of Smooth surface
A	1	60	51	35	2	65
	2	58	51	18	4	90
	3	54	48	31	1	75
	4	59	51	20	3	80
	5	57	49	27	5	95
B	1	55	48	26	3	75
	2	59	51	24	2	60
	3	59	51	20	4	90
	4	59	51	14	4	90
	5	56	49	17	3	85
C	1	56	49	24	1	25
	2	53	46	20	2	60
	3	56	49	18	4	70
	4	59	52	15	5	100
	5	56	48	18	3	85
D	1	62	54	15	5	100
	2	62	54	11	5	100
	3	64	56	17	5	100
	4	61	54	8	5	100
	5	65	56	7	5	100

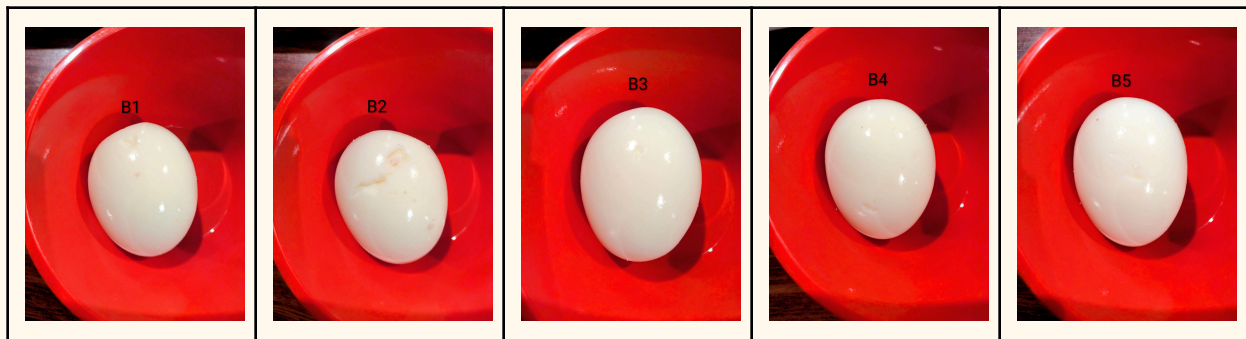
Note : Fresh eggs = Best Before 3/AUG-
 : Old eggs = Best Before 6/July
 : Water with Baking soda foaming a lot during boiling .

Singular Egg Photos

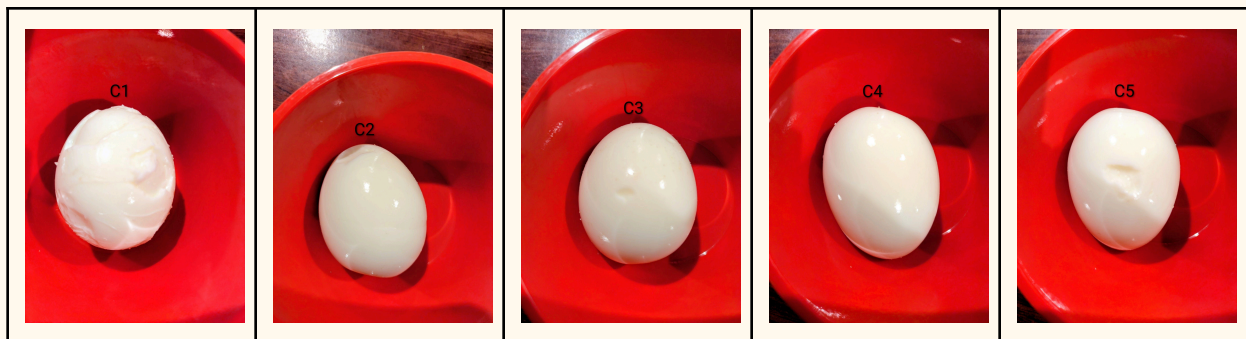
Group A: Fresh Eggs In Water



Group B: Fresh Eggs In Water And Vinegar



Group C: Fresh Eggs In Water And Bi-carb Soda



Group D: Old Eggs In Water



Egg Grading/Scoring

Appearance Score

Score	Description
5	Perfectly smooth with no visible damage.
4	Minor surface damage.
3	Moderate damage but most of the egg remained smooth.
2	Large damaged areas.
1	Severe damage with a large amount of egg white removed.

Appearance Score

Percentage	Description
100%	Entire surface is smooth.
90%	Very small damaged area.
80%	Small damaged areas
70%	Moderate damage
<60%	Large damaged areas

Reference List

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<https://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/eggs/shell-eggs-farm-table>

AI Acknowledgement

Artificial intelligence (ChatGPT by OpenAI) was used to assist with improving grammar, checking spelling, organising the report structure and suggesting ways to present the data clearly. The investigation, brainstorming ideas, experimental design, data collection, measurements, photographs, analysis and final conclusions were completed by the student.

OSA RISK ASSESSMENT FORM

for all entries in ☒ Models & Inventions and ☒ Scientific Inquiry

This must be included with your report, log book or entry. One form per entry.

STUDENT(S) NAME: Thavin Siow ID: 107964520J

SCHOOL: Norwood International High School

Activity: Give a brief outline of what you are planning to do.

I am planning to find out if new/old boiled eggs are easier to peel. I am going to boil the eggs, and peel them to see if they are easier to peel.

Are there possible risks? Consider the following:

- Chemical risks: Are you using chemicals? If so, check with your teacher that any chemicals to be used are on the approved list for schools. Check the safety requirements for their use, such as eye protection and eyewash facilities, availability of running water, use of gloves, a well-ventilated area or fume cupboard.
- Thermal risks: Are you heating things? Could you be burnt?
- Biological risks: Are you working with micro-organisms such as mould and bacteria?
- Sharps risks: Are you cutting things, and is there a risk of injury from sharp objects?
- Electrical risks: Are you using mains (240 volt) electricity? How will you make sure that this is safe? Could you use a battery instead?
- Radiation risks: Does your entry use potentially harmful radiation such as UV or lasers?
- Other hazards.

Also, if you are using other people as subjects in an investigation you must get them to sign a note consenting to be part of your experiment.

Risks	How I will control/manage the risk
• Hot Water (burning) • Cuts and scrapes • Slipping	• clearing environment, wearing gloves, protective clothing • peel eggs under cold water on a flat surface • Clean up spills immediately with paper towels.

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Thavin Siow

SIGNATURE(S): Thavin

☒ By ticking this box, I/we state that my/our project adheres to the listed criteria for this Category.

TEACHER'S NAME: Jessica Robjohns

SIGNATURE: Jessica DATE: 21/06/2025