Boiling and Peeling Eggs

https://goo.gl/bJzJDo
https://goo.gl/v1xTsd
https://goo.gl/BnUfXH
https://goo.gl/SqLisi
Stavros has just begun working as a chef at the restaurant ‘Delicious’. Every morning he peels off boiled eggs for the customers at the restaurant. Unfortunately, his boss is deeply disappointed in him, because quite often the eggs are not hard-boiled enough and hence they cannot be uniformly peeled. Therefore, he needs to find the best way to prepare easy-to-peel eggs. Stavros needs your help in finding solution to his problem.

What **problem** does Stavros encounter at his work?

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Formulate a **driving question** that will guide your investigations in finding a solution to Stavros’ problem.

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https://goo.gl/GYxRVT
What variables might affect the boiling and peeling of eggs?

What variables might **not** affect the boiling and peeling of eggs?
Write down what you know about boiling and peeling of eggs based on your previous experiences and knowledge. Focus on concepts or phenomena related to science. Please feel free to surf the internet to seek for additional information.

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
Have you ever heard of “egg denaturation”?

If you are already familiar with this phenomenon, provide a definition below and explain the processes that take place during this phenomenon.

If you have not heard of this term before, please browse it on the Internet and once you collected all necessary information about this phenomenon, provide a definition below and explain the processes that take place during this phenomenon.

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
**Worksheet 2: Phase 2**

**Sub-Phase A**

Work together with your group peers to fill in the blanks in the problems presented below.

**Problem 1**

Stella obtained two eggs, a fresh one and an old one, and would like to find which of the two eggs can be better uniformly peeled when boiled. In doing this, she boiled each egg in a pot full of water, as shown in the following images, and then peeled them.

![Old egg](https://goo.gl/5QvcXO) ![Fresh egg](https://goo.gl/5QvcXO)

What **question** did Stella aim to investigate?

| Does the ....................... of ................ affect the .........................? |
Problem 2

Nikos planned to prepare a salad with boiled eggs for his birthday party. However, he didn’t know how much water should be used in order to make the eggs to uniformly peeled after they are boiled.

In doing this, he put an egg in each coffee pot, put different amount of water in each pot as shown in the picture below, let them boil for 15 minutes, and finally peeled them.

![100 ml of water](https://goo.gl/KtOSK7)
![300 ml of water](https://goo.gl/9M1F80)

What question did he aim to investigate?

Does the ...................... of ................. affect the .........................?
Problem 3

I am wondering if an egg that is boiled in a black beaker is peeled more uniformly than an egg boiled in a white one.

https://goo.gl/FP5mc4

What **question** did she aim to investigate?

Does the ………………….. of ……………….. affect the…………………………………….?
Look carefully the three questions you formulated in the previous activities. Do they have a word in common?

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Each question entailed two variables, namely Variable A and Variable B. What is the Variable A and Variable B in each of the three formulated questions?

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Use the phrases "variable A" and "variable B" to write down the general form that each question was formulated upon.

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The questions that follow the aforementioned structure are called investigative questions.

https://goo.gl/IFdNkI

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
We want to know whether the eggs boiled in salty water are peeled more uniformly than these boiled in tap water.

Problem 4

What is the question under investigation?

https://goo.gl/3cis1v
Problem 5

I am wondering if large eggs are peeled more uniformly than small eggs.

What is the question under investigation?

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Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
In page 2 you identified several variables that might affect the boiling and uniformly peeling of hard-boiled eggs (see page 2). Choose 3 variables among the identified variables and then formulate the corresponding investigative question for each of them.

Investigative Questions:

1. ...........................................................................................................................................

2. ...........................................................................................................................................

3. ...........................................................................................................................................

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
Sub-phase B

Provide a possible explanation of the relationship between the two variables for each of the preceding investigative questions (see page 11).

Consider a variable that does not affect the boiling and peeling of eggs. How do you know that this variable doesn’t affect the boiling and peeling of eggs?
Now you are going to formulate your hypotheses.

https://goo.gl/lfDnKl

- “A hypothesis provides a tentative explanation for the function of a phenomenon. Also, a hypothesis can be either confirmed or rejected.

- A hypothesis draws on observation and scientific knowledge. It can be tested through experimentation or further observation and can lead to a prediction” (NSTA, 2008, pp.102-103).

- A hypothesis can be formulated in the form of an "If ... then..." statement or a "the more/less...the more/less..." statement.

- A hypothesis describes the relationship between 2 variables: variable A and variable B. For example: "The rougher the surface of the ramp is, the less time of flight of the marble would be".

Choose 2 of the variables that might affect the boiling and peeling of eggs identified on page 2 and formulate the corresponding hypothesis for each of them.

Hypotheses:

1. ...........................................................................................................................
...........................................................................................................................
...........................................................................................................................

2. ...........................................................................................................................
...........................................................................................................................
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Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
Read the following statements together with the members of your team and circle the statements representing hypotheses.

a) A hen’s egg is peeled more uniformly than a goose’s egg.

b) A fresh egg maybe uniformly peeled.

c) The higher the water temperature is, the easier-to-peel eggs would be.

d) Large objects sink in a basin filled with water.

e) If I place an apple inside the water of a basin, it will float. If I place an orange inside the water of a basin, it will sink.

f) I guess that the coin sinks in water.

g) Honey is dissolved in water.

h) A small quantity of sugar is dissolved more quickly in water than a larger one.

i) Salt is dissolved faster in water than sugar.

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
Formulate a hypothesis for each investigative question you wrote on page 11 and insert them into the table below.

The example provided in the table below is a representative one that will help you.

<table>
<thead>
<tr>
<th>Investigative question</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the type of surface of a ramp affect the time of flight of a ball rolling down the ramp?</td>
<td>More rough surfaces will impede the ball from rolling on the ramp and thus the time of flight will be greater than in the case of ramps covered in smooth surfaces.</td>
</tr>
</tbody>
</table>

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
Hello, I am Stavros and I need your help. I need to find the best way to boil easy-to-peel hard-boiled eggs.

I want to examine whether an old egg is peeled more uniformly than a fresh one.

How should Stavros conduct his experiment to detect the egg that can be peeled in the most uniform way?
Stavros should keep in mind the following “rules of thumb” in designing and conducting a fair experiment:

1. …………………………………………………………………………………………………………
   …………………………………………………………………………………………………………

2. …………………………………………………………………………………………………………
   …………………………………………………………………………………………………………

3. …………………………………………………………………………………………………………
   …………………………………………………………………………………………………………

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
Pay attention to the design of the experiment under study below!

Which question did Stavros want to investigate?

- If you don’t remember how we formulate investigative questions, see page 8.

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Formulate a hypothesis based on your investigative question.

- If you don’t remember how we formulate a hypothesis, see page 13.

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How many and what kind of eggs are needed for the experiment?

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Explain your response.

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Complete the table below.

<table>
<thead>
<tr>
<th>Egg</th>
<th>Egg’s age</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

https://goo.gl/jjbR9u
Let’s assume that one of the eggs can be peeled in a more uniform way than the other. How can you ensure that this resulted only because of its age, and not because of the higher temperature of the water it was boiled in or because of its size?

Which variables need to be kept constant?

Variables that need to be kept constant:
1. ..................................................
2. ..................................................
3. ..................................................
4. ..................................................
5. ..................................................
6. ..................................................
7. ..................................................
8. ..................................................

https://goo.gl/zOHuxt
Based on your investigative question, which is the variable A?

Based on your investigative question, which is the variable B?

Describe a procedure/a functional way to measure/evaluate the effect of the variable A on the variable B. For instance, how would you decide if egg 1 is better uniformly peeled than egg 2?

Complete the following sentence based on the experimental design you proposed above.

When I design a fair experiment, the variable .......... needs to be varied, the variable ........ needs to be measured and .................................................................

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
Let’s assume that egg 1 is peeled in a more uniformed way than egg 2. What conclusion can be drawn?

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Why is keeping constant specific variables (see page 20) important for your experimental design?

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Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/QC37y0

https://goo.gl/3RDWSi

https://goo.gl/jVEbzg
Read carefully the following experimental designs designed by a group of pupils at your age.

Experiment 1

"Julia and Alexander boiled a fresh egg for 10 minutes and an old one for 20 minutes in order to find which one can be peeled in a more uniformed way. If the first egg is peeled more uniformly, then we can conclude that the less time of boiling an egg, the more uniformed the peeling is".

Discuss with your group peers and decide whether the experimental design is fair. Explain your reasoning.

https://goo.gl/FOd04z

Experiment 2

"Michael and Catherine intended to determine if the amount of water affects the time it takes to freeze. In doing so, they filled two same bottles with 50 ml of water and 250ml of salt water respectively. They placed the bottles in the freezer and observed which one froze first".

Discuss with your group peers and decide whether the experimental design is fair. Explain your answer. https://goo.gl/QPYrji
Make the appropriate revisions in the design of the above experiments, in order to make them become fair.

Experiment 1

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Experiment 2

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Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzc
Go back to your initial experimental design on page 16 and assess whether your experimental design was fair or not. If your experimental design was not fair, make any necessary changes and/or improvements. In your description you should mention all the necessary steps for conducting the experiment.

What we learned so far...

To conduct a fair experiment, the following rules should be taken into account:

1. ........................................................................................................................................
   ........................................................................................................................................
2. ........................................................................................................................................
   ........................................................................................................................................
3. ........................................................................................................................................
   ........................................................................................................................................

Go back on page 17 and compare your two answers.

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/JVEbg
Discuss with your team members and decide of what you will observe/measure, how you will observe/measure it, and how you will collect your data during performing the experiment.

1. ____________________________
2. ____________________________
3. ____________________________
4. ____________________________
5. ____________________________
6. ____________________________
7. ____________________________

https://goo.gl/qcybJn

► Discuss with your team members and decide of what you will observe/measure, how you will observe/measure it, and how you will collect your data during performing the experiment.

https://goo.gl/qhWucj
In your opinion, which egg will be peeled more uniformly?

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https://goo.gl/IFdNkl

What you have written above is your **prediction**.

The prediction answers to the question: What do you think that will happen if...?

The prediction describes the outcome of an experiment and does not include any explanation.

▶ Go back on page 14. Underline the statements representing predictions.

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
Run the experiment to test if your prediction is correct. Make sure that you have all the materials that are needed for your experiment.

Record your group’s data and results in the google form. Click the following link: http://goo.gl/forms/aiKqqlx0gK

Plot your data in the blank space below using the most appropriate graph (e.g., line graph, bar chart etc).

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
Have you collected enough data to answer your question? For example, can you use only two measurements to investigate if the age of an egg affects its boiling and peeling?

In the link https://goo.gl/AxAMfP you can share your data and results with the rest of the groups.

Now you have access to the data of all groups and hence you can compare them with your own data.

**Conclusion** *(Delete the unsuitable verb)*

The age of egg affects / does not affect the peeling of the egg.

Is your prediction confirmed or rejected?

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Is your hypothesis on page 18 confirmed? If not, formulate a new hypothesis based on the data yielded from your experiment.

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Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi  
https://goo.gl/VEbzw
We are going to investigate the following question:

Formulate a hypothesis based on your investigative question.

Follow the same procedure as above and investigate a new question from the list of questions formulated in page 11.

https://goo.gl/afjkRF

Sub-phase A

Formulate the question you plan to investigate.

https://goo.gl/afjkRF
Which variables will be changed and in what way?

Which variables will be measured and how?

Which variables will be kept constant and how?

Why is it important to keep all these variables constant?

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/JVEbzg
The following experiment was designed by a group of pupils at your age. Read it carefully.

Experiment 3

"Peter aims at identifying the factors influencing the peeling of eggs. He believes that wrapping an egg with gauze will influence its boiling and peeling. He designed and perform a valid test that entailed the following steps: he took two identical eggs, wrapped only the first one with gauze, and then boiled both eggs in the same beaker for 10 minutes. After peeling both eggs, he found that wrapping the egg with a gauze does not affect its peeling.

Next, he took two other eggs to examine if the egg’s size affects the peeling of eggs. He wrapped the larger egg in gauze and placed it in a black beaker. He placed the small egg in white beaker, without wrapping it."

Discuss with your group peers if the latter experimental design was fair. Explain your reasoning.

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSI
https://goo.gl/jVEbzg
Perform the experiment to examine whether your prediction is confirmed or rejected. Make sure that you have all the equipment you need.

Record your group’s data and results in the google form. Click the following link: http://goo.gl/forms/2UIId28KQ3

Plot your data in the blank space below, using the most appropriate graph (e.g., line graph, bar chart etc).

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
Sub-phase B

- Have you collected enough data to answer your question? If not, repeat your experiment to collect more data that will enable a valid conclusion.

- In the link https://goo.gl/2q1AXn you can have access to the data of all groups and compare them with your own data.

- Share your data and results with the other groups.

**Conclusion** *(Delete the inappropriate verb)*

………………………………………………..affects / does not affect ……………………………………………………………

Is your prediction confirmed or rejected?

…………………………………………………………………………………………………………………………

Is the hypothesis that you formulated on page 30 confirmed? If not, formulate a new hypothesis based on the data arose from your experiment.

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Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
You did great! Follow the same procedure as above now to investigate your second question.

https://goo.gl/afjkRF
Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/JVEbzg
Read carefully the experiment below, which was designed by a pupil.

Experiment 4

Rania made several observations. The observations are illustrated in the table below:

<table>
<thead>
<tr>
<th>Egg</th>
<th>Egg’s age</th>
<th>Egg’s size</th>
<th>Dyed eggs</th>
<th>Peeling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 days</td>
<td>small</td>
<td>Yes</td>
<td>Non uniform</td>
</tr>
<tr>
<td>2</td>
<td>20 days</td>
<td>large</td>
<td>Yes</td>
<td>Uniform</td>
</tr>
<tr>
<td>3</td>
<td>10 days</td>
<td>small</td>
<td>No</td>
<td>Uniform</td>
</tr>
<tr>
<td>4</td>
<td>20 days</td>
<td>large</td>
<td>No</td>
<td>Uniform</td>
</tr>
<tr>
<td>5</td>
<td>4 days</td>
<td>medium</td>
<td>No</td>
<td>Non uniform</td>
</tr>
</tbody>
</table>

Rania concluded that the size of the egg affects the uniform peeling of eggs, based her observations/measurements. Do you agree with her? Explain your reasoning. In your response make reference on the measurements you used for reaching your conclusion.

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzd
Define the steps for designing and conducting fair experiments:

1. …………………………………………………………………………………………………………
   …………………………………………………………………………………………………………

2. …………………………………………………………………………………………………………
   …………………………………………………………………………………………………………

3. …………………………………………………………………………………………………………
   …………………………………………………………………………………………………………

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
Thus far, we have focused on several variables to investigate whether they affect the boiling and peeling of eggs. Provide an overview of your findings in the table below.

<table>
<thead>
<tr>
<th>Variables affecting the boiling and peeling of eggs</th>
<th>Variables not affecting the boiling and peeling of eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/afjkrF
https://goo.gl/3RDWSi
https://goo.gl/JVEbzg
Worksheet 5: Phase 5

Sub-phase A

- You will prepare a poster presentation for the last two investigations you performed in order to present it to the other groups. (Decide by yourselves what information a poster should contain.)

- Place your poster on the wall of your classroom. In your oral poster presentation try to communicate the procedure you applied to the audience.
Sub-phase B

Discuss with your group peers the following questions and record your ideas:

What practical difficulties and problems did you encounter during the inquiry phases? How did you overcome them?

Would you revise anything you followed throughout the phases?

Once all previous activities are completed, discuss your work with your teacher. Please make sure that all team members can explain what you mutually expressed in your writing.

https://goo.gl/3RDWSi
https://goo.gl/jVEbzg
References: