





# How to cook a perfect soft-boiled egg using a periodical phenomenon?









Elèves de 2nde Section Européenne Lycée Jean-Pierre Vernant, Pins-Justaret

# Table of contents

Introduction	3
Experiment Enhanced experiment Parameters Uncertainties Experimentation Egg cooking	<b>4</b> 4 5 5 6 7
The light garland  First experiment  Enhanced experiment  Experiment with a new element: the luxmeter  Final experiment  Egg cooking!	8 9 10 11 12
The blue bottle  Experiment Protocol Results Calculation Problems Remarks, improvement Pictures Our egg	14 14 15 15 16 16 16 18
Breathing  First experiment Second experiment Third experiment Final experiment First Egg cooking Second Egg cooking	19 20 21 22 23 24
Heartbeats  Experiment to study the parameters (1st day)  Experiment to study the parameters (2nd day)  Test to count heart beatings of Perle in egg cooking condition (without the egg)  Cooking of the egg	25 25 28 30 31

#### Introduction

At the end of November, we received this document:

2nde euro How to measure time using a periodical phenomenon? 2020-2021

Your class is currently enrolled in a competition!

More details on this website: https://www.sfpnet.fr/la-nuit-des-temps-2021

We present to you the following challenge:

- In groups of four, choose a periodical phenomenon in one of the following fields: biology, physics, chemistry
- perform different experiments to discover what makes the period change (the parameters)
- · how precise is your method to measure time?
- Application: use the periodical phenomenon you studied to cook a perfect soft-boiled egg (oeuf mollet)...

To present your study, you have to write a document with:

- the apparatus used
- the parameters
- · the uncertainties
- the choices made to perform the cooking of the egg
- a video with the cooked egg
- anything else you think is essential to win the competition!



At the end of the study, the class will choose the best way to present the document, and all the groups will have to present their documents as decided. All the studies will be gathered into a single document to be sent to the organization of the competition.

Groups were decided rapidly. First, we had to remember what a periodical phenomenon is... after a few minutes this definition came up:

#### A periodic phenomenon is one that reproduces itself, identical to itself, at equal intervals of time.

Then each group had to find a periodical phenomenon, it took us longer... Finally, the following phenomenon were chosen:

- sound waves
- light garland
- the blue bottle
- breathing
- heartbeats

We were all really enthusiastic to participate in the "La Nuit des Temps" contest, because we like challenges and experiments. Let's discover our work!

#### **Sound Waves**

By Anaïs Duval, Stessye Adjovi, Lylia Martin and Romane Guirardel



In our group of 4, to find the cooking time of a soft-boiled egg, we choose the periodical phenomenon of the sound waves. The period is the time required to complete one cycle of the phenomenon. A periodic phenomenon is one that reproduces itself, identical to itself, at equal intervals of time.

That means that the phenomenon repeats itself every so often. The period is the time required to complete one cycle of the phenomenon.



#### Check list

- oscilloscope (in the latis pro app on the computer)
- speaker
- microphone
- Ladle
- Saucepan
- Hot plate

#### PROTOCOL:

- Choose a piece of rhythmic music with percussion (we chose BOP)
- Measure the sound wave frequencies with the oscilloscope
- Heat a pot of water. When it boils, gently plunge the eggs into it.
- Count the equivalent of 6 minutes thanks to the periods in the song as soon as boiling resumes. At the end of this time, remove them with a skimmer and refresh them under cold water.

- Roll them gently on the worktop to crack the shell. Always peel them gently under a trickle of tap water.
- Cut in half
- Look if the egg is well-soft boiled and if the baking is perfect
- Eat!

#### PROBLEMS:

- Too many frequencies and not regular with the BOP song
- The microphone heard the noises in the classroom



Then we do the same experiment but with another song. We picked a karaoke because the singer doesn't sing (no lyrics, only instruments), and we chose "We will rock you" by Queen because the percussion is more regular and loud. We record the sound by connecting the recorder to the computer to record the song directly from the computer



- Disruptive noise
- The sound volume has to be high enough
- Disruptive objects
- Distance between the microphone and the source of the sound
- Distance between the microphone and the persons



- We don't know if the sound waves will vary depending on the distance between the recorder and the speaker
- The sound takes time to move.
- We don't know the exactness, how precise our method is.

#### Click on the links below to listen to the musics

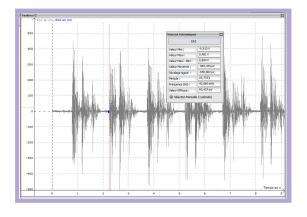




<u>link</u>



- We recorded the BOP song with a speaker and a microphone on the Latis Pro app. It didn't sound well because the microphone heard all the noises in the classroom.
- After some troubles with the BOP song, because there were too many frequencies, which weren't regular, we chose another song. We picked a karaoke because the singer doesn't sing (no lyrics, only instruments), and we chose "We will rock you" by Queen because the percussions are more regular and loud.
- So, we record the sound by connecting the recorder at the computer to record the song directly from the computer. And we obtained perfect sound waves.



#### <u>KESULIS</u> .

Number of "claps" in the music	Duration
1	1484 ms
242	360 000 ms (time needed to cook a soft-boiled egg)

# 6 EGG COOKING

- 1 person plunged the egg and remove it from the saucepan
- 2 persons were counting till 242
- 1 person was drawing a line each time we counted 10 periods to not lose the track

We cooked the egg for 6 minutes and 340 milliseconds.

But as the water evaporated, the egg didn't cook evenly. So, as a result, we tried to remove the eggshell, but the yolk escaped.





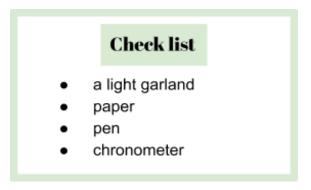


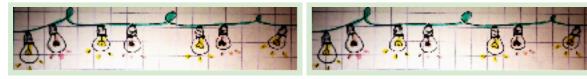
### The light garland

by Emma Bismuth, Charlotte Esplas, Clara Pollack and Camille Villenave



Goal: measure the frequency of the light garland (number of flash during one minute).





#### PROTOCOL:

- Start the chronometer.
- Count the number of flashing in one minute.
- Read the intervals between each turn and do the average of them
- Write the answer on a paper.

#### RESULTS:

- 11 flashings for 1min, a flash every 5'30 approximately.
- 66 flashings for 6 minutes.

#### Results with the Chronometer:







#### <u>CALCULATION</u>:

average interval =(5,50+5,42+5,56+5,56+5,34+5,43+5,43+5,42+5,46+5,74+5,60)/11=60,46/11=5,50 s  $\leftarrow$  hundredth round number

The interval between each turn is around 5,50 seconds.

#### PROBLEMS:

- Not precise.
- We can improve the experiment easily.
- A little bit too simple for the competition...



#### ENHANCED EXPERIMENT

Goal: we do the same experiment but with an electric plug instead of a chronometer.

#### Check list

- a light guarland
- electric plug
- paper
- pen
- chronometer



#### PROTOCOL:

- Connect the light garland in the "sequential" mode.
- Count the number of flashings in one minute.
- Write the answer on a paper.

#### RESULTS

- 47 flashings for 1min.
- 282 flashings for 6minutes.

#### PROBLEMS:

- Mode: "sequential".
- inattention errors.
- Lack of precision.
- We can improve the experiment easily.
- A little bit light for the competition.

# 3

# EXPERIMENT WITH A NEW ELEMENT: THE LUXMETER

Goal: Measure the peak intensity spike of the light garland with the mode: "in waves" instead of "sequential".

#### Check list

- a light garland
- electric plug
- paper
- pen
- luxmeter





#### PROTOCOL:

- Turn on the light in the "in waves" mode.
- Connect the luxmeter to the computer.
- Place the sensor at three centimeters from the light bulb.
- Measure the highest intensity of a light bulb.
- Repeat the process three times.
- Compare the values obtained.
- Write the values.

#### PROBLEMS:

- If the 3 highest values are different, average them.
- We thought our light garland was regular but during the experiment with the luxmeter we realised she wasn't. So we changed it.

# FINAL EXPERIMENT

#### Check list

- a light garland
- electric plug
- paper
- pen
- luxmeter

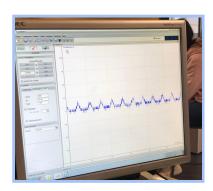


#### REMARKS, IMPROVEMENT:

- We have to hide the luxmeter because of the outside light.
- We selected the mode 2 of the light guirland because we thought that's regular intervals. (So we check if the light guirland it's definitely with regular intervals).
- We have put a blue lamp from the new garland inside a large box in order to be in total darkness.
- Then, we placed the sensor of the luxmeter.
- We have fixed the lamp to the luxmettre so that it touches the sensor.
- We made the experiment twice, one during 6 min and another during one min. During the two experiments we had the same result: 11 regular intervals for one minute so 66 intervals as 6 min.

#### <u>FIRST</u> <u>Experiment</u>

- 1min
- 2000 points
- 30ns



#### <u>SECOND</u>

#### EXPERIMENT:

- 6min
- 3000 ns
- 2000 points



We will use this light garland with its technical feature to do a perfect cooking of our soft-boiled egg.

# EGG COOKING!

#### Check list

- Heat source
- Saucepan
- Ladle
- very cold water
- gloves



#### PROTOCOL

We made the same protocol as the 4th experiment, by just replacing the light garland.

#### <u>COOK PROCEEDING</u>

The cook went very well. We had to count 66 flashes of the garland.

We started counting as soon as it was lit. Clara was marked bars every time a flash occurred, for don't get lost.

Once the 66 flashes were over, we stopped the cooking and we put the egg directly into cold water to stop the cooking. Miss Picco was timed during the cook, and when we finished the cook, it was 5,59 minutes so we were relieved and delighted. When the egg was cut, it was perfectly soft-boiled.

RESULTS

We obtained a perfect soft boiled egg!!! 😄

### Come on! It's not a fail, it is a success,

# the challenge is taken up!







Link to watch our cooking video:

https://www.canva.com/design/DAEVgPSBxpE/SnMEOCdtDtqDCmol2idAUQ/edit

#### The blue bottle

by Cécile Bidan, Karelle Blachon, Laly Lauberny and Timéo Lafont--Lumbreras





#### **EXPERIMENT**

Goal: Measure the quantity of reactants to add for the experiment time to be 1mn.

In a beaker, we pour sodium hydroxide, distilled water, glucose powder and drops of methylene blue. When we mix the solution, it becomes blue and discolour after a few seconds.

The glucose helps the solution to discolour. On the contrary, when we mix the solution, the oxygen allows the solution to become blue again.

The discolouration time is different depending on the quantity of glucose, the number of methylene blue drops and the mixing time.

#### Check list

- beaker
- powder glucose
- potassium hydroxid solution
- methylene blue
- magnetic stirrer
- spinbar
- weighing tray
- weighing scale
- bulb
- volumetric pipette
- spatula

#### PROTOCOL

- take 25 mL of sodium hydroxide with a volumetric pipet
- put it in a 500 mL beaker
- take 25 mL of distilled water with a volumetric pipet
- put it in the beaker
- weigh 0.5g of glucose with a scales in a weighing tray with a spatula
- put the glucose in the beaker
- put 5 drops of methylene blue in the beaker
- put the beaker on the magnetic stirrer
- put the spinbar in the beaker
- mix the solution during 7 seconds
- wait until the solution discolour (55 seconds)
- repeat the last two points 6 times



#### RESULTS

#### First experiment

- 25 mL of sodium hydroxide
- 25 mL of distilled water
- 0.7g of glucose
- 5 drops of methylene blue
- Disolouration time 1'20" / mixing time 10"

### Second experiment

- 25 mL of sodium hydroxide
- 25 mL of distilled water
- 0.5g of glucose
- 5 drops of methylene blue
- Discolouration time around 1' / mixing time 10"

# Third experiment

- 25 mL of sodium hydroxide
- 25 mL of distilled water
- 0.5g of glucose
- 5 drops of methylene blue
- Discolouration time 45" / mixing time 5"

# Fouth experiment

- 25 mL of sodium hydroxide
- 25 mL of distilled water
- 0.5g of glucose
- 5 drops of methylene blue
- Discolouration time 55" / mixing time 7"

#### **CALCULATION**

1 round : mix for 7 seconds + 55 seconds to discolour For the experiment, we have to get closer to 6 min

Experiment:  $(7s +55s) \times 6 = 6min 12s$ 

(The mixing time is counted in the experiment because we can't stop the chronometer in the experiment so we have to add this time to the discoloring time.)

#### **PROBLEMS**

- Not precise.
- The discolouration time decreases over time.

#### REMARKS, IMPROVEMENT

The first discolouration isn't regular and is longer than the others. So we didn't consider it.

#### **PICTURES**









#### THE SCIENTISTS











#### THE APPARATUS USED



- Magnetic stirrer
- Spinbar



- Powder glucose
- Methylene blue
- Distilled water
- Potassium hydroxid solution



- Volumetric pipette
- Bulb
- Beakers



- Weighing scale Weighing tray
- Spatula

#### OUR EGG

We named our egg Jean-Sébastien. He was perfect since the first try even if someone cracked the shell.

Here are pictures of him!



### **Breathing**

by Alice ALBY, Marguerite ATTARD and Elora CICHOCKY



Goal: Measure the frequency of breathing (number of breathing during one minute).



#### Check list

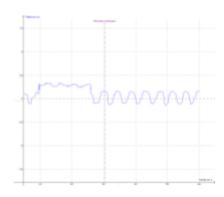
- The logiciel Latis bio on a computer
- An apparatus to measure the breathing
- A thermometer

#### PROTOCOL:

- Open Latis bio on a computer
- Prepare the apparatus, careful change the end piece between each guinea pig
- Start a new session
- Breath in quiet conditions, sat down and don't forget to pinch your nose

#### RESULTS:

18 breathings plus one breath in 1 minute



#### PROBLEMS:

- Not precise, the frequencies are not all the same
- The apparatus is difficult to use
- Adaptation time



Goal: we do the same experiment but we modify the parameters

#### Check list

- The logiciel Latis bio on a computer
- An apparatus to measure the breathing
- A thermometer

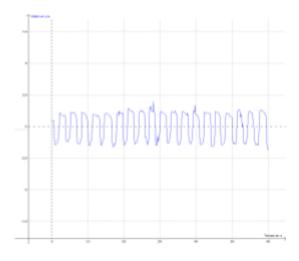


#### <u>PROTOCOL</u>

- Open Latis bio on a computer
- Prepare the apparatus, careful change the end piece between each guinea pig
- Start a new session
- Breath while squatting, don't forget to pinch your nose

#### RESULTS

19 breathings plus one breath in 1 minute



#### PROBLEMS

- Not precise, the frequencies are not all the same
- The apparatus is difficult to use
- Breathing harmonises with the squats



Goal: we do the same experiment but we modify parametres

#### Check list

- The logiciel Latis bio on a computer
- An apparatus to measure the breathing
- A thermometer



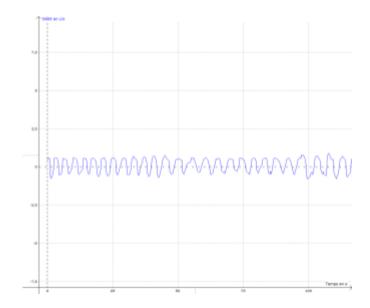


#### PROTOCOL:

- Open Latis bio on a computer
- Prepare the apparatus, careful change the end piece between each guinea pig
- Start a new session
- Breath while being confronted to stress, don't forget to pinch your nose

#### RESULTS:

26 breathings in one minute



#### PROBLEMS:

- Not precise, the frequencies are not all the same
- The apparatus is difficult to use
- Irregularity of the graph due to stress

# FINAL EXPERIMENT

#### Check list

- A notebook
- A pencil
- A piece of paper
- A chronometer





#### PROTOCOL:

- Lay down the guinea pig
- Put the notebook on his belly
- The guinea pig has to close his eyes
- Start the chronometer
- Writet a bar every 10 breathings
- Stop the chronometer at 6 minutes
- Count the total of bars

#### RESULTS:

76 breathings in 6 minutes



#### PROBLEMS:

- The guinea pig musn't count her breathings
- Has to think about something else
- Her breathings don't last the same time

# FIRST EGG COOKING

#### Check list

- Heat source
- Saucepan
- Ladle
- Very cold water
- A copy book
- A pencil





#### PROTOCOL:

We made the same protocol as the 4th experiment.

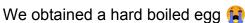
#### COOK PROCEEDING:

To cook the egg, we calculated that we had to count 76 breathings in 6 minutes.

We started counting as soon as the egg was in the boiling water. Marguerite marked bars every ten times that Alice breathed.

Once the 76 breathings were over, we stopped the cooking and we put the egg directly into cold water to stop the cooking. Miss Picco timed the cook, and when we finished the cook, it was 8.30 minutes. The cooking was too long and we had a hard-boiled egg.

#### RESULTS:



# 6 SECOND EGG COOKING

#### PROTOCOL:

We made the same protocol as the 4th experiment except we chose to do 70 breathings because 80 was too much

#### COOK PROCEEDING:

To cook the egg, we calculated that we had to count 76 breathings in 6 minutes.

The previous egg was hard boiled because the cooking was way too long. We decided to only count 70 breathings. We started counting as soon as the egg was in the boiling water. Elora marked bars every ten times that Alice breathed. Once the 70 breathings were over, we stopped the cooking and we put the egg directly into cold water to stop the cooking. Miss Picco timed the cook, and when we finished the cook, it was 4.45 minutes. The cooking was too short and we had a boiled egg.

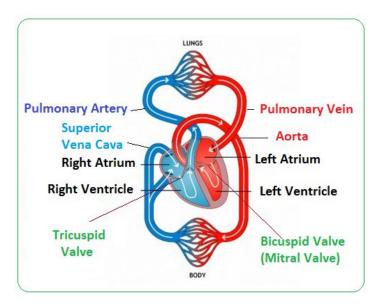
#### RESULTS:

We obtained a boiled egg 
Our experiences were not successful.

#### **Heartbeats**

by Julie Roquebernou, Pablo Battesti, Yannael Tison, Perle Giberne, Laure Vulliez

The heartbeat is the contraction of the heart which supplies blood to the entire human body. The number of beats per minute is used to determine the heart rate (70 on average in humans). With each heartbeat, the heart ejects oxygenated blood into the organs of the body via the aorta and deoxygenated blood to the lungs via the pulmonary artery.





#### EXPERIMENT TO STUDY THE PARAMETERS (1ST DAY)

#### Check list

- the Latis-bio software
- three electrodes
- a computer
- an inflatable mattress
- a smartphone with Youtube





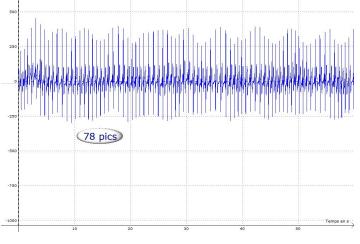
#### PROTOCOL:

- Lie and relax Perle on the mattress
- Put the three electrodes on Perle : two at wrist and one on an ankle
- Switch on the computer
- Open the software Latis bio
- Count heart beatings of Perle at rest with this software during one minute
- Count heart beatings of Perle when she look at her smartphone during one minute
- Wait five minutes
- Count heart beatings of Perle when she heard rap during one minute
- Wait fives minutes
- Count heart beatings of Perle when she watch a laughing video
- Wait fives minutes
- Count heart beatings of Perle when she watch a scary video
- Wait five minutes
- Count the heart beatings of Perle when she heard a relaxing video



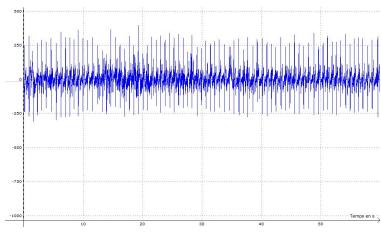
#### RESULTS:

**Graph 1: rest** (the witness)



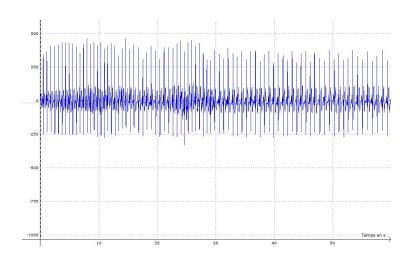
#### Graph 2: use of screen

We see that the heart rate increases. It may be because of the cerebral activity and the dopamine released during the use of screen



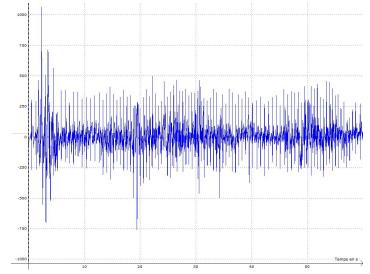
**Graph 3: listening to rap music** 

The heart rate increase but is not irregular



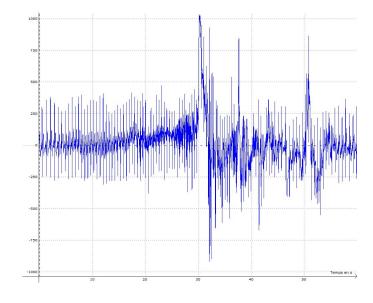
#### Graph 4: laugh

The heart rate increase a lot and is very irregular



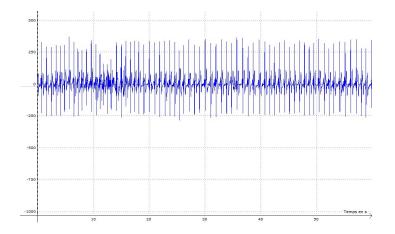
#### Graph 5: fear

The heart rate increase quickly and decrease little by little



#### Graph 6: relaxing music

We don't see a real difference with the control. It's not significative





# EXPERIMENT TO STUDY THE PARAMETERS (2ND DAY)

#### Check list

- the Latis-bio software
- · three electrodes
- a computer
- some space around
- an inflatable mattress

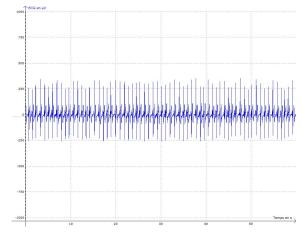
#### PROTOCOL:

- Lie and relax Perle on the mattress
- Put the three electrodes on Perle : two at wrist and one on a ankle
- Switch on the computer
- Open the software Latis bio
- Count heart beatings of Perle at rest with this software during one minute
- Count heart beatings of Perle when she is standing during one minute
- Before the end of this minute, catch Perle by surprise and wait the end of the minute
- Wait five minutes
- Count heart beatings of Perle when she is squatting during one minute
- Count heart beatings of Perle immediately during one minute



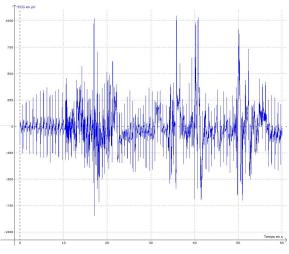
#### RESULTS:

**Graph 1: rest** (the control)



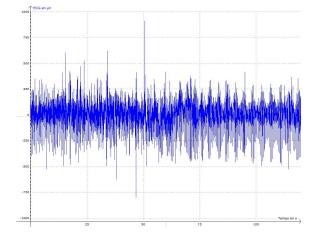
#### Graph 2: surprise

The heart rate increases a lot and quickly. The pulse is very irregular.



#### Graph 3: sport and rest

The heart rate increase a lot and is regular and Perle recovers slowly



#### CONCLUSION

The parameters which can change the heart rate are: the stress, the motion, a physical effort, a cardiovascular disease, the hydratation, the digestion, drugs, thoughts of the person, a drink of energetic drink, the different type of noise around, the environment (light, something funny around, a screen...). Stress factors influence heart rate through three mechanisms: nervous, chemical and physical. The autonomic nervous system is characterised by a sympathetic and parasympathetic nervous system. The function of the first system is to increase the heart rate; the function of the second is to decrease it.

# TEST TO COUNT HEART BEATINGS OF PERLE IN EGG COOKING CONDITION (WITHOUT THE EGG)

#### Check list

- a smartwatch with an electrocardiogram
- an inflatable mattress
- an quiet environment

#### PROTOCOL:

- Relax the guinea pig
- Measure the number of bpm of Perle with Samsung connected watch;
- Count the carotids beats. After x beats (x= number of bpm) draw a line on a sheet of paper
- Repeat this action 6 time

#### PROBLEMS:

- We couldn't count heart beatings with Latis Bio during the eggs cooking because peaks on this software are so cluster and uncountable, so we must count heart beatings of Perle ourselves
- It's difficult to feel the pulse of Perle. The best place to feel it is at the carotid artery

# COOKING OF THE EGG

#### Check list

- a smartwatch with an electrocardiogram
- an inflatable mattress
- an quiet environment (in few cases)
- an egg
- · a pan with cold water
- a pan with boiling water

#### ⇒ Count heart beatings



#### UNCERTAINTIES

- The person who counts heart beatings can make mistakes
- The heart rate of Perle can change during the experience.

#### PROTOCOL:

- Boil water in a pan
- Relax the guinea pig
- Measure the number of bpm of Perle with Samsung connected watch;
- When the water is boiling and the guinea pig is relaxed, put an egg in the pan
- Count the carotids beats. After x beats (x= n bpm) draw a line on a sheet of paper
- Repeat this action 6 time
- Get the egg out the pan
- Put the egg is a cold water pan



#### THE VIDEO OF EGG COOKING

<u>https://drive.google.com/file/d/1J1SY1xnaYjANJrqt8TGyo19xMTCzqWyn/view?usp=sharing</u>

#### CONCLUSION:

On the whole we achieve to cook a perfect soft boiling egg at the first try. It was a very interesting experiment. It allowed us to bring us together and we have from now more knowledge in biology and in english. Indeed, we learnt a lot of things doing that. It was a real pleasure to take part in this contest and we hope our experiments were attractive to you.



