Co-funded by the European Union

Learning Unit:

How much salt do we eat? How does salt affect our health and how can we reduce its level in our daily diet?

Theme:
Nutritious and Healthy Food Consumption.

Main School subjects involved: Biology, English, Chemistry, Mathematics.

Worksheets and relevant digital tools are available at the end of this unit and within the GOODFOOD Resources Library (website: HYPERLINK "https://goodfoodeplus.cebas.csic.es/" https://goodfoodeplus.cebas.csic.es/)

Total duration: ≈11 -18 h (complete activity).
≈2-3 h (separate activities)

Core concept:

The consumption of high quantities of salt has been associated with an increase in blood pressure and the development of hypertension as well as other disorders. It is important to learn and understand that the excess of salt is relevant for the development of serious chronic diseases. Learning to investigate as well as to estimate the daily amount of salt we need/consume will help the students to improve their food choices and to become responsible consumers of the future with improved body health.

Co-funded by the European Union

Learning Objectives

Students will learn to:

- Plan and develop a research project following a number of steps based on the scientific method.
- Explore the quantity of salt in different food products: understand nutritional labels and nutritional applications and websites.
- Measure and compare the salt content of different foods by means of an experimental method.
- Estimate the daily salt intake and compare it with the daily reference values: how much do we eat; how much do we need.
- Understand the meaning of blood pressure in relationship with hypertension.
- Learn the relevance of understanding and applying to their own dietary choices, the knowledge about the amount of salt present in foods and the relationship with disease prevention.

Steps of the Learning Unit

Orientation

Duration: ≈2 h.
School subjects involved: Biology, Chemistry, English, Art
Where the activity takes place: classroom/fieldwork
Method (how the students have to work): in groups
Equipment / materials: Notebooks, pens, board, mobiles (for taking pictures), colour pencils, paper for drawing, scissors, pins, etc.

Description:

Brainstorming exercise: What do the students know about the content of salt in foods?

Phase 1. –Next, the students will try to respond to a series of general questions to check their knowledge about the content of salt in food (≈30-40 minutes). We include here a list of potential questions:

1. Do you know what the main salt present in our foods is?
2. Do you know the chemical formula of salt?
3. Why do we add salt to our food?
4. Can you think of any foods with a high content of salt? With a low content of salt?
5. Do you know whether the content of salt is included in the nutritional labels of foods?
6. Do you know what the daily recommendation of dietary salt is?
7. Do you think that salt is bad for our health?
8. Can you think of any examples of the relationship between the intake of salt and a disease?
9. Have you heard about hypertension? Do you know what it means?

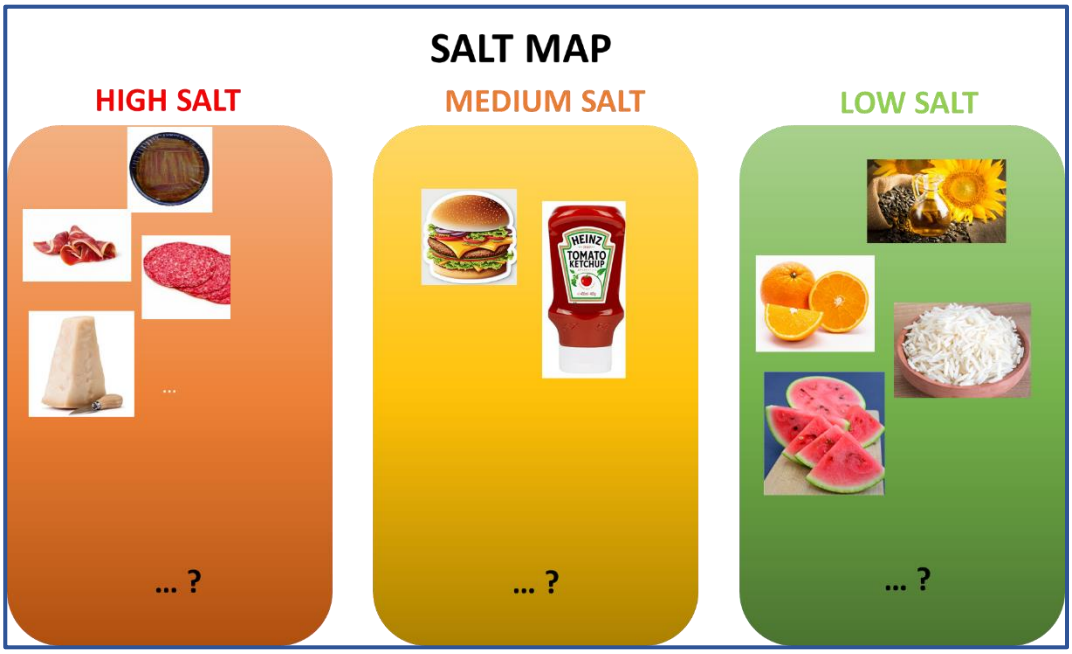
This latest exercise has also been prepared in the form of a **Kahoo' – Salt in our daily foods** (9 questions, 1 minute/question; link to the pdf with the kahoot questions at the end of this unit).

A few other questions can be added to check the students' interest in learning more about the content of salt in our daily foods:

1. Should we fully eliminate the salt from our food? Should we avoid foods that contain a lot of salt?
2. Do you like searching for different food products in the supermarket and checking/comparing their salt composition by reading the nutritional labels?
3. Do you understand the meaning of the salt information indicated in the nutritional labels?
4. Would you like to learn to determine/understand better the salt content in foods?

Phase 2. – In the classroom, and with the help of the teachers, the students will prepare a List of Foods containing the foods and ingredients they used in their initial recipe as well as other different foods/ingredients. Examples: processed foods and meats, sausages, salty nuts, chips, salty snacks, etc. To

introduce ART in this phase, the students can prepare the list of foods with drawings/pictures of the different foods/ingredients. Next, and according to their own knowledge/opinion, they will rank the foods from those they think have the highest salt content to the lowest one, and will create a **SALT MAP** (e.g. paper poster or a power-point poster, see example below). Alternatively, they may play a **CARD GAME** (available through the GOODFOOD website: https://goodfoodeplus.cebas.csic.es/the-goodfood-card-game/) in which they will rank the food items from higher to lower content of salt (≈30-40 minutes). The card game can be equally used for ranking other nutrients (fats, sugars, or CO_2 equivalents).



Conceptualisation

Duration: ≈30 min.
School subjects involved: English, Biology.
Where the activity takes place: classroom.
Method (how the students have to work): in groups or as a whole class.
Equipment / materials: notebooks, pens, board.

Description:
The hypotheses to investigate within this Learning Unit will be formulated/discussed in class by the students working in groups. They will then be refined in plenary by the whole class with the help of the teachers. Based on the Orientation phase, the questions will focus on finding out about the content of salt in different foods, and how to measure it. The students will include the foods/ingredients present in the recipes they have initially prepared/selected. They should also include additional foods from the previous List of Foods examined during the orientation phase and (or) other foods suggested by the teachers/students. The more choices they have, the better they will be able to compare and differentiate the content of salt in different foods and to select alternative foods and ingredients that can be used in the preparation of a second healthier recipe.

Hypotheses (examples).

- What is the salt content and what differences I find in the foods/ingredients in my recipe?
- What are the main differences in the quantity of salt between the foods/ingredients we have selected?
- What changes can I make to prepare a recipe/meal with a lower level of salt than the one in our initial recipe?

Investigation

Core concept: A high intake of salt has been associated with the risk of developing diseases such as hypertension. It is important that we learn to choose the right foods/meals with less quantity of salt. During this investigation, the groups of students will choose, plan and carry out a specific activity to learn:

How to estimate the quantity of salt in different foods? – Activity 1

How to measure the salt content in different foods using an experimental approach? – Activity 2

How to estimate the amount of daily salt we eat/should eat? – Activity 3

Understanding the meaning of high blood pressure (hypertension) – Activity 4

Activity 1. – Applying current information available in the web to learn about the salt content in food.

Description:

Sodium chloride (NaCl) is the main salt present in our foods and its concentration is a crucial parameter that strongly influences the storage, flavour and quality of many foods. It helps to prevent the growth of pathogens and hence its spoilage. In recent years, consumers have developed a tendency to low sodium intake, since a diet rich in sodium leads to higher blood pressure. Therefore, it is very important to measure and control the amount of salt we eat.

In this activity, the students will improve their understanding of the nutritional labels as well as learn to use some Apps and Web-based tools to know more about the salt content of different foods.

Duration: ≈2-3 h.
School subjects involved: Biology, Chemistry, Mathematics, English
Where the activity takes place: In the classroom and (or) as homework
Method (how the students have to work): in groups of several students with the help of the teachers/researchers.

- *1. Planning the investigation activities.*

- Selection of the foods/ingredients that will be investigated including the initial recipe ingredients and some alternative ones (from the initial List/Poster).
- Computers/Mobile phones with Internet connection and Excel program.

- Access to databases and Apps where you can search for the salt content of foods (List with recommended tools included at the end of the Learning Unit).

➢ *2. Performing the investigation activities.*

For the analysis and comparison of the salt quantities:

- The students will go to a (super)market where there are many types of foods, and will search for as many as possible of all those different foods from the initial List/Map of Foods. They can take pictures/notes of the products and of the nutritional labels, but primarily, of the TYPE and QUANTITY of SALT indicated. In addition, they will also try a mobile App such as YUKA, and note down the results of salt indicated by this App (if they do this task outside the school time, this can take for as long as they like/can; if they go from school, it can take around 50-60 minutes).
- Back in class or as homework, the students will additionally use and compare some of the different digital tools (websites) to further investigate the salt content of the foods/ingredients selected (for example, they can use and compare the USA/UK databases against the ones available in their own country/language).

➢ *3. Analysis of results and main findings.*

The students will organise the results of all the investigations in a **Table of Results 1 – Activity 1** (Excel file 1) where they will include all the information on the salt content collected from the different foods/ingredients examined. Importantly, they should check how the salt content is reported (e.g. salt, NaCl, Na) as well as the units. Present all the collected values in g/100 g of product to allow for comparisons between foods and ingredients. They will have a final list with the salt content of the ingredients/foods of their recipe as well as that of alternative products, which may contain lower levels. They will also have data from different sources: supermarket nutritional labels, different databases/Apps. When the salt content is indicated as Na, it is possible to convert the value to NaCl or salt. The calculation is explained below and already included in the corresponding column of the Excel file.

Explanation: NaCl (Mw = 58,5) contains Cl (chloride) and Na (sodium) in equal proportions but, as both elements have different molecular weights (Cl Mw = 35,5; Na Mw = 23,0) we find that in 1 g of salt we find about 0,6 g of Cl and about 0,4 g of Na. Thus, we can apply the following formulas to convert the amount of Na or the amount of Cl into the corresponding amount of salt:

$g\ Na \times 2.5 = g\ NaCl$ $\quad$ $g\ Cl \times 1,7 = g\ NaCl$

According to the information collected in the Table, the students will rank the foods from the highest to the lowest levels of salt, and will check how much of these results agree with those of the previous List of Foods (**SALT MAP**), and will reorganise it accordingly (≈30-40 minutes).

The students will prepare a final report of the activity explaining the work done and presenting the results attained with the different approaches. They can also prepare a list of inferences about the use of the different tools: problems encountered, best informative source, etc. These issues will be later presented and discussed during the CONCLUSION and DISCUSSION sections of the project.

Activity 2. – Experimental approach to estimate and differentiate the quantity of salt in different foods.

Description:

In this activity, the students will learn to prepare and use a basic experimental approach to estimate the content of salt in a selection of foods/ ingredients.

Duration: ≈2-3 h.
School subjects involved: Biology, Chemistry, Mathematics, English
Where the activity takes place: Laboratory hands-on experience (in the school lab).
Method (how the students have to work): in groups of several students with the help of the teachers/researchers.

- *1. Planning the investigation activities.*

  - From the initial List of Foods, select and buy the foods that will be used in this experiment, including some of the foods/ingredients used in the initial recipe. They should analyse at least three or four very different ones, (i.e. foods with higher and lower content of salt). Taste them and note down the flavour (e.g. salty, sweet, neutral, strong, etc). *Suggestion: Chips, salty almonds, sausage, etc.*

  - Prepare the material for the experiment: beakers and Erlenmeyer flasks (20 or 50 mL), measuring cylinders (20 or 50 mL), pipettes, burette, markers, safety goggles and gloves, digital scale, domestic blender, reagents (silver nitrate, potassium chromate, sodium chloride or table salt, etc…), distilled water, extraction hood or open air/ventilated working area.

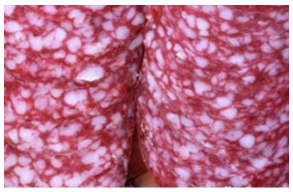
- The titration Mohr's method (named after Karl Friedrich Mohr).

  This method determines the concentration of ion chloride ion in a solution by titration with silver nitrate 0.1N (formula of N = Normality; V × N = gr / Mw; silver nitrate Mw=169.87 g/mol). As the silver nitrate solution is slowly added with a burette, a precipitate of silver chloride forms. The end-point of the titration occurs when all the chloride ions have been precipitated. Then additional silver ions react with the chromate ions (indicator: potassium chromate, 5% ≈ 5g/100 mL), to form a red-brown precipitate of silver chromate.

➢ *2. Performing the investigation activities.*

For the comparison of the salt composition, the students shall follow the next protocol:

- Sample preparation is indicated for each food sample (total samples to titrate will depend on the number of foods analysed and the repetitions per sample, normally ×3 replicates).
- Sample grinding: the sample must be grinded to the smallest particle size possible to get a most homogenous mixture. This can be done, for example, using a domestic blender or grinder or a plastic bag and a hammer. Keep the final sample in a container and use it as soon as possible. If needed, they can be kept in a fridge at low temperature (e.g. a meat sample or a cheese sample).
- Using the digital scale, weight out a certain amount of the grinded sample (e.g. salty almonds: ≈5.0 g; sausage "*salchichón*":≈3.0 g) into a glass laboratory flask (marked with the name of your food sample – Flask 1). First, weigh the Flask 1 empty, and then weight the Flask 1 with the added grinded sample. Note down the results in the **Table of Results Activity 2** (in Excel file 2).



- Next step is to prepare the solution of salt from the food sample. Pour a certain volume of distilled water (no salt in it), e.g. 20 mL (you can measure this volume with a glass cylinder) into the Flask 1 with the weighted grinded sample. Agitate thoroughly the sample in the water for a few minutes (e.g. 5 min) to extract and dissolve the salt. Let the solution settle for a while and filter it through a paper filter so that it retains any solid particles.
- If you like, you may prepare a positive control with a solution of NaCl or table salt in distilled water. Weigh out 0.05 g of NaCl and dissolve into 20 mL of distilled water (in this case, there is no need to filter it).

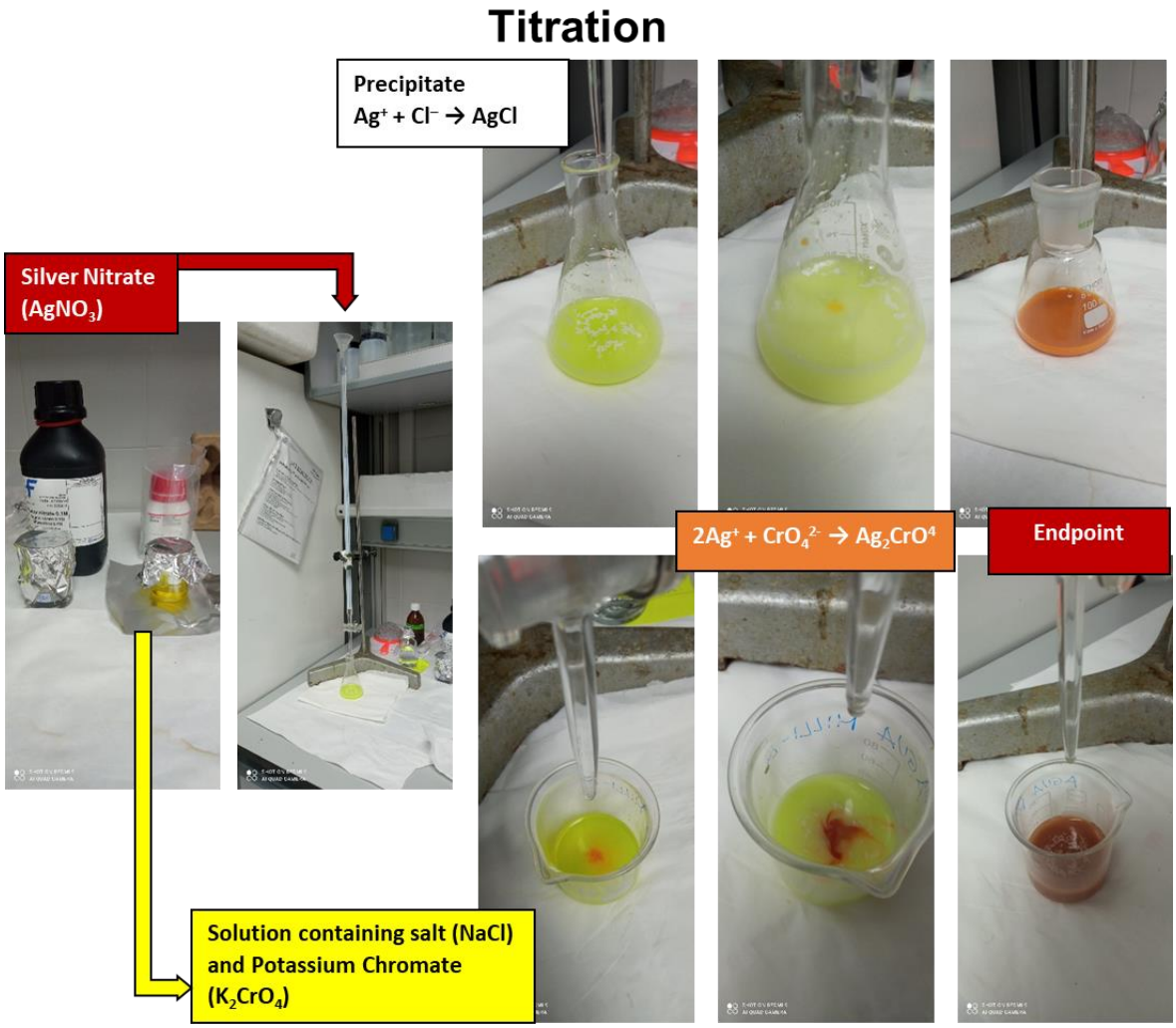
- Titration procedure:

  - Take an aliquot of 10 mL of the filtered sample solution into an Erlenmeyer or precipitate flask.
  - Add 0.5 mL of the indicator potassium chromate (≈5%). The solution will turn yellow.
  - The burette is filled with 0.1 N of $AgNO_3$ until the zero point.
  - The sample is slowly titrated with $AgNO_3$ solution. At the beginning you may notice the formation of a whitish precipitate and the slow formation of a perceptible pale red-brown colour that rapidly disappears. Eventually, the colour will extend to the whole solution and will remain. This is the end of the titration.
  - Note down the titration volume.
  - The following formula is used to calculate the amount of chloride.

mg Cl^- = V_{Ag} (mL) × N_{Ag} (eq/L) × 35.5 g/eq (Cl^-)

V: mL of $AgNO_3$ used in the titration.
N: Normality of $AgNO_3$ (0.1 N)

You can find a video with the explanation of the whole process at YouTube: https://www.youtube.com/watch?v=m6t8Wvo9sGA



3. Analysis of results and main findings

Include and revise all the data and information collected in a **Table of Results – Activity 2** (Excel file 2). Revise and make sure all the units are the same. Present the results in g salt (NaCl) per 100 g of product.

The students will prepare a final report of the activity explaining the work done and presenting the results attained for the different foods analysed. They can also prepare a list of inferences about the application of

the experimental approach: problems encountered, etc. These issues will be later presented and discussed during the CONCLUSION and DISCUSSION sections of the project.

Activity 3. - Daily salt intakes and daily salt recommendations.

Description:

The students will estimate *via* Internet and/or Apps how much salt is recommended for them to eat on a daily basis. They will also estimate the amount of salt they eat daily and how much is that of the daily recommendations.

Duration: ≈1-2 h.
School subjects involved: Biology, Chemistry, Mathematics, English.
Where the activity takes place: In the classroom and (or) as homework.
Method (how the students have to work): in groups of several students with the help of the teachers/researchers. This group may be the same as for Activity 1 or share data between them.

- *1. Planning the investigation activities to be implemented.*

  - Computers/Mobile phones with Internet connection.
  - Apps and Databases where you can search for the daily salt recommendations and calculations (List with recommended tools included at the end of the Learning unit).

- *2. Performing the investigation activities.*

To find out how much salt is needed daily:

  - The students will search for the daily quantity of salt needed. They can do so by looking in different websites such as those of the WHO or the Harvard School (links included at the end of the unit). Alternatively, they can also apply the DRI Calculator (also included at the end of the unit). They can introduce the data for different people (e.g. some of the participant students, friends, relatives, teachers, etc) to see if there are differences in the salt recommendations depending on the person.
  - Using the information acquired from the salt content of different foods/ingredients (they can attain this information with/from their colleagues working in Activity 1) and from the daily salt recommendations they have annotated, the students can then calculate the percentage of the daily salt recommendations that they are consuming with each food/serving size.
  - The students can also estimate the average amount of salt they consume in a day (or, at least, in one meal of the day). See **Table of Results Activity 3** (Excel file 3). This can be done by writing in a **food diary** all the foods/ingredients they eat as well as the approximate serving quantities using a bench/digital scale or estimating the quantity using specific guides (see material provided at the end of the unit). They will then search for the salt content using the specific web sites provided (e.g. they can compare the country specific one and the USA sites; see links at the end of the unit). They can next work out the amount of salt ingested per food as well as the % of the total amount recommended per food. In the end, they will know how much salt they are consuming a day and

how much is that in comparison with the total amount recommended. Suggestion: they can weigh out in plastic bags the total amount of salt ingested to have a good idea of how big this quantity is.

- *3. Analysis of results and main findings.*

  Inspect and note down the results found using the specific tools and Apps into the **Table of results - Activity 3** (Excel file 3). Write a report of the results and prepare a presentation with the main issues learnt and the conclusions.

  The students will prepare a final report of the activity explaining the work done and presenting the results attained with the different approaches. They can also prepare a list of inferences about the use of the different tools: problems encountered, best informative source, etc. These issues will be later presented and discussed during the CONCLUSION and DISCUSSION sections of the project.

Activity 4. - Search for information about blood pressure, the meaning of hypertension, and how the amount of salt in our diet influences blood pressure.

Description:

The students will explore what blood pressure is, how to measure it and the normal values for systolic and diastolic pressure. They can also explore the blood pressure among school-mates, teachers and (or) members of their family and close relatives (if available) and will try to understand the meaning of these values. They will be initiated in the search for scientific information about these issues. They will also investigate which foods are or are not recommended to battle these metabolic alterations.

Duration: ≈2-3 h.
School subjects involved: Biology, English.
Where the activity takes place: In the classroom and (or) as homework.
Method (how the students have to work): in groups of several students with the help of the teachers/researchers. This group may be the same as for Activity 2 or share data between them.

- *1. Planning the investigation activities to be implemented.*

  - Computers/Mobile phones with Internet connection.
  - Sphygmomanometer to measure blood pressure.
  - Reliable scientific websites/articles where they can find information about blood pressure and the values that are currently accepted as healthy, risk, or unhealthy. (List with some links to specific databases with cardiovascular information, links to recent scientific articles or, links to scientific databases like PubMed or Google scholar).

- *2. Performing the investigation activities.*

  - Search for scientific information regarding the definition of systolic (SBP) and diastolic (DBP) blood pressure and critical values for blood pressure.

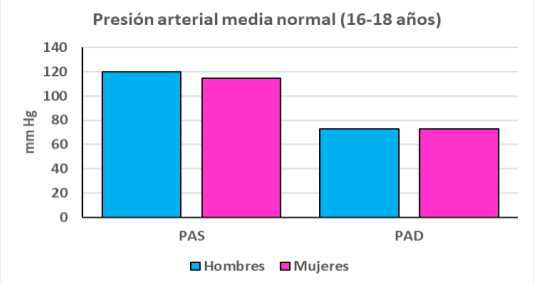
- Investigate blood pressure values: measure blood pressure: classmates, teachers. All the values (SBP, DBP) will be included in the final table **ANONYMOUSLY**.

➢ *3. Analysis of results and main findings.*

The students will collect the information in a **Table of results – Activity 4** (Excel file 4). The more values they collect, the better. With these data the students:

1) will investigate and interpret the meaning of the results of the blood pressure; i.e. they can indicate whether the values are considered low, normal or elevated;

2) can also try to see whether there is a relationship between sex/age and blood pressure. For this part, they may want to join the data of all the volunteers collected and prepare a graphical representation (see example).



Conclusion

Duration: ≈1-2 h.
School subjects involved: Maths, English, Biology.
Where the activity takes place: classroom.
Method (how the students have to work): in groups of several students with the help and collaboration of teachers of different subjects (to be discussed with the teachers).
Equipment / materials: Notebooks, pens, foods (or photographs of foods/nutrition labels), computers, mobile phones.

Description:

With the results acquired:

- Reporting: the different groups of students will elaborate a report with their main findings (Tables of results) and present/explain their conclusions to their colleagues. For this, the students can produce a poster and/or make a presentation (PowerPoint, videos, any other tools they may like, etc).
- Brainstorm: the different groups of students will try to come up with some general common ideas with regards to:
  - ✓ Which methods can be easily used and are sufficiently reliable to estimate the salt content of different foods.
  - ✓ How to read and understand the nutritional labels.
  - ✓ How/Which Apps and Web-based tools use to investigate the salt content of foods.
  - ✓ What general recommendations should be followed in our daily food choices.
  - ✓ How important it is to check and maintain healthy levels of blood pressure.
  - ✓ How to improve their recipe or prepare a healthier one so that it may help to maintain healthy blood pressure values.
  - ✓ …

Discussion

Duration: ≈1-2 h.
School subjects involved: Maths, English, Biology, Chemistry, Art.
Where the activity takes place: classroom.
Method (how the students have to work): in groups of several students with the help and collaboration of teachers of different subjects.
Equipment / materials: Notebooks, pens, foods (or photographs of foods/nutrition labels), computers, mobile phones.

Description: In this phase the students will discuss further their own findings by talking about the whole experience and indicating what were the main difficulties they found, what things they did not understand so well, or what phases they found more difficult to perform, what they liked most, what they did not like, what they have learned about the salt in our foods and diet, and its relationship with health, etc

With the knowledge acquired, the students can:

- Propose general changes/recommendations in their food habits concerning the salt content to try to change to healthier foods and reduce the consumption of salt.

- Propose specific alternative foods/ingredients that may be used to prepare an improved recipe taking into account these changes/recommendations: “less salty recipe”.

- How much has that second recipe been improved? How much have they reduced/changed the intake of salt? Work out the new salt levels and the % of daily recommendations that these changes promote.

- Propose a simple nutritional label/advertisement/video (???) with the information about salt that they would consider important to help the consumers make a healthier choice with lower levels of salt.

Links and Worksheets Templates

Kahoot about the Salt in Foods:

https://drive.google.com/file/d/1t_efGkcqkS5KJKEhP6U8E1ohlh7ZSB_Z/view

Table of Results – Activity 1 (Excel file 1):

https://docs.google.com/spreadsheets/d/1CxsYqPEolBhD9MQ4AXjZUk6k_00xVaYS/edit?gid=535691890#gid=535691890

Table of Results – Activity 2 (Excel file 2):

https://docs.google.com/spreadsheets/d/1Pq-a39ZsDGKSMGH89VwGgv07pgSvPYkj/edit?gid=520788022#gid=520788022

Table of results - Activity 3 (Excel file 3):

https://docs.google.com/spreadsheets/d/1Tm0Xu4dDDIsW2xjSKp-wOKm3z5L_k6XS/edit?gid=1158783858#gid=1158783858

Table of results – Activity 4 (Excel file 4):

https://docs.google.com/spreadsheets/d/1bHf_Hd5NX5Gpat15Gdx2x-JaRyQfrLPA/edit?gid=1255433313#gid=1255433313

Recommended Digital Tools and informative websites

Databases for salt content

FoodData Central: https://fdc.nal.usda.gov/ - Integrated data system that provides expanded nutrient profile data and links to related agricultural and experimental research. English - USA.

FOODB: https://foodb.ca/ - The world's largest and most comprehensive resource on food constituents, chemistry and biology. It provides information on both macronutrients and micronutrients, including many of the constituents that give foods their flavour, colour, taste, texture and aroma. FooDB is offered to the public as a freely available resource. English - Canada.

Country specific

SPAIN

BEDCA: https://www.bedca.net/bdpub/index.php - Spanish Food Composition Database. Spanish - Spain

BADALI: http://badali.umh.es/home - Spanish Nutrition Database with general composition of many foods as well as information on many nutritional and health issues. Spanish - Spain

ITALY

Italy BDA: https://bda.ieo.it/ Banca Dati di Composizione degli Alimenti per Studi Epidemiologici (Italian and English).

Italy AlimentiNutrizione: https://www.alimentinutrizione.it/ - CREA Centro di ricerca Alimenti e Nutrizione (Italian).

GREECE

FAO Food-based dietary guidelines:
https://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/greece/en/

Nutritional Apps

MYFOODDATA*: https://www.myfooddata.com/ (A very complete and easy to use application with many different tools to work on nutrients, food composition, calories, etc. Based on USDA Food Data Central. Recommended App but it has information mainly on USA foods and may not contain specific foods from other countries).

YUKA: https://yuka.io/es/aplicacion/

Salt needs and recommendations/Association with risk disease

WHO recommendations: https://www.who.int/news-room/fact-sheets/detail/salt-reduction

Harvard school of Public Health – The Nutrition Source:.
https://www.hsph.harvard.edu/nutritionsource/salt-and-sodium/

AESAN: https://www.aesan.gob.es/AECOSAN/web/nutricion/detalle/plan_consumo_sal.htm

https://www.aesan.gob.es/AECOSAN/docs/documentos/nutricion/estudio_contenido_sal_alimentos.pdf

Personal Nutrients Calculator: https://www.nal.usda.gov/human-nutrition-and-food-safety/dri-calculator - Calculator of your own recommendations based on your sex, age and BMI. English – USA.
Serving size guides

Spanish guide (65-70 euros): https://www.finut.org/guia-fotografica-de-porciones-de-alimentos-consumidos-en-espana/ (copy at CEBAS).

Websites for checking information about the levels of blood pressure

John Hopkins Institute (English): https://www.hopkinsmedicine.org/health/conditions-and-diseases/high-blood-pressure-hypertension

MedlinePlus Health Information: https://medlineplus.gov/spanish/healthtopics.html

American Heart Association: https://www.heart.org/en/health-topics/high-blood-pressure/understanding-blood-pressure-readings