Co-funded by the European Union



M-STEM Lesson Presentations

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

CC BY NC SA

VAEV R&D · Colegio Séneca S.Coop.And · Agrupamento de Escolas de Barcelos – Educação Pública de Qualidade · Eurasia Institute · Inspectoratul Școlar Județean Teleorman · City of Malmö

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Co-funded by
the European Union

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE



2023-1-FR01-KA220-SCH-000151516

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

CC BY NC SA

Co-funded by the European Union

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

Introduction

These lesson plans are designed to inspire students to engage with STEM in an interactive and enjoyable way, using innovative approaches suited for virtual and immersive learning environments. Built around M-STEM subjects such as artificial intelligence, machine learning, renewable energy, sustainable technology, mathematics, and the sciences, the content encourages curiosity, creativity, and real-world problem solving. The lessons are structured to motivate learners by presenting complex concepts in a fun, accessible manner, while providing teachers with ready-to-use materials that support modern, technology-enhanced classrooms.

Co-funded by the European Union

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

The primary target group includes STEM teachers and educators seeking fresh, digital-forward teaching resources to enhance student engagement. These lesson plans also benefit students by fostering interest in future STEM careers, while offering educational institutions flexible content that can be adapted across diverse learning settings. Ultimately, the materials aim to empower educators and inspire learners through collaborative, innovative STEM education.

M-STEM VAEV R&D Colegio Séneca S.Coop.And AGRUPAMENTO DE ESCOLAS DE BARCELOS EDUCAÇÃO PÚBLICA DE QUALIDADE EURASIA INSTITUTE INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN City of Malmö

Co-funded by the European Union

VAEV R&D · Colegio Séneca S.Coop.And · Agrupamento de Escolas de Barcelos · Eurasia Institute · Inspectoratul Școlar Județean Teleorman · City of Malmö



Artificial Intelligence

METAVERSE-BASED STEM EDUCATION FOR
A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

Learning Objectives:

By the end of this lesson, students will be able to:

- Define Artificial Intelligence (AI)
- Define AI key components.
- Identify real-world applications of AI
- Discuss AI role in the Metaverse.
- Know about Adaptive Learning in Virtual Classrooms
- Discuss the Ethical Challenges of AI in the Metaverse

M-STEM
Co-funded by the European Union
VAEV R&D
Colegio Séneca S.Coop.And
Agrupamento de Escolas de Barcelos
Educação Pública de Qualidade
Eurasia Institute
Inspectoratul Școlar Județean Teleorman
City of Malmö

Share your experience!

Have you ever used an AI tool like Siri, Alexa, Google Assistant, ChatGPT, or an AI-powered chatbot?

Share your experience!

- **What AI tool did you use?**
- **What did it help you with?**
- **Did you find it useful or challenging?**

Let's discuss how AI is already a part of our daily lives!

M-STEM

Co-funded by the European Union

VAEV R&D

Colegio Séneca S.Coop.And

AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE

EURASIA INSTITUTE

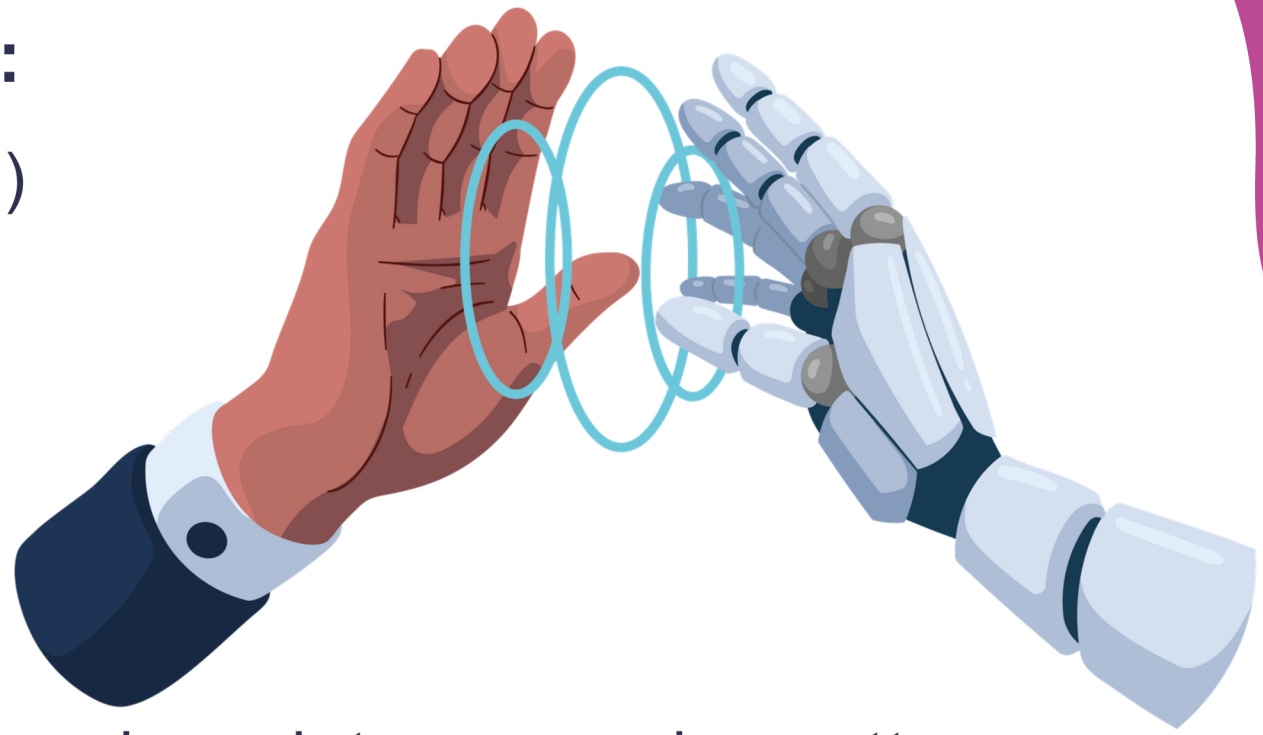
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN

City of Malmö

What is Artificial Intelligence ?

Artificial Intelligence:

Artificial Intelligence (AI) is the development of computer systems that can perform tasks that would normally require human intelligence.



AI enables machines to analyze data, recognize patterns, make decisions, and improve over time based on experience.

Unlike traditional software that simply follows pre-programmed instructions, AI can learn from data and make intelligent decisions, allowing it to adapt to new situations.

Co-funded by the European Union

Co-funded by the European Union

Key Components of Artificial Intelligence

Key Components of AI:

Machine Learning

the ability of a machine to learn from experience. It allows AI systems to process large datasets, recognize patterns, and improve performance over time without being explicitly programmed.

Neural Networks

Neural Networks mimic the way the human brain processes information. They consist of layers of interconnected nodes that process data and find complex patterns.

M-STEM

Co-funded by the European Union

VAEV R&D

Colegio Séneca S.Coop.And

AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE

EURASIA INSTITUTE

INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN

City of Malmö

Key Components of AI:

Natural Language Processing

NLP enables machines to understand and generate human language. It involves tasks like translating languages, answering questions, and even detecting sentiment in text.

Computer Vision

Computer Vision enables machines to interpret visual information from the world, such as recognizing objects or faces.

M-STEM

Co-funded by the European Union

VAEV R&D

Colegio Séneca S.Coop.And

AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE

EURASIA INSTITUTE

INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN

City of Malmö

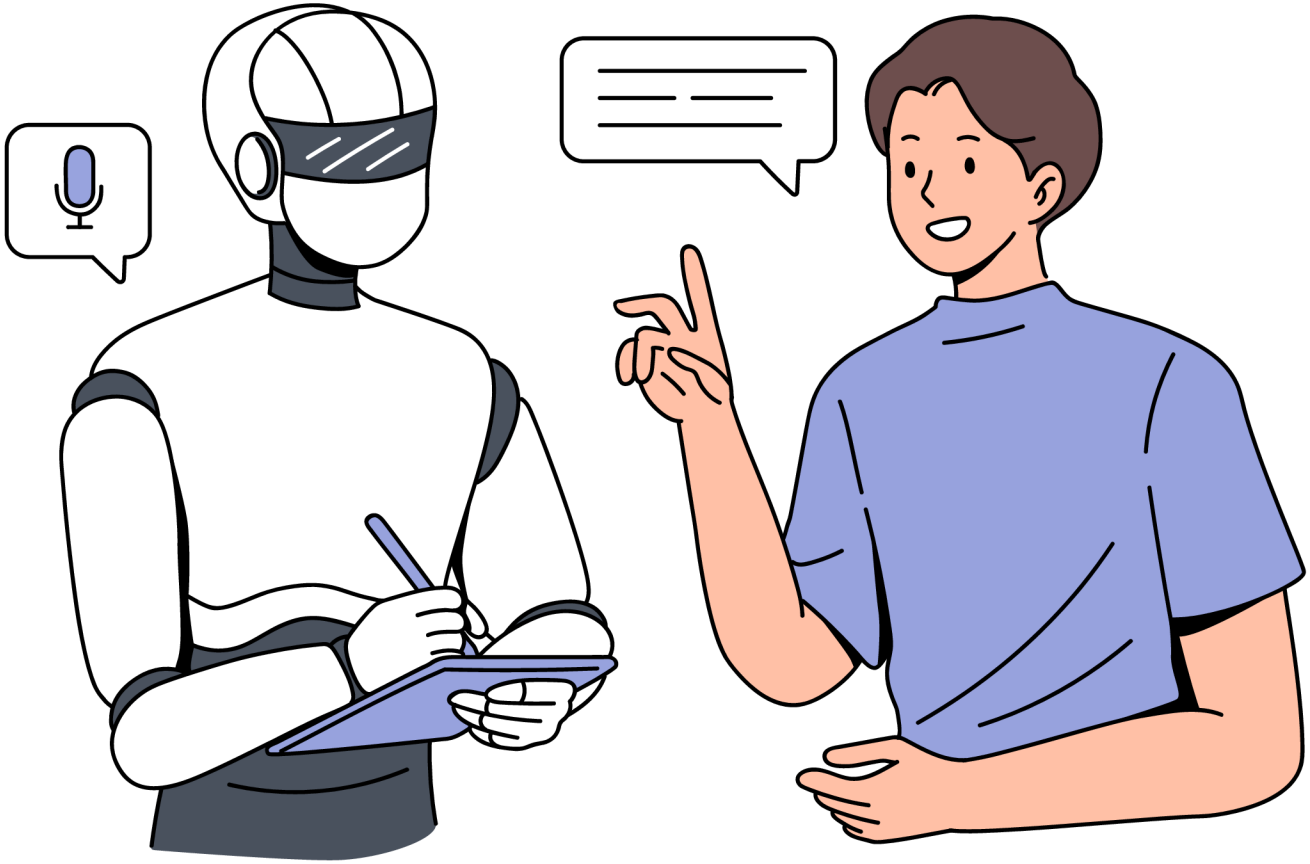
AI in the Real World

Co-funded by the European Union

AI in the Real World

Personal Assistants:

AI-powered virtual assistants like Siri, Alexa, and Google Assistant can set reminders, play music, and answer questions based on natural language processing.



Co-funded by the European Union

AI in the Real World

Self-Driving Cars:

AI in self-driving cars processes data from cameras and sensors to navigate safely through the environment. A Tesla uses AI to detect pedestrians, read traffic signs, and avoid obstacles, all in real-time.

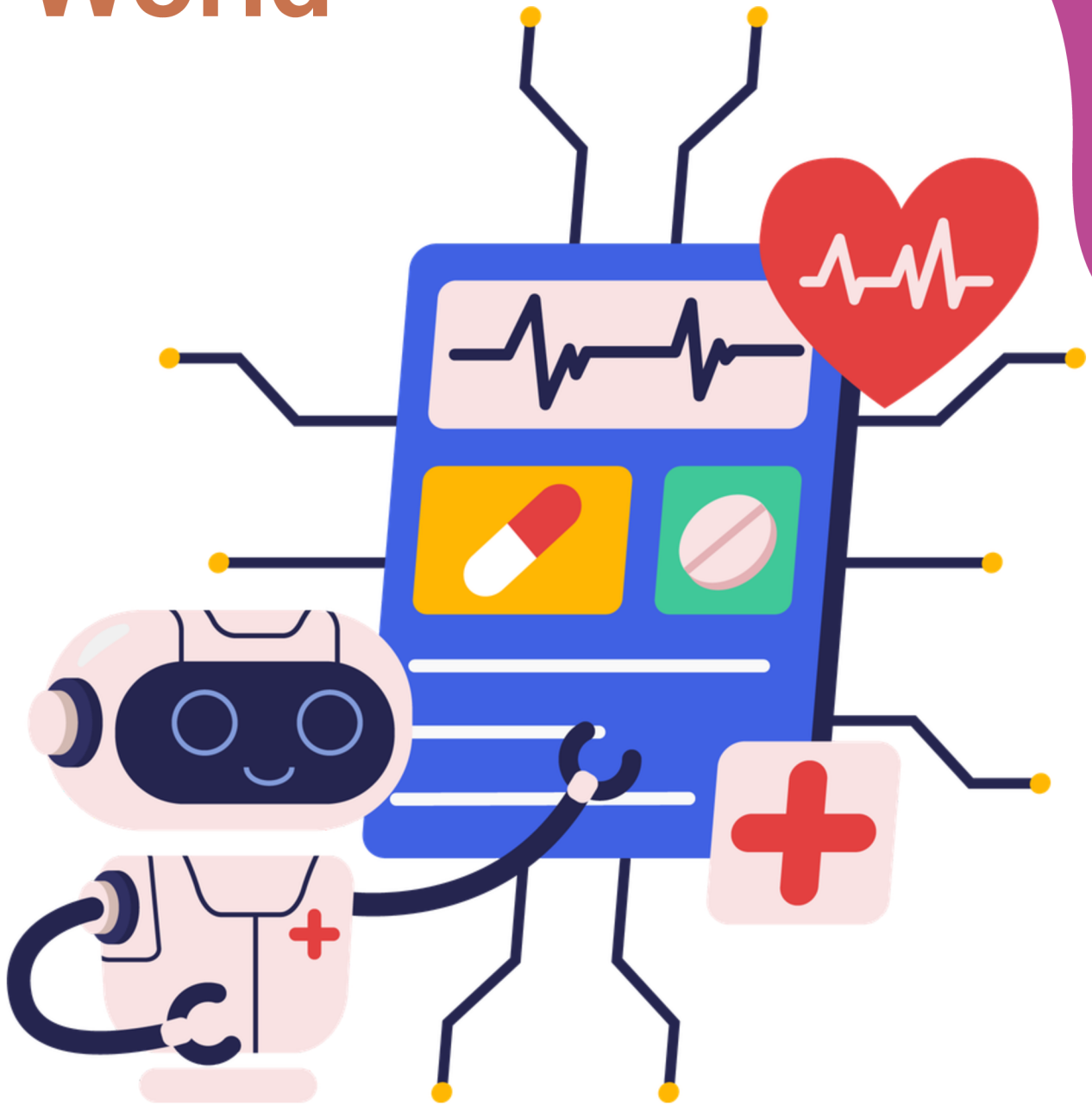


Co-funded by the European Union

AI in the Real World

Healthcare AI:

AI is used to assist doctors in diagnosing diseases, analyzing medical images, and even predicting health conditions. AI systems can analyze X-rays and MRIs to detect anomalies like tumors.



Co-funded by the European Union

AI in the Real World

Chatbots:

AI-driven chatbots are used in customer service to instantly respond to inquiries and solve issues. AI-powered customer service bots help you solve problems on websites without human agents.



Have you had the opportunity to use an AI chatbot? If so, could you please share your experience?

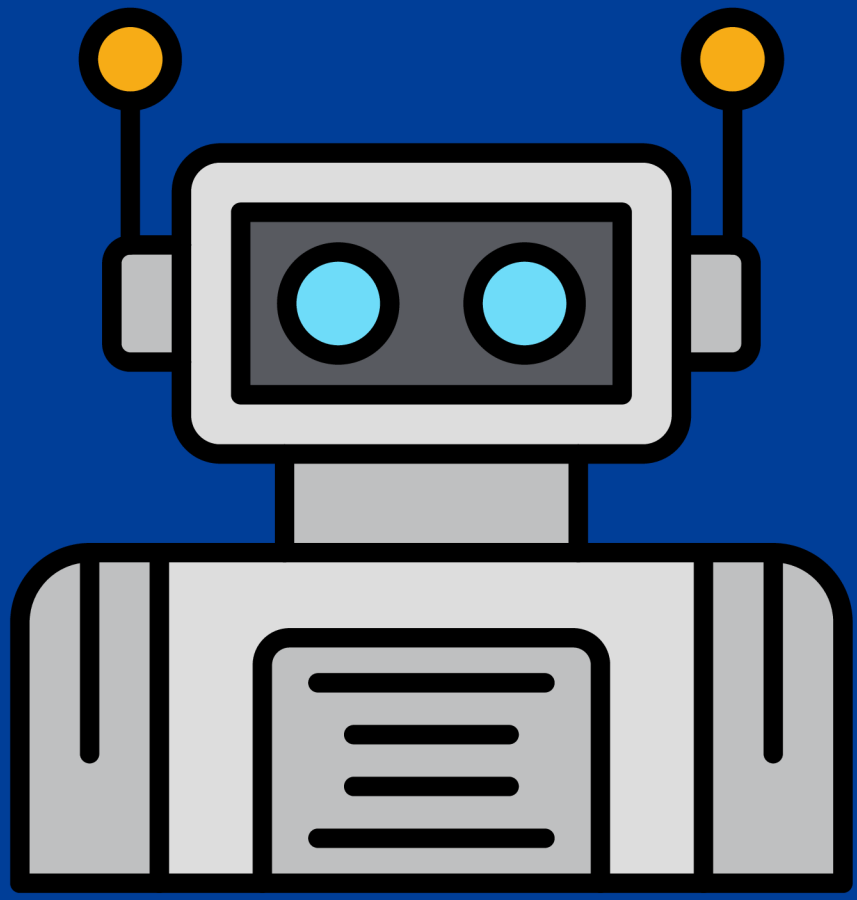
Co-funded by the European Union

Co-funded by the European Union

AI's Role in the Metaverse:

Realistic NPCs (Non-Player Characters)

In the Metaverse, NPCs are AI-powered characters that can interact with users in a natural way. These NPCs can learn and adapt to how users behave. AI-driven NPCs can function as shopkeepers or guides, interacting with players in a personalized way.



Co-funded by the European Union

AI's Role in the Metaverse:

Personalized Experiences:

AI can create a unique experience for every player based on their actions, preferences, and choices in the virtual world. In virtual worlds like Second Life or Roblox, AI can customize the environment and quests based on individual interactions.



Co-funded by the European Union

AI's Role in the Metaverse:

Automated World Creation:

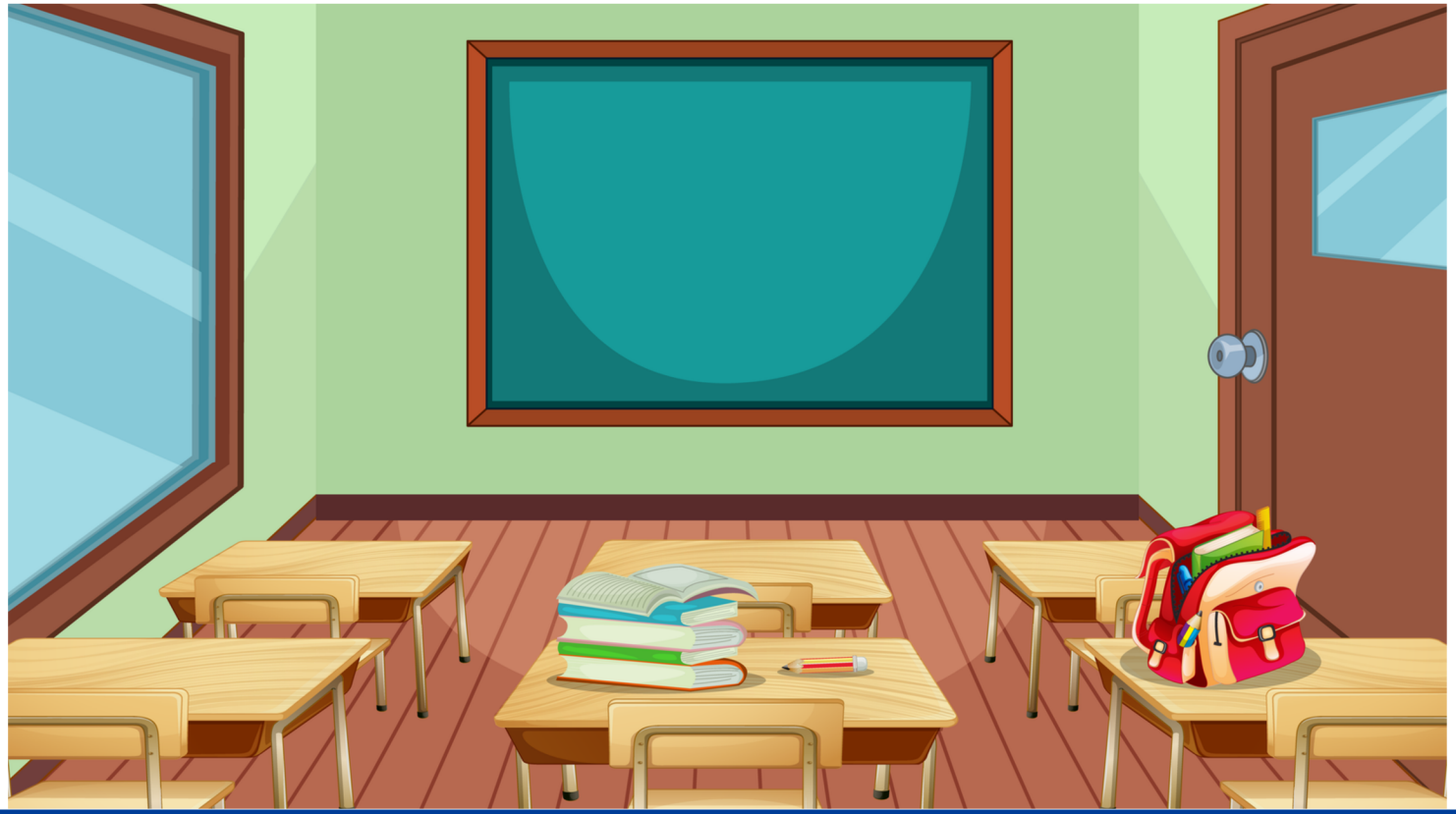
AI can generate environments and objects in the Metaverse, like creating new landscapes, buildings, and even avatars without human input. Games like Minecraft use AI to generate new terrain for players to explore.

AI-Enhanced Learning:

AI can create custom educational experiences for learners in virtual environments. In virtual classrooms, AI can adjust difficulty levels and give personalized feedback to students based on their progress.

Co-funded by the European Union

Adaptive Learning in Virtual Classrooms



Co-funded by the European Union

Adaptive Learning in Virtual Classrooms

Real-Time Adjustment:

AI can adapt lessons in real-time depending on the student's progress. For example, if a student is struggling, AI can provide extra resources or simplify concepts.
In virtual classrooms, AI can help students navigate through personalized learning materials at their own pace.



Co-funded by the European Union

Custom Learning Paths:

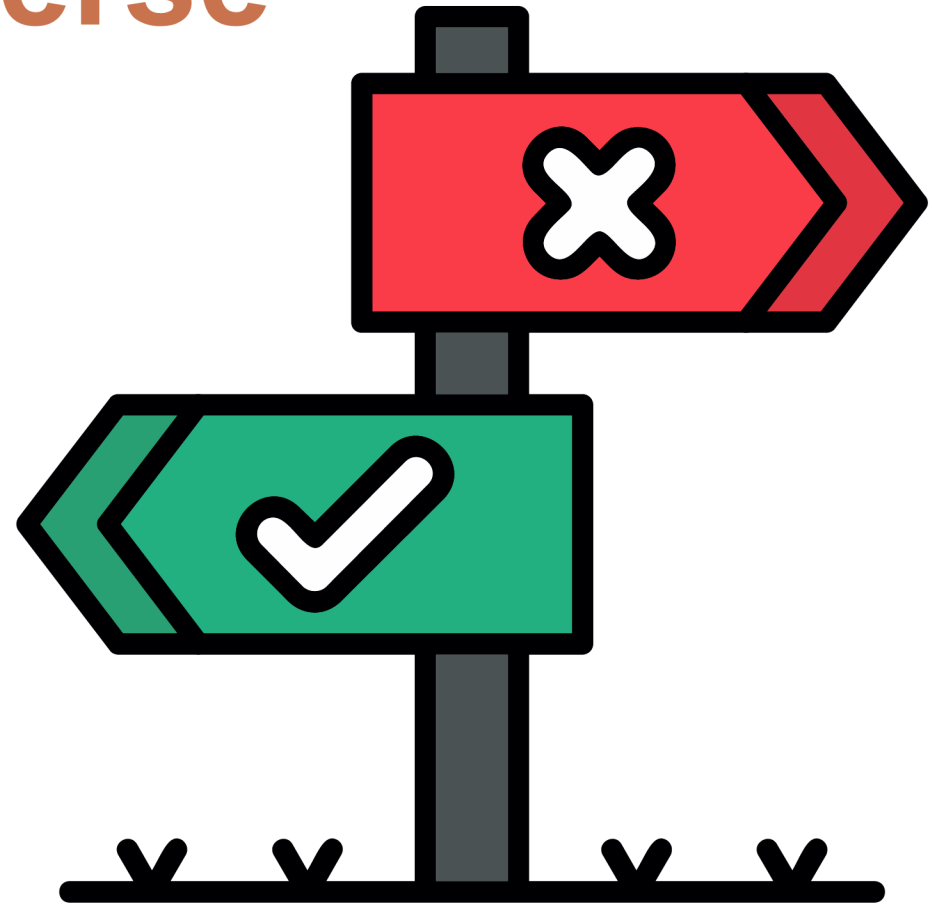
AI can create individualized learning plans based on the student's strengths and weaknesses. An AI tutor could create a unique path for each student in a virtual STEM course.



Automated Grading & Feedback:

AI can automatically grade assignments and provide personalized feedback, allowing teachers to focus on more complex tasks.AI can grade multiple-choice or short-answer questions instantly and give instant feedback to students.

The Ethical Challenges of AI in the Metaverse



Co-funded by the European Union

1 Bias & Fairness:

AI can reflect human biases based on the data it is trained on, leading to unfair outcomes. An AI in the Metaverse might treat players from different countries differently based on biased data.

2 Privacy & Data Security:

AI systems collect and process large amounts of personal data, raising concerns about privacy and how that data is stored and used.Virtual worlds collect data about users' interactions, which could be exploited if not properly protected.

M-STEM
Co-funded by the European Union
VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

3 Job Automation:

AI can replace human roles in areas like customer service, game design, and teaching. AI NPCs could replace human hosts in virtual events, reducing job opportunities in these fields.

4 Over-Reliance on AI:

Over-dependence on AI could lead to a lack of creativity or loss of human control in virtual environments. If AI takes over too much in the Metaverse, players might stop using their own imagination or decision-making abilities.

M-STEM

Co-funded by the European Union

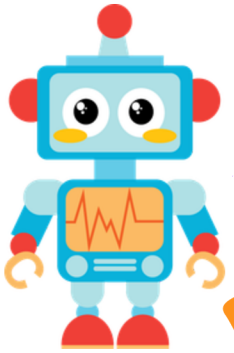
VAEV R&D · Colegio Séneca S.Coop.And · Agrupamento de Escolas de Barcelos · Eurasia Institute · Inspectoratul Școlar Județean Teleorman · City of Malmö

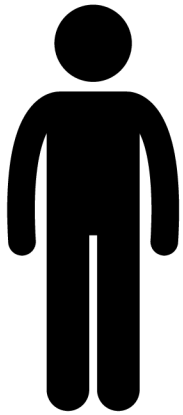
Practical Exercise

Read the following statements and decide which ones cannot be done by Artificial Intelligence

- Can analyze vast amounts of data to predict future trends.
- Can create an original artwork with emotional depth, like a human artist.
- Can perform facial recognition to identify individuals in photos.
- Can understand and interpret complex human emotions during a personal conversation.

Co-funded by the European Union





- Can analyze vast amounts of data to predict future trends.
- Can create an original artwork with emotional depth, like a human artist.
- Can perform facial recognition to identify individuals in photos.
- Can understand and interpret complex human emotions during a personal conversation.

Co-funded by the European Union

AI can analyze large datasets to predict trends and perform tasks like facial recognition, but it cannot create art with emotional depth or truly understand complex human emotions during a conversation. While AI can generate art, it lacks the emotional experience of a human artist. Similarly, while AI can recognize faces, it cannot interpret the emotional nuances that humans naturally understand in personal interactions.

M-STEM
Co-funded by the European Union
VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

Conclusion Open Discussion:
What excites or concerns you most about AI's future?

Co-funded by the European Union



Machine Learning

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

Co-funded by the European Union

Learning Objectives:

By the end of this lesson, students will be able to:

- Define Machine Learning (ML)
- Identify Key Components of Machine Learning
- Explain the different types of Machine Learning
- Identify real-world applications of ML, including its use in the Metaverse.
- Understand how ML systems "learn" and make predictions based on data.
- Identify the process of training a machine learning model
- Explain the challenges and future of ML

M-STEM
Co-funded by the European Union
VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

Defining Machine Learning



Co-funded by the European Union

How do we define Machine Learning?

Machine Learning:

Machine Learning is a branch of Artificial Intelligence (AI) where systems learn from data and improve over time without explicit programming. Instead of humans programming specific rules for each task, ML algorithms "learn" from patterns in data.



Think of it like teaching a child to recognize different animals: you show them many pictures of a dog, and after a while, they learn to identify what a dog looks like. Machine Learning works similarly, but with data!

Co-funded by the European Union

Co-funded by the European Union

Key Components of Machine Learning



Key Components of Machine Learning

Data

Data is the raw material for Machine Learning. The more data you provide, the more accurate the model becomes. For example, to teach a machine to recognize cats, you need many images of cats.

Model

A model is the algorithm that processes data to make decisions or predictions. It is like a student who uses the information (data) to make conclusions.

M-STEM
Co-funded by the European Union
VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

Key Components of Machine Learning

Learning Algorithm:

The algorithm adjusts the model based on the patterns it detects in the data. This is like giving a student feedback, improving their ability to answer questions.

Feedback/Prediction:

Once trained, the machine can make predictions (e.g., identify a picture of a cat) and can continue to improve by receiving feedback on whether it was correct.

M-STEM

Co-funded by the European Union

VAEV R&D

Colegio Séneca S.Coop.And

AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE

EURASIA INSTITUTE

INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN

City of Malmö

Types of Machine Learning

Co-funded by the European Union

Supervised Learning:

In supervised learning, the model is trained using labeled data. For example, if you have pictures of animals labeled as “cat” or “dog,” the model learns to predict the labels for new, unseen images.

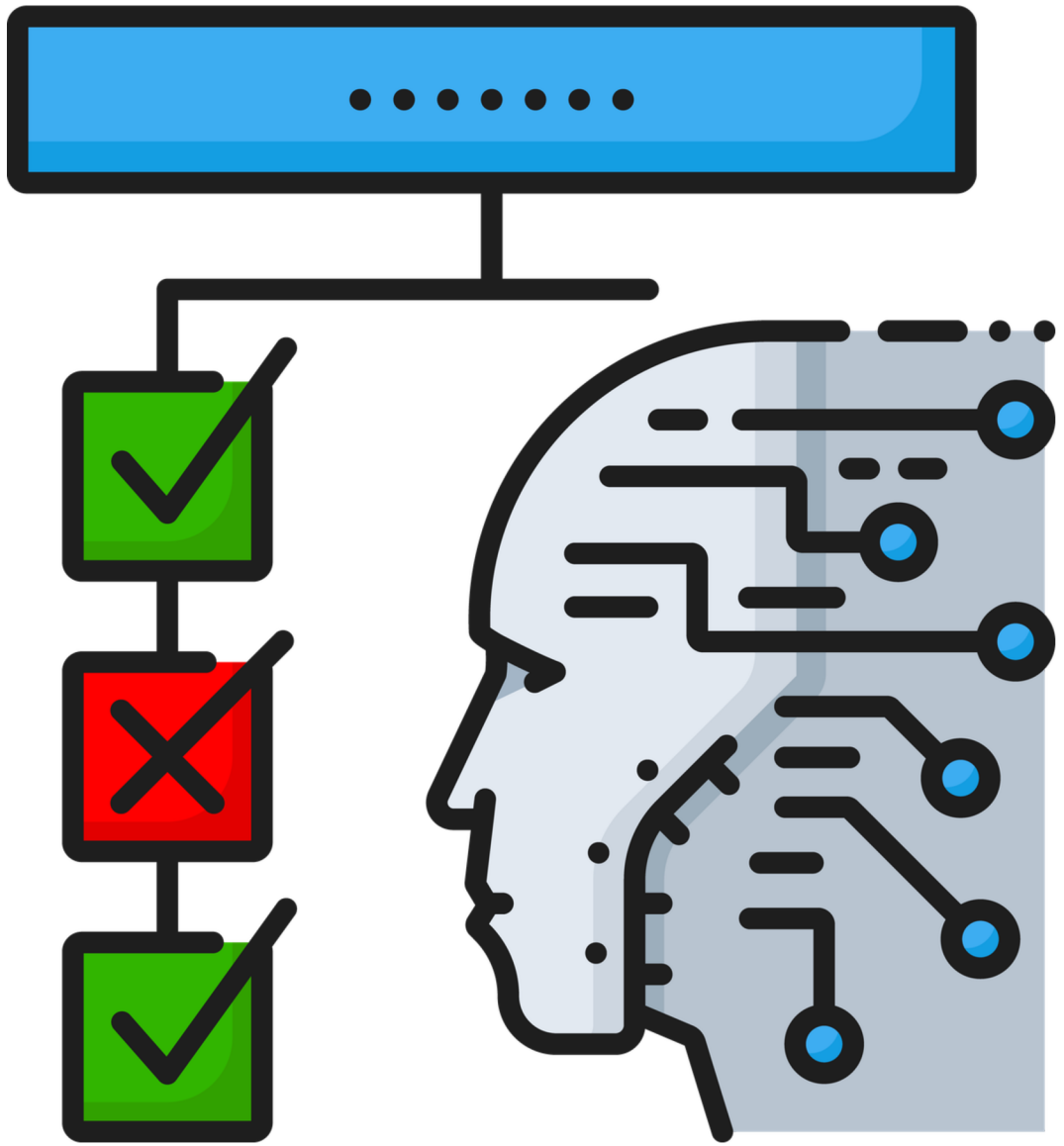
Unsupervised Learning:

Here, the model is given unlabeled data and tries to find patterns or groupings within the data. For example, an unsupervised model might group customers based on their buying behavior without being told what each group represents.

Co-funded by the European Union

Reinforcement Learning:

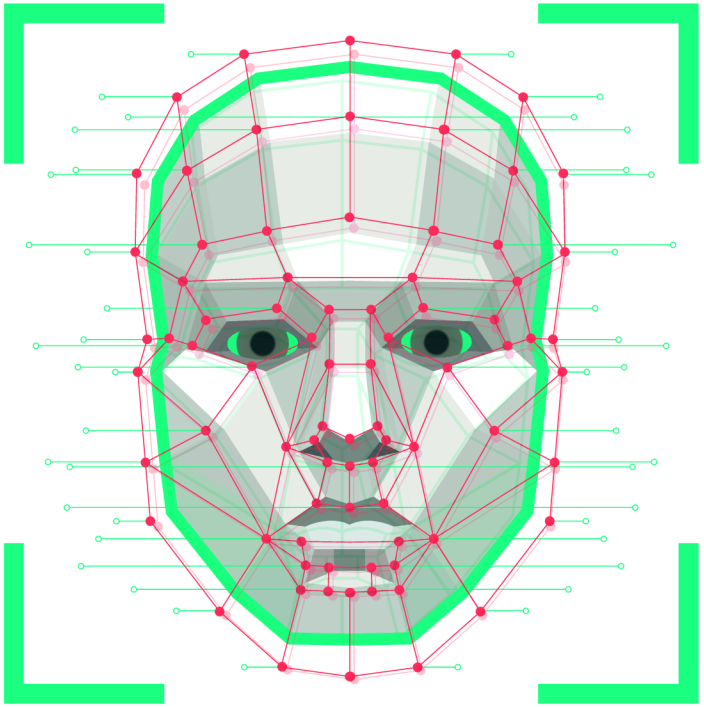
The model learns by trial and error, receiving rewards or penalties. For example, AI playing a video game learns by scoring points or losing lives, and it adjusts its strategy to maximize its score.



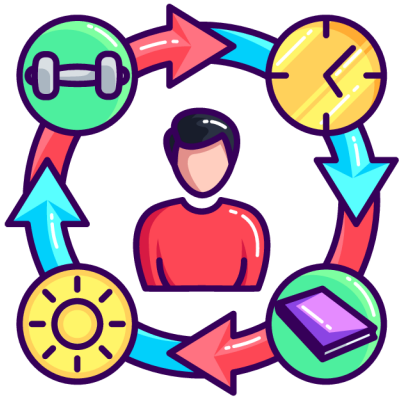
Co-funded by the European Union

Examples:

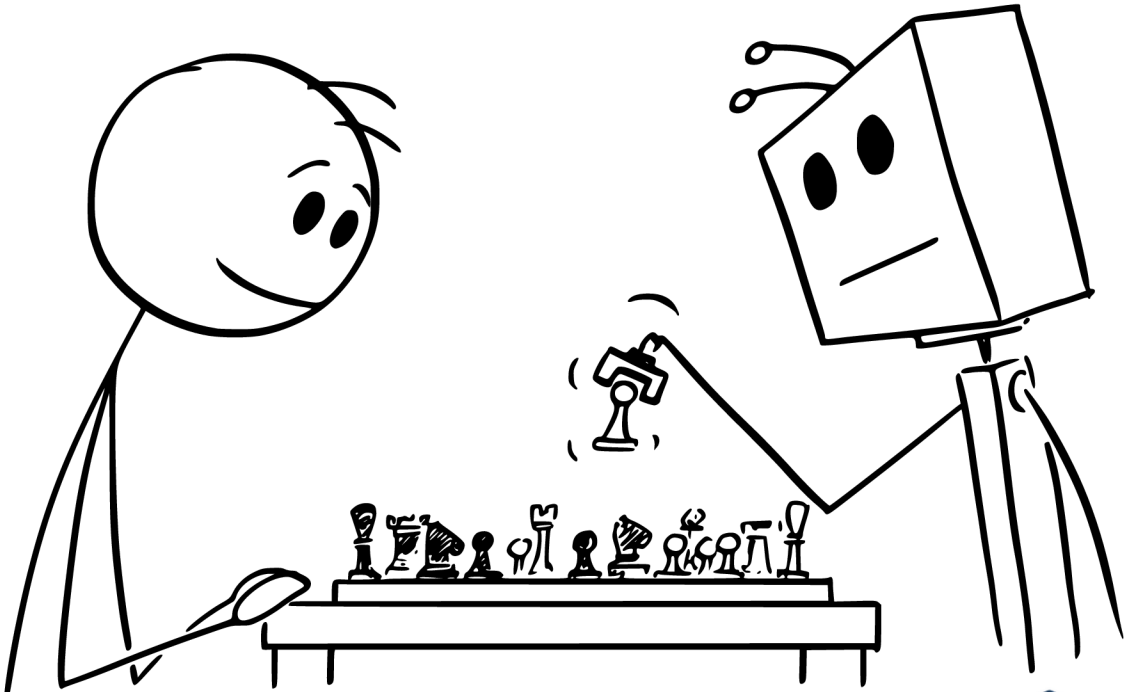
- Supervised Learning: Image recognition systems



- Unsupervised Learning: Clustering customers based on purchase habits.



- Reinforcement Learning: AI playing and improving at games like chess or Go.



Co-funded by the European Union

Real-world Applications of Machine Learning



Co-funded by the European Union

Real-world Applications of Machine Learning

Healthcare

ML is used to predict patient health risks, such as detecting early signs of diseases like cancer by analyzing medical images or patient data.

Entertainment

Services like Netflix or YouTube use ML algorithms to recommend movies or videos based on your viewing history.

Co-funded by the European Union

Real-world Applications of Machine Learning

Finance

Banks use ML to detect fraudulent transactions by analyzing patterns in user spending.

Metaverse

ML is used to create responsive NPCs that adapt to player behavior, making virtual worlds feel more interactive.

Co-funded by the European Union

Machine Learning in the Metaverse



Co-funded by the European Union

Co-funded by the European Union

Machine Learning in the Metaverse



Virtual Environments:

Machine Learning is used in virtual environments to create more realistic experiences. For example, NPCs in games can use ML to learn from interactions with players and respond intelligently. These characters get better at reacting to players over time.

Co-funded by the European Union

Machine Learning in the Metaverse



Dynamic Learning:

As players interact with the environment, ML enables NPCs to adapt. For instance, in a game, if a player always takes a certain path, the NPC might start predicting that behavior and block the path.

Co-funded by the European Union

Consider a game like “The Sims,” where characters' actions and personalities evolve based on the player’s decisions, all powered by machine learning.



Co-funded by the European Union

The Role of Data in Machine Learning

Importance of Data Quality:

The quality of the data affects how well a model performs. Inaccurate or insufficient data will result in a model that makes poor predictions.

Training Data vs. Test Data:

The data is divided into two sets: one for training the model and one for testing its accuracy. Training data teaches the model, while test data evaluates its performance.

Co-funded by the European Union

The Process of Training a Machine Learning Model



Collect Data: Gather large amounts of relevant data to train the machine. For example, photos of animals for an image recognition task.

Prepare Data: Clean and organize the data to ensure it is in a suitable format for training.

Train the Model: Use an algorithm to teach the model using the prepared data.

Evaluate the Model: Test the model with new data it hasn't seen before to check its accuracy.

Deploy the Model: Once the model is trained, it can be deployed to make real-time predictions (e.g., recognizing faces in security cameras).



Example of a Simple Machine Learning Task



1 Task Example:

Teaching a model to predict whether an email is spam.

2 Data:

The model is trained using a dataset of labeled emails (spam or not spam).

3 Training Session:

The model identifies patterns in the email content (keywords, links, sender addresses) to predict if an email is spam or not.

4 Outcome:

After training, the model can predict whether a new, unseen email is spam.

From that example we can understand,how do machines learn

Feedback loops:

ML models adjust based on feedback. For instance, if the model makes an incorrect prediction, it updates its parameters to get better in the future.
Example: Consider a self-driving car that continuously improves its driving decisions as it receives feedback from sensors about road conditions.

The Future of Machine Learning

- **AI Powered Healthcare**
  - Machine learning is revolutionizing medical diagnostics, drug discovery, and personalized treatment. AI models can detect diseases (e.g., cancer, Alzheimer's) earlier and with greater accuracy than traditional methods.

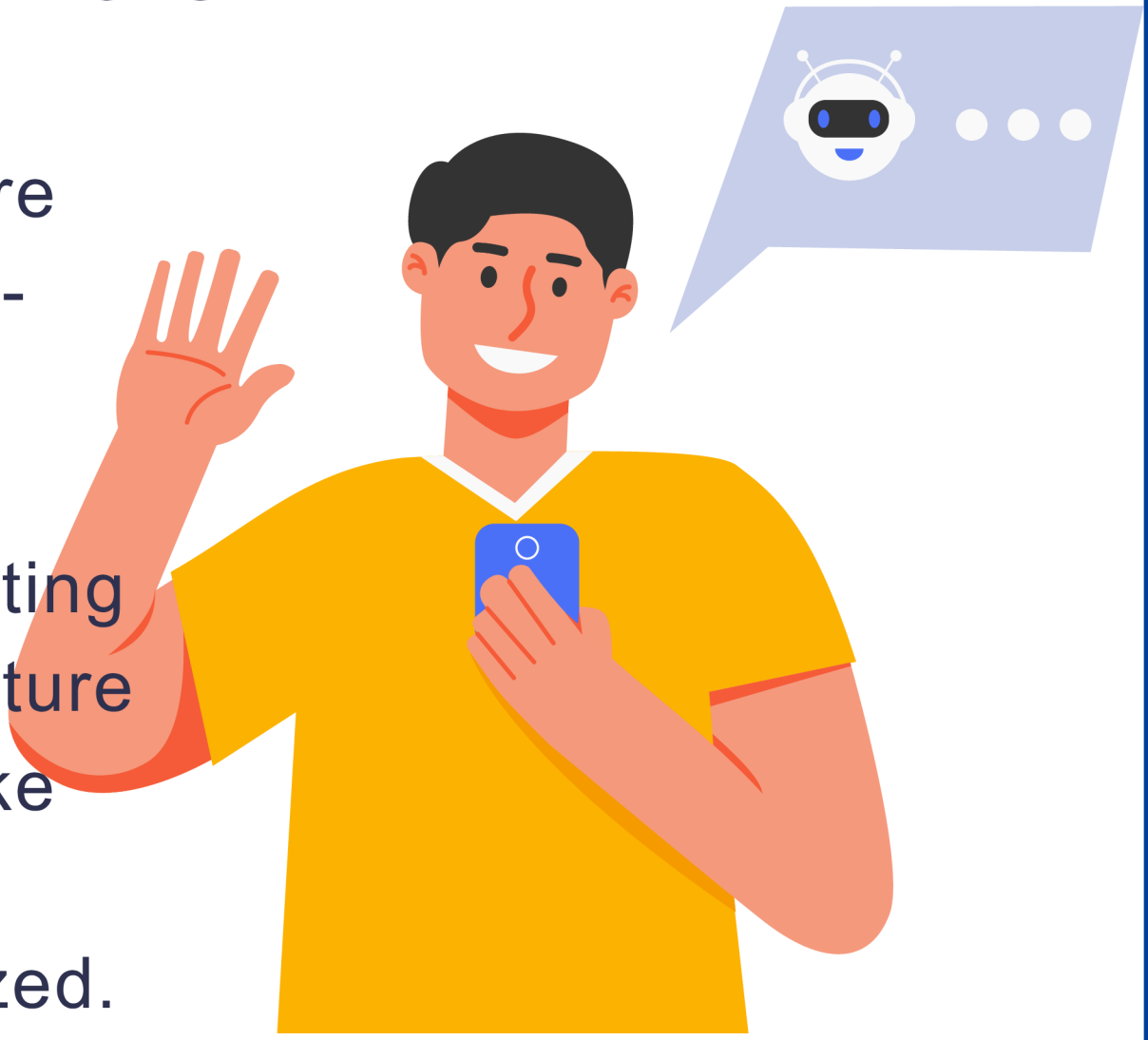


- **Autonomous Vehicles & Reinforcement Learning**
  - Self-driving cars rely on reinforcement learning (RL) to navigate complex environments, improving safety and efficiency. Advanced ML models help vehicles adapt to real-time traffic conditions, recognize obstacles, and make split-second decisions.

Co-funded by the European Union

Smarter Personal Assistants & Virtual Companions

- AI assistants like Siri, Alexa, and ChatGPT are becoming more human-like, understanding emotions, responding contextually, and assisting with complex tasks. Future advancements will make AI companions more intuitive and personalized.



M-STEM
Co-funded by the European Union
VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

Discussion Time

- How do you think Machine Learning will impact our daily lives in the next 10 years?
- Will AI replace certain jobs, or will it create new opportunities?
- How can we ensure ethical and unbiased AI development?
- What industries do you think will benefit the most from ML advancements?



M-STEM
Co-funded by the European Union
VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

Co-funded by
the European Union



Biology

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D
Colegio Séneca S.Coop.And
Agrupamento de Escolas de Barcelos
Eurasia Institute
Inspectoratul Școlar Județean Teleorman
City of Malmö





Co-funded by the European Union















Learning objectives

By the end of this lesson, students will be able to:

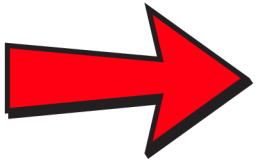
- Knowing what a mutation is, and differentiate between the different types of mutations according to the cells affected, andaccording to the mechanism that has caused the alteration in the genetic material.
- Know the causes and types of mutations
- To understand what genetic engineering is and its most commonly used techniques.
- Know in detail how the CRISPR gene-editing tool works.
- To argue their opinion on the ethical implications of gene editing.

Co-funded by the European Union

WHAT IS A MUTATION?

Mutations are alterations in DNA due to errors or damage during replication or chromosome partitioning in cell divisions.

They can be divided according to the following criteria:



Co-funded by the European Union

Depending on the cells affected, mutations can be:

Germline mutations:

- Affect the gametes or the zygote.
- They are transmitted to offspring.
- They are the primary source of genetic variability. They are affected by natural selection and are essential in the **evolutionary process**.

Somatic mutations

- Affect somatic cells (cells of the organism).
- They are not passed on to offspring, so they are not heritable.
- They only affect the individual who has them.
- They have no evolutionary impact.

Co-funded by the European Union

Mutations and evolution

When mutations are beneficial, the new phenotypes can increase the organism's probability of survival and reproduction by providing better characteristics that allow it to adapt to the environment.

Natural selection means that those individuals that are better adapted to environmental conditions are more likely to survive.

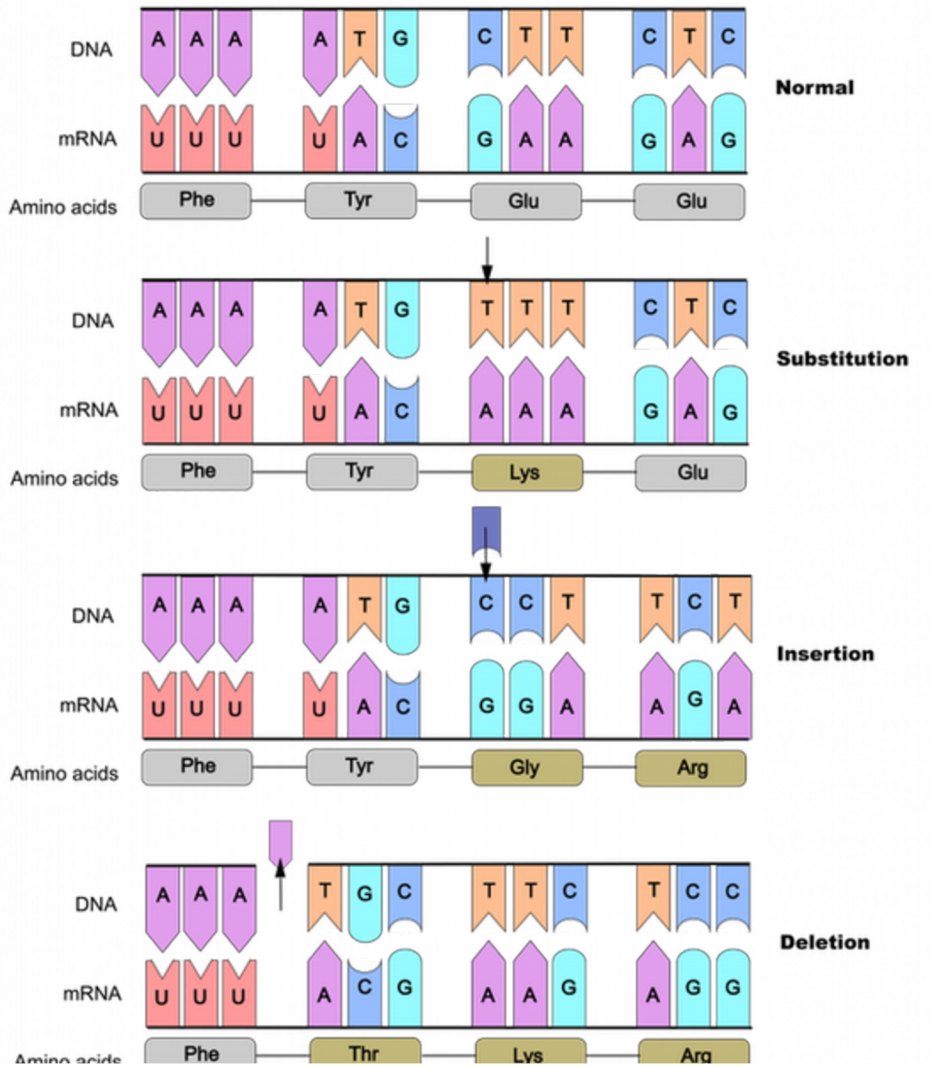
Mutations are biologically important, as they are a source of genetic variability or diversity in populations and enable species to evolve.

Depending on the mechanism that has caused the alteration in the genetic material, mutations can be:

GENE MUTATIONS

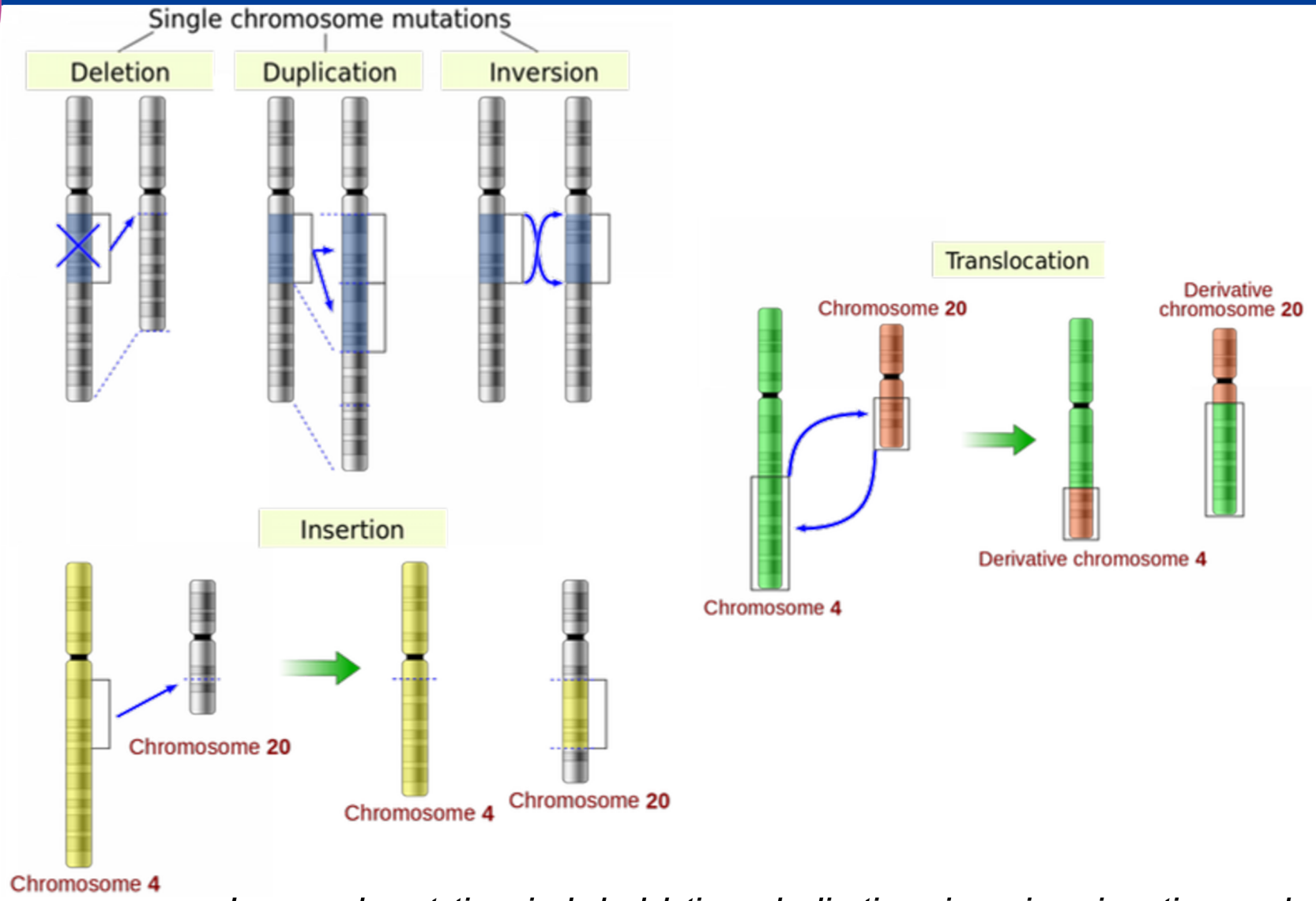
Gene mutations are alterations in one or more nucleotides of DNA that occur during the DNA replication process. They are not visible under the microscope.

They can be caused by substitution, addition or loss of nitrogenous bases.



[A summary of the types of point mutations] [Image]. (n.d.). Wikimedia Commons. Licensed under CC BY-NC https://open.lib.umn.edu/evolutionbiology/chapter/5-10-point-mutations-affect-gene-expression-2/

Co-funded by the European Union



Large-scale mutations include deletions, duplications, inversions, insertions, and translocations. (Chromosomal mutations by YassineMrabet is in the public domain)

Co-funded by the European Union

Co-funded by the European Union

CHROMOSOMAL MUTATIONS

Chromosomal mutations can affect the structure (structural mutations) or the number of chromosomes (numerical mutations). They are visible under the microscope. In addition to phenotypic alterations, they lead to incorrect meiosis and abnormal gametes.

1. **Structural mutations**

They are caused by a change in the linear position of genes on chromosomes. They can be deletions, duplications, translocations or inversions.

2. **Numerical mutations**

These are alterations in the number of chromosomes. In humans they can cause miscarriages. Numerical mutations are classified as polyploidy and aneuploidy.

Chromosomal mutations



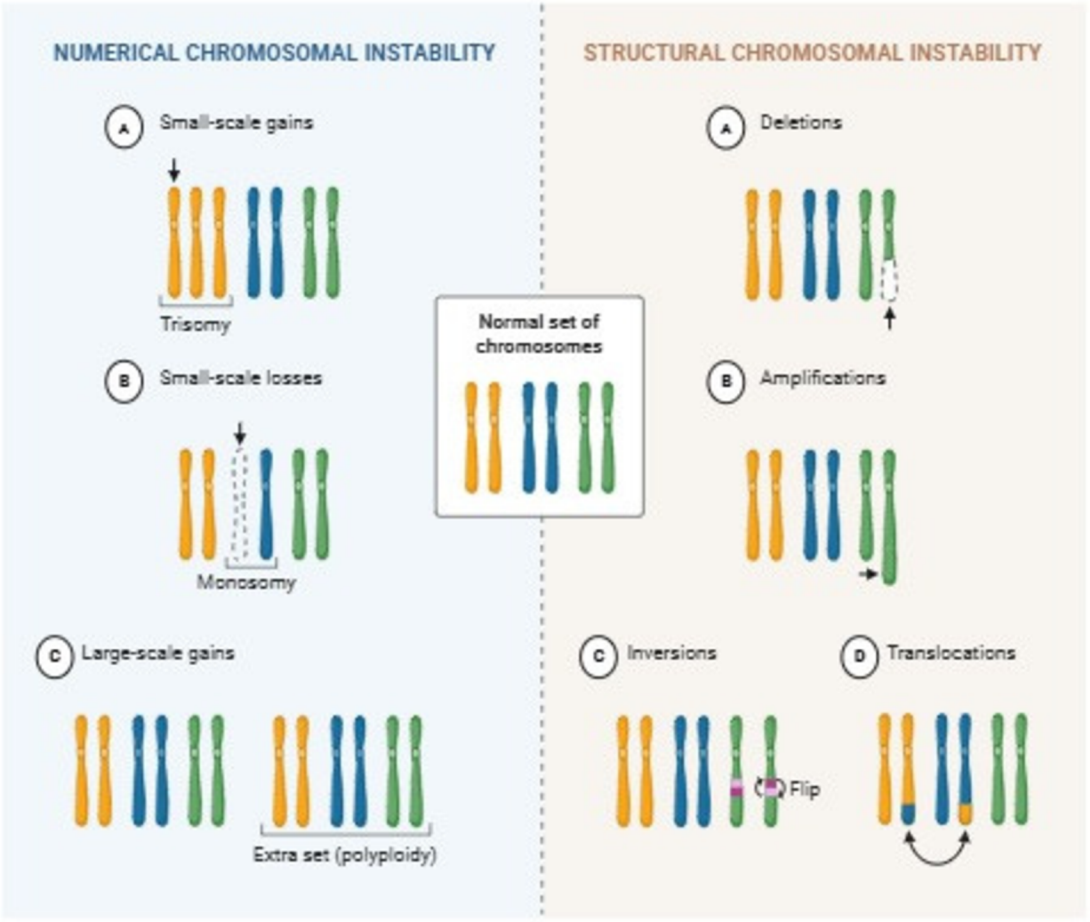


Image adapted from a resource created with BioRender (www.biorender.com), originally published in [microbenotes.com, https://microbenotes.com/chromosomal-mutation/]

Co-funded by the European Union

Co-funded by the European Union

GENETIC ENGINEERING

Genetic engineering is part of biotechnology, a multidisciplinary science that develops techniques for using and modifying living organisms in order to obtain products that are useful to humans. Genetic engineering deals with the modification of genes or the transfer of genes from one organism to another.

The main techniques applied by genetic engineering are:

Gene editing (CRISPR-Cas9)

Polymerase chain reaction (PCR)

Molecular cloning of DNA.

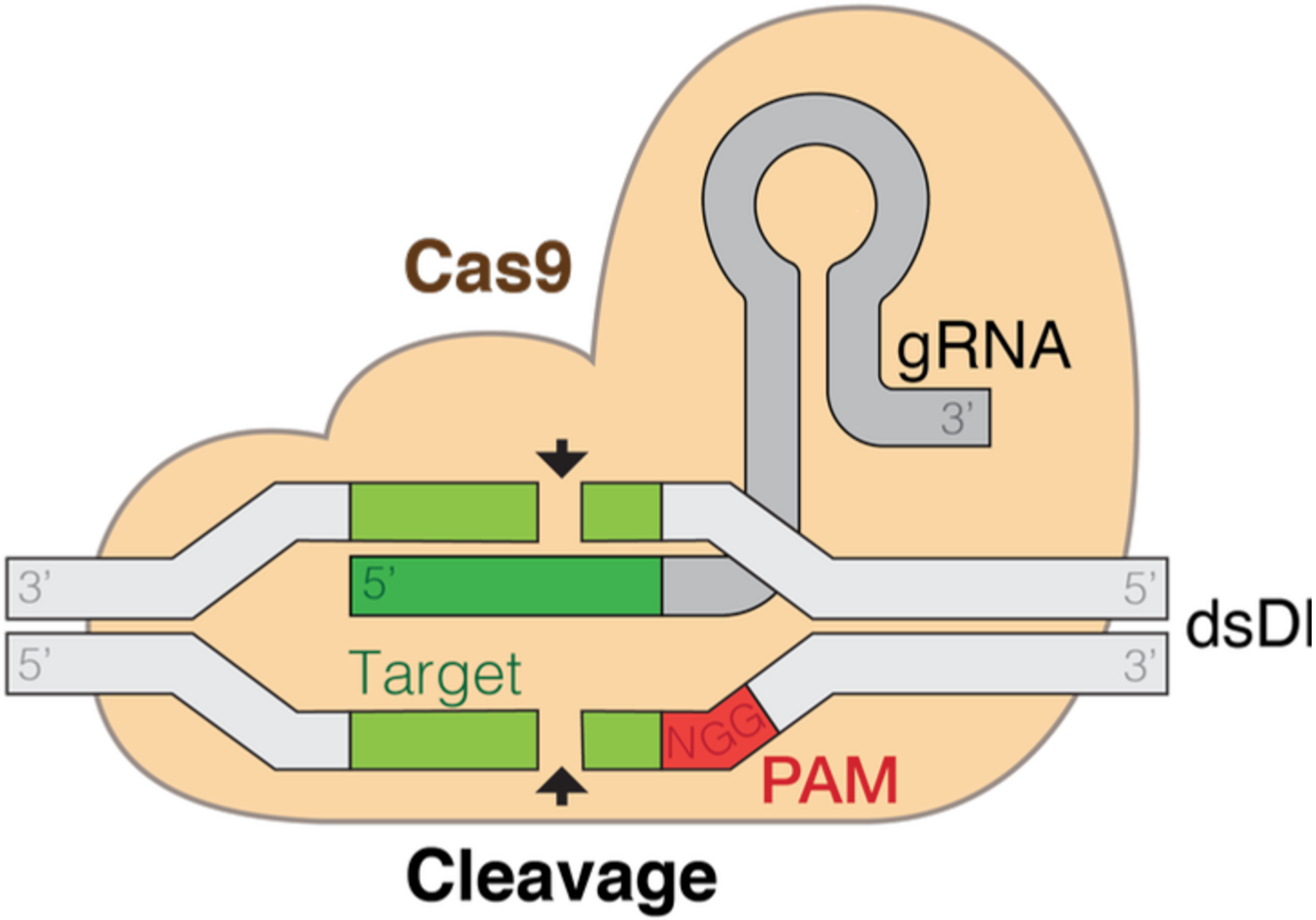
Co-funded by the European Union

Gene editing (CRISPR-Cas9)

The gene editing technique is based on the use of Cas9 proteins to cut and paste DNA fragments from any cell. This allows genes to be inactivated or modified by removing or adding nucleotides from their sequence, like editing text.

The steps are as follows:

1. Synthesis of a complementary RNA with the gene sequence to be edited: the target DNA.
2. The guide RNA binds to the Cas9 proteins and positions them to cut the target DNA.
3. Finally, once edited, the gene is modified by deleting or adding nucleotides.



Jesianes. (2018). [Illustration of the gRNA-Cas9 complex] [Image]. Wikimedia Commons. https://commons.wikimedia.org/wiki/File:GRNA-Cas9.png

M-STEM
Co-funded by the European Union
VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

Co-funded by the European Union

AND NOW... LET'S DEBATE!



1. **Is it ethical to modify the genome of a human embryo to prevent genetic diseases, and would your opinion change if the aim was to improve physical or intellectual characteristics?**
2. **In 2018, a Chinese scientist announced that he had edited the DNA of twin girls to make them resistant to HIV. What do you think of this decision? Was it ethical? Why or why not?**



Co-funded by
the European Union



Human Anatomy

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D
Colegio Séneca S.Coop.And
Agrupamento de Escolas de Barcelos
Eurasia Institute
Inspectoratul Școlar Județean Teleorman
City of Malmö





Co-funded by the European Union



Learning objectives

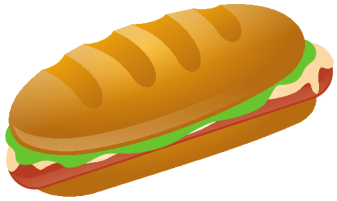
By the end of this lesson, students will be able to:

- Know the anatomy of the digestive system.
- Know how the process of digestion works, differentiating between what happens in each of the parts.
- Differentiate between mechanical and chemical digestion, and know where the digestion of each of the nutrients occurs.
- Recognise pseudoscientific hoaxes related to food, and be able to ‘debunk’ them using reliable sources of information.

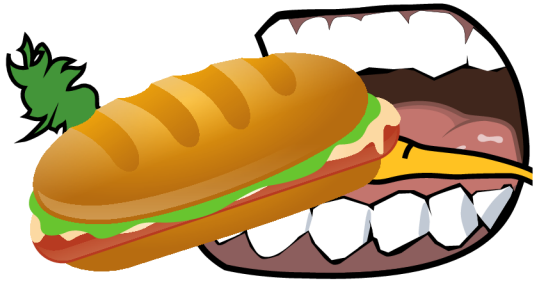
Co-funded by the European Union

LET'S TAKE A SNACK!

If you want to discover the incredible journey our food makes inside our body, and how our body is able to take advantage of all the nutrients included in those foods, pay attention!

From  to 

Take a bite of your sandwich...and let's get started!



Co-funded by the European Union

THE DIGESTIVE PROCESS

It takes place in the digestive tract and transforms food into nutrients necessary for cellular activity.This process takes place in four stages: **ingestion, digestion, absorption and egestion.**

INGESTION

Once we take our first bite of food, it goes through three processes:

Chewing: Mechanical and voluntary process in which food is broken down into very small pieces.

Insalivation: Chemical process that takes place simultaneously with chewing. it consists of mixing chewed food particles with saliva.
The mass resulting from chewing and insalivation is called the alimentary bolus.

Swallowing: A reflex action consisting of the passage of the bolus of food from the mouth through the pharynx and oesophagus into the stomach.

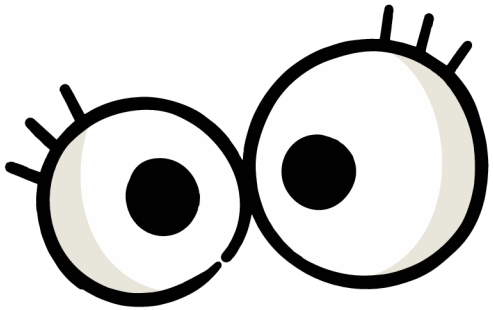
Co-funded by the European Union

DIGESTION

Digestion is a chemical process carried out by digestive enzymes present in saliva, gastric juices, intestinal and pancreatic juices and bile.

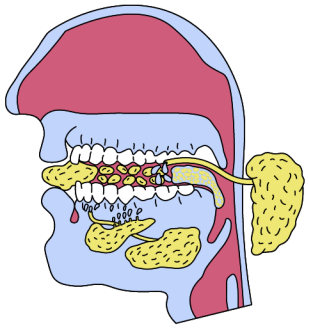
As a result of digestion, the ingredients of our snack are broken down into their simple nutrients (monosaccharides, amino acids, glycerine, fatty acids...), which can be assimilated by the cells.

Let's see what happens

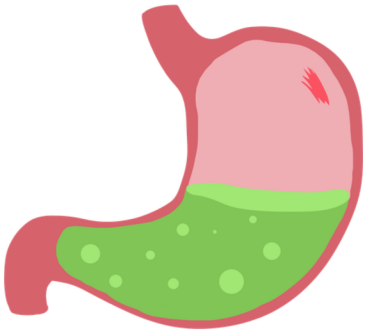


- **Digestion in the mouth:**

The chemical digestion of the carbohydrates (starch) in the bread of our sandwich begins in the mouth, by the action of ptyalin (amylase) in the saliva.



Food bolus



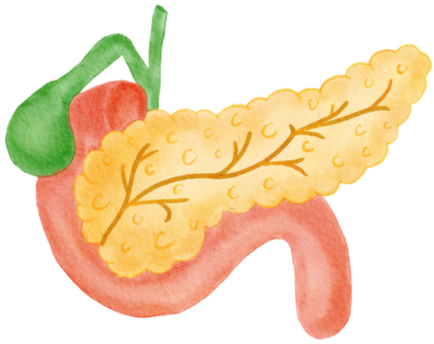
- **Digestion in the stomach**

In the stomach, the chemical digestion of the proteins in our ham begins with the help of pepsin (protease) in the gastric juice.

After passing through the stomach, the food has the appearance of a thick slurry called chyme.

Co-funded by the European Union

Chyme



- **Digestion in the duodenum**

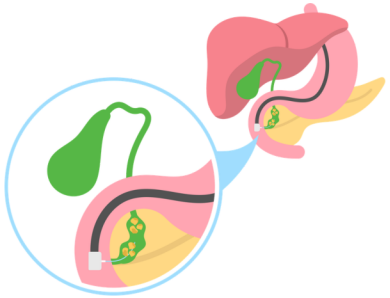
The chemical digestion of the nutrients in the chyme is completed in the duodenum:

- The carbohydrates in our bread are broken down into monosaccharides (glucose) by the amylases of the pancreatic and intestinal juices.
- The proteins in the ham are broken down into amino acids by the proteases of these juices.
- The fats in the olive oil are broken down into fatty acids and glycerol by bile and intestinal and pancreatic lipases.

M-STEM
Co-funded by the European Union
VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

Co-funded by the European Union

Bile does not contain enzymes, but it is essential for the digestion of fats. It has an emulsifying effect on fats, breaking them down into tiny droplets that are easily attacked by lipases.



After passing through the duodenum, the contents of the intestine are a whitish liquid called **chyle**, which contains the nutrients necessary for the cells (glucose, amino acids, fatty acids, glycerol, water, mineral salts and vitamins).

Co-funded by the European Union

ABSORPTION AND EGESTION

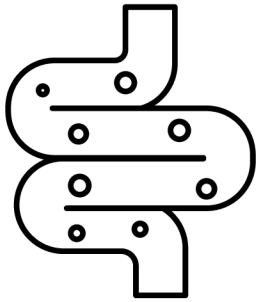
Absorption is the process of passing nutrients resulting from digestion into the blood capillaries via the cells of the intestinal epithelium.

- **Absorption in the small intestine**

Absorption in the small intestine

In the jejunum and ileum, the absorption of almost all nutrients from the chyle (monosaccharides, amino acids, fatty acids, glycerol, vitamins, mineral salts and water) takes place.

They pass into the blood capillaries via the cells of the intestinal epithelium (enterocytes).



An exception is the fatty acids and glycerol resulting from the digestion of fats, which are taken up directly by the chyliferous vessels and pass slowly into the blood.



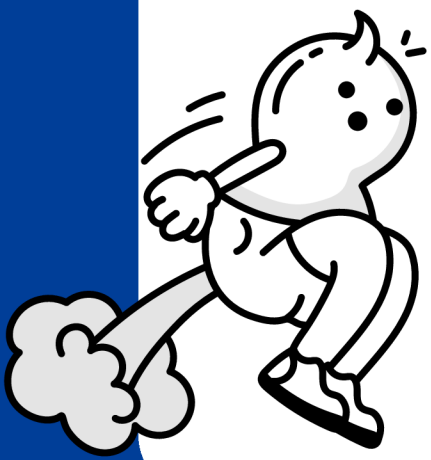
- **Absorption in the large intestine**

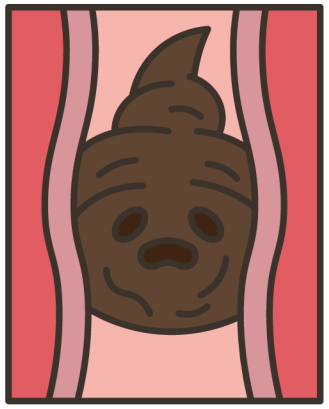
By the time the chyle reaches the large intestine, almost all of its nutrients and water have already been absorbed in the small intestine. It is a mass rich in non-digestible dietary fibre (cellulose) and ions (sodium, magnesium and chlorides).

M-STEM
Co-funded by the European Union
VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

Co-funded by the European Union

On its way through the large intestine, the chyle is concentrated by absorption of water and mixes with the bacteria that live in the colon and make up the intestinal flora. These bacteria break down some of the cellulose for their own nourishment and generate certain unpleasant-smelling gases.



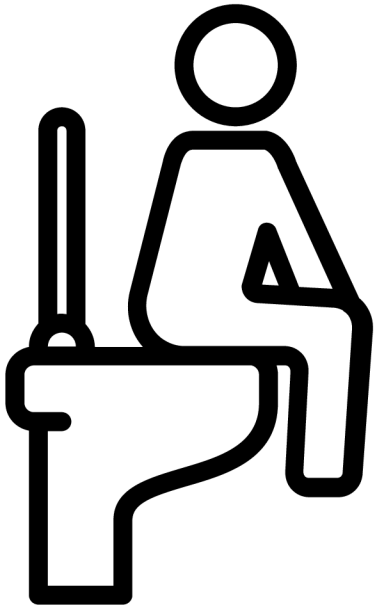


Upon reaching the sigmoid colon, the intestinal contents are a thick mass of indigestible waste, known as faeces. The sigmoid colon has a powerful musculature, the contraction of which increases the pressure on the faeces and directs them into the rectum, to be passed out in the next stage.

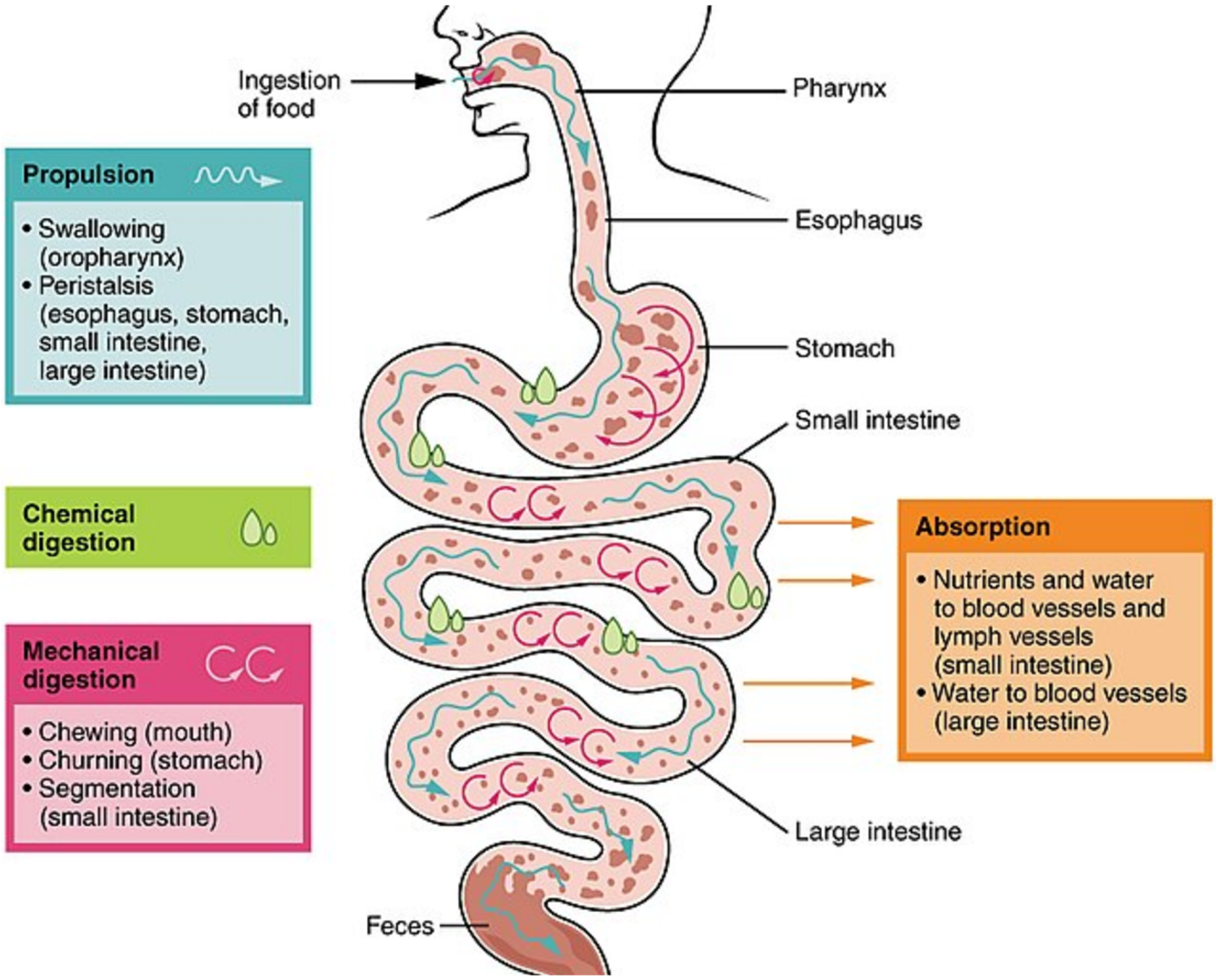
Co-funded by the European Union

EGESTION

Egestion, also called defecation, is the expulsion of faeces through the anus.



Co-funded by the European Union



OpenStax College. (2013). Digestive process [Image]. Wikimedia Commons. https://commons.wikimedia.org/wiki/File:2405_Digestive_Process.jpg

Co-funded by the European Union

MYTHBUSTERS

Finally, after all you have learned, you will have to become a detective and find the most dangerous pseudo-scientific myths circulating on the Internet and 'dismantle' them.

Do you dare?



Co-funded by
the European Union

AND NOW... LET'S DEBATE!



1. **Is it ethical to modify the genome of a human embryo to prevent genetic diseases, and would your opinion change if the aim was to improve physical or intellectual characteristics?**
2. **In 2018, a Chinese scientist announced that he had edited the DNA of twin girls to make them resistant to HIV. What do you think of this decision? Was it ethical? Why or why not?**



Co-funded by
the European Union



The Importance of pH in Everyday life

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D · Colegio Séneca S.Coop.And · Agrupamento de Escolas de Barcelos · Eurasia Institute · Inspectoratul Școlar Județean Teleorman · City of Malmö

Co-funded by the European Union

Time to think...



What does pH mean and how do you think it influences everyday life?

- **Watch the following video to get some answers.**
- **Can you also think of further examples?**

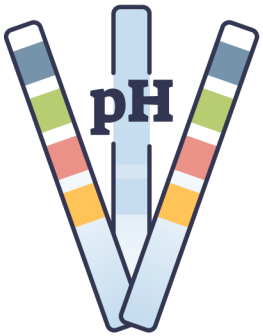


Co-funded by the European Union

Learning objectives

By the end of the lesson, you will be able to:

- **define** the concept of **pH** and understand the pH scale
- **use** various methods of measuring **pH** (pH strips, chemical indicators, pH meter)
- **explain** the importance of **pH** in various fields (food, health, environment, agriculture)
- **identify** the *effects of pollution* in everyday life (*aquatic ecosystem*), applying knowledge about **pH**.



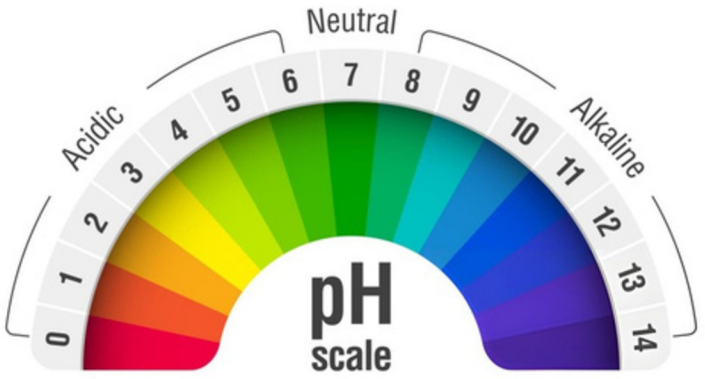


What is pH?

The term **"pH"** is a **measure** of **hydrogen ion concentration**, a **quantitative** measure of the ***acidity or alkalinity*** of a solution

What is the pH scale?

The pH scale measures how acidic or alkaline a substance is.



- **0 ≤ pH <7 => acidic pH | acidic solution**
- **pH = 7 => neutral pH | neutral solution**
- **7 <pH ≤ 14 => Basic pH (alkaline) | basic solution (alkaline)**

M-STEM

Co-funded by the European Union

VAEV R&D · Colegio Séneca S.Coop.And · Agrupamento de Escolas de Barcelos · Eurasia Institute · Inspectoratul Școlar Județean Teleorman · City of Malmö

Co-funded by the European Union

How can we determine pH values?

Watch the following video in order to find out about different ways of determining pH!

pH strips



chemical indicators



pH meter



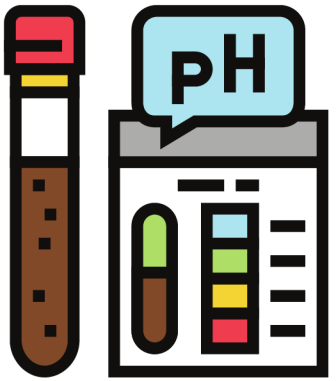
Co-funded by the European Union

Practical activity

For the next activity, you will be **working in three groups**. Each team will **determine pH values** for the following solutions:

- **tap water**
- **bottled carbonated water**
- **cola**
- **vinegar**
- **NaOH**





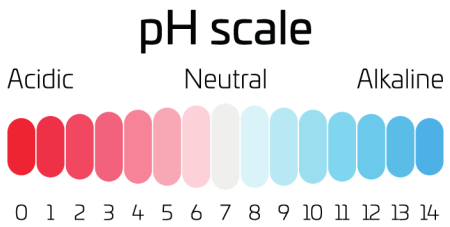
Each group will use a **different method** to determine pH values:

- **pH strips,**
- **chemical indicators,**
- **pH meter.**

You will have to **record the values** of the determinations.

Co-funded by the European Union

Time to reflect



- How **easy** was it to **determine pH values** using the method allocated to your group?
- What **advantages** can you identify regarding the method you have used?
- What **disadvantages** are there about your method?



Co-funded by the European Union

Interactive activity

What do you think happens if different polluting agents are thrown into rivers, seas or oceans? Does the water pH change its values? Are there any consequences on the aquatic ecosystem?

For the next activity, you will have to determine **how pH values change** when:

- there is an **oil spill**
- **industrial pollutants** are discharged into rivers
- **pesticides and fertilizers** are thrown into water



Equally important, you will have to observe **the effects of pH changes on the ecosystem.**





Oil spills

When there is a **leakage of petroleum** from an oil tank into the sea or ocean, the **pH levels** of the water can be **adversely affected.** Typically, **seawater has a pH of around 8.1 to 8.3,** which is **slightly alkaline**.

However, **petroleum spills** introduce **hydrocarbons and other toxic compounds**, which can lead to localized **changes in pH**, often making the water **more acidic**.

Studies have shown that **oil spills** can **lower pH levels** in affected areas by **0.5 to 1.0 units**, significantly impacting marine ecosystems.

Oil spills

These changes in pH levels can have **detrimental effects on marine life.** For instance, many marine organisms, such as **corals, shellfish, and certain fish species,** are **sensitive to pH fluctuations**.

Acidic conditions can **impede the ability of shellfish to form their calcium carbonate shells**, leading to weakened populations. Furthermore, l**ower pH levels** can **disrupt the reproductive processes** of fish and other marine organisms, **impacting** their growth and **survival rates**.

M-STEM

Co-funded by the European Union

VAEV R&D

Colegio Séneca S.Coop.And

AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE

EURASIA INSTITUTE

INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN

City of Malmö

Co-funded by the European Union

Industrial pollutants discharged into river systems



This can significantly alter the pH levels of the water. Normally, **freshwater rivers** have a **pH range of 6.5 to 8.5**,

The introduction of pollutants such as **heavy metals, acids, and chemicals** from industrial processes can lead to a **decrease in pH**, making the **water more acidic.**



Industrial discharges can **lower river pH by up to 2 units** in severely impacted areas, leading to **values below 6.5**.

Many fish species, such as **salmon and trout,** **thrive in neutral to slightly alkaline** waters. **When pH drops**, it can **affect their respiratory functions** and **disrupt their reproductive cycles**. For example, a **pH below 6.0** can lead to **increased mortality rates** in fish embryos and juveniles.

Co-funded by the European Union

Introduction of pesticides and fertilizers into river systems

Fertilizers, particularly those **high in nitrogen** and **phosphorus**, can lead to **nutrient loading** in water bodies. This process, known as eutrophication, can **cause algal blooms** that **deplete oxygen levels** and, in some cases, **lower the pH of the water to around 6.0 or lower.**





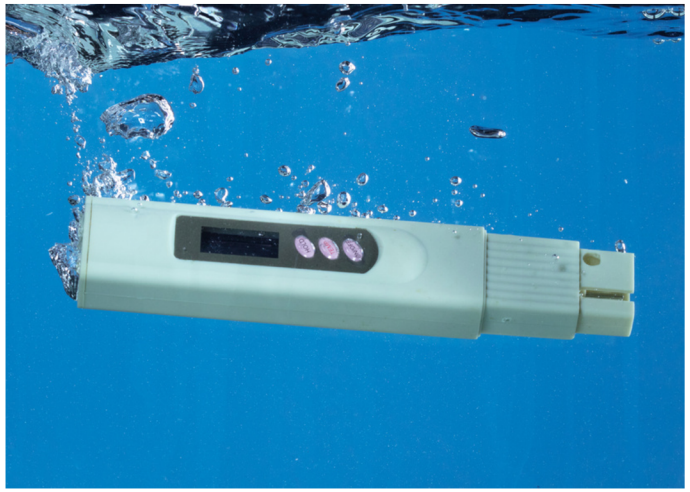
Pesticides can sometimes be **acidic or alkaline**, depending on their formulation. When pesticides enter river systems, they can **disrupt the natural pH balance**. For example, **certain herbicides** have been shown to **lower pH levels**, creating conditions that are detrimental to aquatic life.

Co-funded by the European Union

What happens to acquatic organisms ?

Fish species, such as trout and salmon, are particularly sensitive to pH fluctuations. A **drop in pH** can **impair** fish **respiration and reproductive** process.



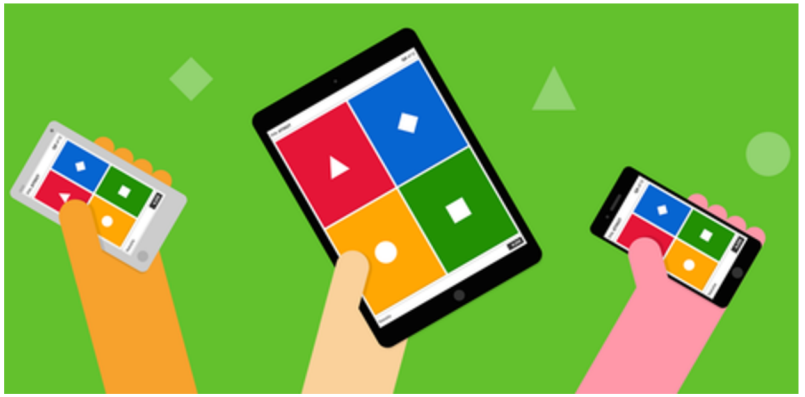




Co-funded by the European Union

Let’s see what we have learnt!

Join in the following kahoot game and find out how much you know about pH and its importance for everyday life.







Homework Activity 1

Create a material in which they present, synthetically, the optimal pH values for the development of plants commonly found in their area. To complete the task, students can use different sources of information.

Homework Activity 2

In teams of 5 members, create a poster, in digital format, presenting solutions for preventing/treating the negative consequences caused by changes in pH on the human body.

Co-funded by the European Union

Co-funded by the European Union

Conclusion

- The importance of **pH in everyday life** cannot be overstated, as it plays a **vital role** in our ***health, the environment, and various industries***.

- Maintaining the right pH levels in the body is **crucial** for **optimal physiological functions**, influencing everything from digestion to metabolic processes.

- A comprehensive awareness of pH's significance allows individuals and communities to make **informed choices**, promoting **better health** and **environmental sustainability**.

- By recognizing the **impact of pH in our daily lives**, we can **enhance our well-being** and contribute positively to the world around us.

Co-funded by
the European Union



Designing a greener future – environmental innovation in the Metaverse

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D · Colegio Séneca S.Coop.And · Agrupamento de Escolas de Barcelos · Eurasia Institute · Inspectoratul Școlar Județean Teleorman · City of Malmö

Co-funded by the European Union

How environmental awareness is connected to renewable energy

Environmental awareness means understanding how our actions affect the planet—and making informed choices that help protect nature, people, and the climate. One of the most important areas where we can make a difference is in how we produce and use energy.
For many years, most of the world's energy has come from fossil fuels like coal, oil, and natural gas. These energy sources release large amounts of greenhouse gases when burned, which contributes to climate change, air pollution, and environmental damage. As awareness of these problems has grown, so has the need to find cleaner and more sustainable alternatives.

That's where renewable energy comes in.

Co-funded by the European Union

How environmental awareness is connected to renewable energy - continuing

Renewable energy sources—such as solar power, wind power, geothermal energy, hydroelectricity, and biomass—are naturally replenished and have a much smaller environmental footprint. They don't release carbon dioxide or harmful pollutants during use, and they reduce our dependence on limited and polluting fossil fuels.

By becoming more aware of environmental issues, people are starting to demand greener solutions. This shift in mindset is driving innovation, new technologies, and creative ways to integrate renewable energy into homes, schools, cities, and everyday life.

Environmental awareness isn't just about knowing the facts—it's about making choices that lead to real change. Choosing renewable energy is one of the most powerful ways we can take care of the planet, both now and for future generations.





Co-funded by the European Union















Renewable energy

Renewable energy is power that comes from sources that naturally replenish themselves, meaning they don't run out like fossil fuels. Examples of renewable energy include solar power from the sun, wind power from turbines, and hydropower from flowing water. Using renewable energy is important because it helps to reduce pollution and protect our planet for the future. By choosing renewable energy, we can create a cleaner and more sustainable world for everyone.

Solarpower

Converts the sun's light into electricity using solar panels. It is a renewable and environmentally friendly source of energy because the sun provides unlimited energy without emitting carbon dioxide.

1. The sun shines on the solar panel – Solar panels consist of solar cells that capture the sunlight.

2. Light is converted into electricity – The solar cells contain semiconductor material (often silicon) that creates an electric current when the sun hits them.

3. The electricity can be used directly or stored – The power can be sent out into the grid or stored in batteries for later use.

Windpower

Converts the movement of the wind into electricity with the help of wind turbines.

1. The wind blows – When the wind moves, it causes the wind turbine's rotor blades to spin.

2. The motion drives a generator – The rotor blades are connected to a generator that converts the kinetic energy into electrical energy.

3. The electricity is sent into the electricity grid – The electricity produced is passed on to households and industries.

M-STEM

Co-funded by the European Union

VAEV R&D · Colegio Séneca S.Coop.And · Agrupamento de Escolas de Barcelos · Eurasia Institute · Inspectoratul Școlar Județean Teleorman · City of Malmö

Biogas

Is formed when organic matter, such as food waste, manure or sewage sludge, is broken down by bacteria in an oxygen-free environment. This process is called anaerobic digestion.

1. Organic waste is collected – For example, food scraps, plant waste or manure.

2. Decomposition takes place in an oxygen-free environment – Bacteria break down the material in a biogas plant and create gas.

3. The biogas is used as energy – The gas consists mostly of methane (CH_4) and can be used for electricity, heating or as vehicle fuel.

Geothermal

Heat that comes from the Earth's interior. It is a renewable and sustainable energy source that can be used to produce electricity and heat.

1. Heat from the Earth's interior – Deep beneath the Earth's crust there is hot magma and hot water vapor.

2. Hot steam is taken up – Through boreholes, the hot steam or hot water is brought to the surface.

3. Conversion to energy – The steam powers turbines that produce electricity, or are used directly for heating.

M-STEM

Co-funded by the European Union

VAEV R&D · Colegio Séneca S.Coop.And · Agrupamento de Escolas de Barcelos · Eurasia Institute · Inspectoratul Școlar Județean Teleorman · City of Malmö

Hydropower

Hydropower is a renewable energy source that converts the movement of water into electricity. It is one of the largest and most reliable sources of energy in the world.

1. Water collects in a dam – A hydroelectric power plant is often built on a river or river, where the water level is regulated with a dam.

2. Water is released through turbines – As water flows through the power plant, turbines that are connected to a generator spin.

3. Electricity is generated and sent into the grid – The generator converts the kinetic energy into electricity that can be used in homes and industries.

M-STEM

Co-funded by the European Union

VAEV R&D

Colegio Séneca S.Coop.And

AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE

EURASIA INSTITUTE

INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN

City of Malmö

Co-funded by the European Union

How renewable energy reduces environmental impact

Renewable energy comes from natural sources that are constantly replenished, like the sun, wind, water, and heat from the Earth. Unlike fossil fuels (coal, oil, and natural gas), renewable energy produces little to no harmful pollution when used. Here's how it helps the environment:

1. Lower greenhouse gas emissions

Burning fossil fuels releases large amounts of carbon dioxide (CO_2) and other greenhouse gases that trap heat in the atmosphere, causing global warming and climate change. Renewable energy sources generate electricity without releasing these gases, helping to slow down climate change.

Co-funded by the European Union

How renewable energy reduces environmental impact

2. Reduced air pollution

Fossil fuel power plants emit pollutants like sulfur dioxide and nitrogen oxides, which cause smog, acid rain, and respiratory problems. Renewable energy sources produce clean energy, improving air quality and public health.

3. Less water usage

Traditional power plants often use a lot of water for cooling. Solar panels and wind turbines require little to no water, preserving freshwater resources and protecting aquatic ecosystems.

Co-funded by the European Union

How renewable energy reduces environmental impact

4. Conservation of natural resources

Fossil fuels are finite and require destructive extraction methods (like mining and drilling) that harm landscapes and wildlife. Renewable energy relies on abundant, natural flows that don't deplete the Earth's resources.

5. Reduced habitat destruction

1. Renewable energy installations, when planned carefully, have a smaller impact on ecosystems compared to mining or drilling for fossil fuels. Many renewable projects include environmental safeguards to protect wildlife.

How renewable energy reduces environmental impact

6. Encourages sustainable development

By supporting clean energy, communities reduce their carbon footprint and move toward more sustainable ways of living that protect the environment for future generations.

Co-funded by
the European Union



Build a Sustainable Home

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D · Colegio Séneca S.Coop.And · Agrupamento de Escolas de Barcelos · Eurasia Institute · Inspectoratul Școlar Județean Teleorman · City of Malmö

Co-funded by the European Union

Assigment

BUILD A SUSTAINABLE HOME

Choose two renewable energies

Identify ways to reduce energy consumption

Design, create and innovate your house





Co-funded by the European Union















Building your sustainable home in the Metaverse

- Redesign a virtual house
- Integrate renewable energy sources
- Access to building materials, interior design elements and other resources
- Simulate energy production and consumption within the house

Individual work

- Contribute to two ideas to the group's design of the virtual house

Individual work

- Write a brief summary of the two energy sources your group has chosen

Co-funded by the European Union

Co-funded by the European Union

Homework

WRITE ABOUT A SPECIFIC ASPECT OF SUSTAINABLE LIVING (SOLAR PANELS, WIND TURBINES, GEOTHERMAL HEATING, WOOD STOVES).

Good Luck!

Co-funded by the European Union

Other tasks that you could do with your students

Eco-city challenge

Task: Students collaborate to build a sustainable city with clean transportation, green buildings, and public spaces that support both people and nature.

Learning goals: Urban planning, biodiversity, sustainable infrastructure.

Creative twist: Let each team manage different aspects (transport, energy, housing, waste) and simulate how decisions affect the city's environment over time.

Co-funded by the European Union

Other tasks that you could do with your students

Upcycling design lab

Task: Students explore virtual “waste zones” in the Metaverse and repurpose discarded objects to create new, useful, or artistic items.

Learning goals: Circular economy, waste reduction, creative problem-solving.

Creative twist: Host a virtual “Upcycled Design Fair” where students showcase and explain their projects.

Co-funded by the European Union

Other tasks that you could do with your students

Sustainability scavenger hunt

Task: In a pre-built Metaverse world, students complete sustainability-themed challenges or puzzles at different stations (e.g., renewable energy quiz, wildlife habitat puzzle, carbon footprint calculator).

Learning goals: Environmental literacy, systems thinking, teamwork.

Creative twist: Time the activity and reward creative solutions with virtual “eco badges.”

Co-funded by the European Union

Other tasks that you could do with your students

Virtual ecosystem explorer

Task: Students explore different ecosystems (rainforest, coral reef, arctic tundra) in the Metaverse and investigate how human activities affect them.

Learning goals: Biodiversity, climate change, conservation.

Creative twist: Students take on the role of environmental scientists and present findings to a virtual "UN Sustainability Panel."

Co-funded by the European Union

Other tasks that you could do with your students

Build a zero-waste school

Task: Redesign a virtual school environment with the goal of making it zero-waste.

Learning goals: Waste reduction, school sustainability, community action.

Creative twist: Include virtual posters, sorting stations, compost areas, and student-led awareness campaigns inside the world.

Co-funded by the European Union

Other tasks that you could do with your students

Renewable energy simulator

Task: Students experiment with different renewable energy setups (solar panels, wind turbines, geothermal) in a simulated environment and track how their house or community performs under different conditions.

Learning goals: Energy literacy, systems thinking, data analysis.

Creative twist: Let students “pitch” their energy model to the rest of the class like engineers in a startup competition.

Co-funded by
the European Union



Nuclear Fission and Nuclear Fussion

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D
Colegio Séneca S.Coop.And
Agrupamento de Escolas de Barcelos
Eurasia Institute
Inspectoratul Școlar Județean Teleorman
City of Malmö

Co-funded by the European Union

Let's ...

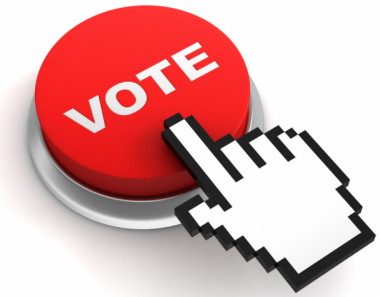


Applying measures to protect the environment and oneself from nuclear radiation



I would like all teams to come and present your poster!

Use one of the post-its to vote for your favourite poster!





What destructive effects of nuclear energy can you identify in the picture below?



What benefits of nuclear energy can you spot in the image below?



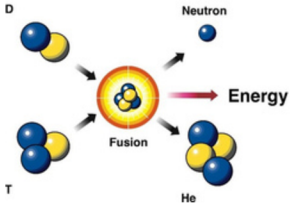


Co-funded by the European Union

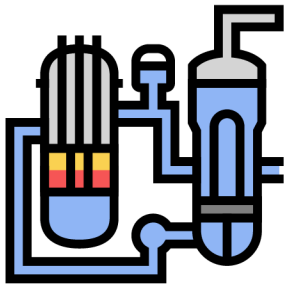
Co-funded by the European Union

Learning objectives

By the end of the lesson, you will be able to:



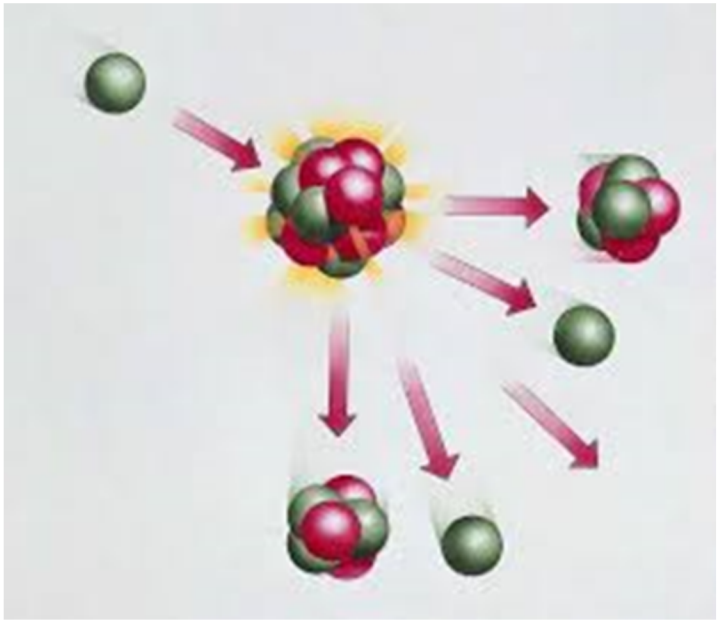
- **understand** nuclear fission and chain reaction;
- **identify** the structural elements of a nuclear reactor;
- **(virtually) assemble** a nuclear reactor
- **analyze/identify** possible effects of nuclear accidents
- **critically assess** the impact of the use of nuclear technologies on society and nature.

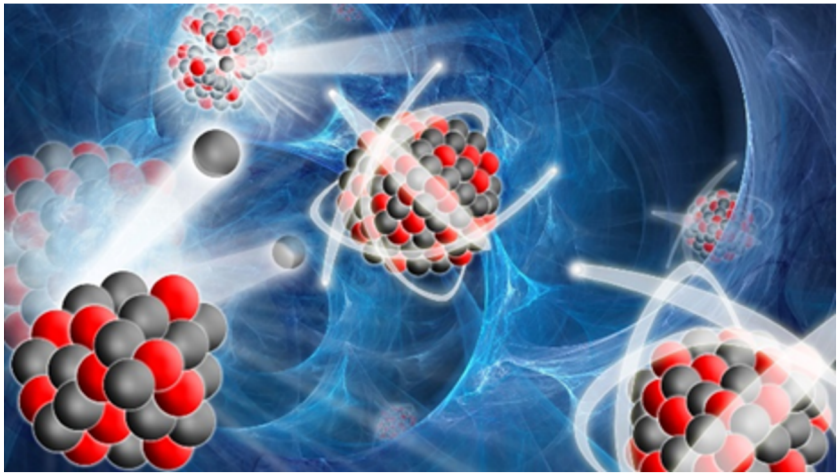




What is nuclear fission?

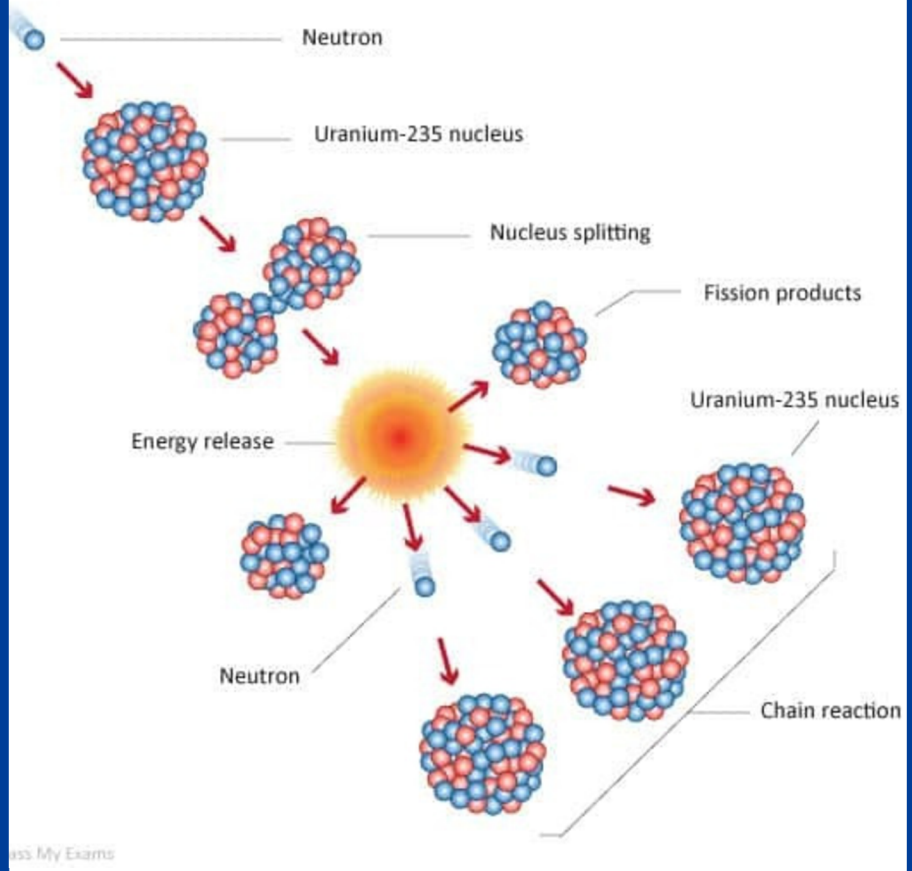
Nuclear fission is the process where the nucleus of *an atom* ***splits into two or more*** *smaller nuclei and other particles.* These particles can include **neutrons**, alpha particles (**helium nuclei**), beta particles (**electrons**), and **gamma rays** (which consist of particles of light, or photons).





Co-funded by the European Union

fission chain reaction



What is fission chain reaction?

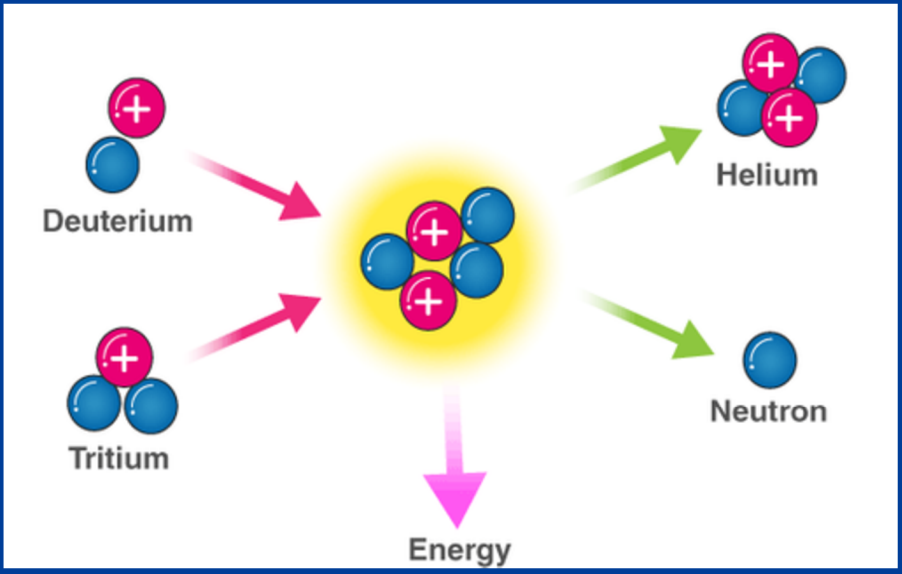
The neutrons released by fission can **initiate a new fission process**, a process that **increases in geometric progression** by **doubling the number of neutrons with each process**. Such a reaction is called **a chain reaction.**

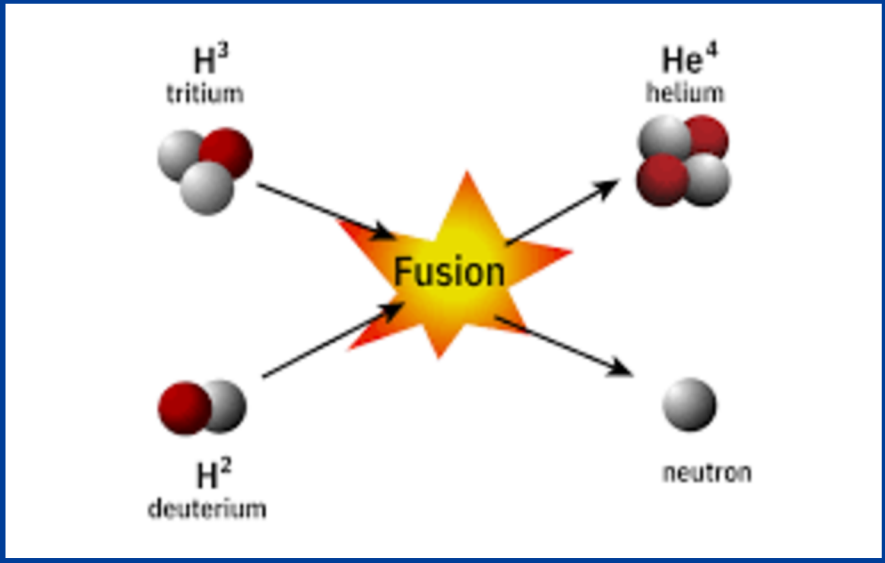
Co-funded by the European Union

Co-funded by the European Union

What do we understand by nuclear fusion?

Fusion reactions power the Sun and other stars. In fusion, **two light nuclei merge to form a single heavier nucleus**. The process **releases energy** because the **total mass of the resulting single nucleus** is **less** than **the mass of the two original nuclei.** The leftover mass becomes energy.





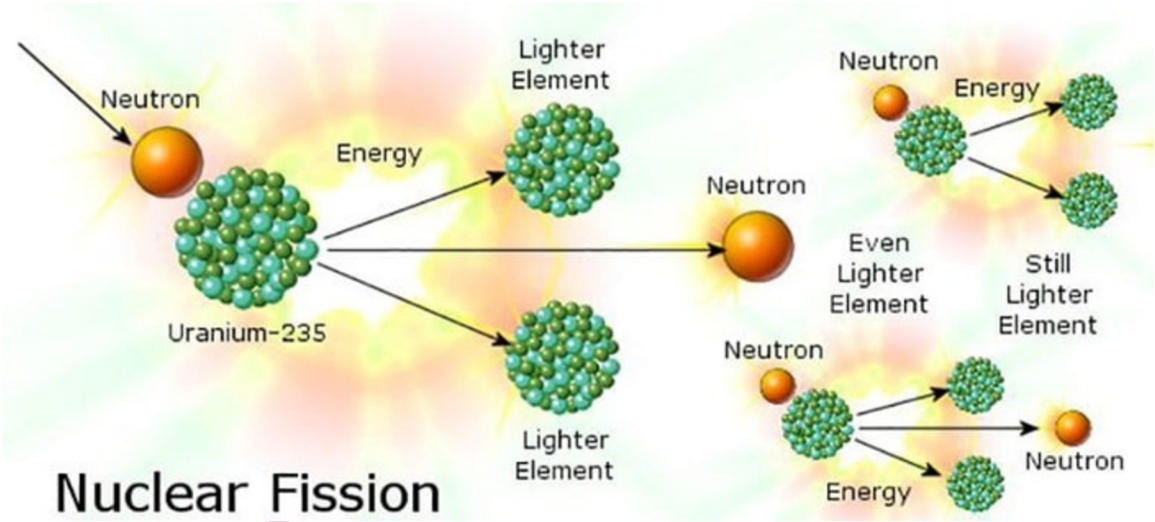
Co-funded by the European Union

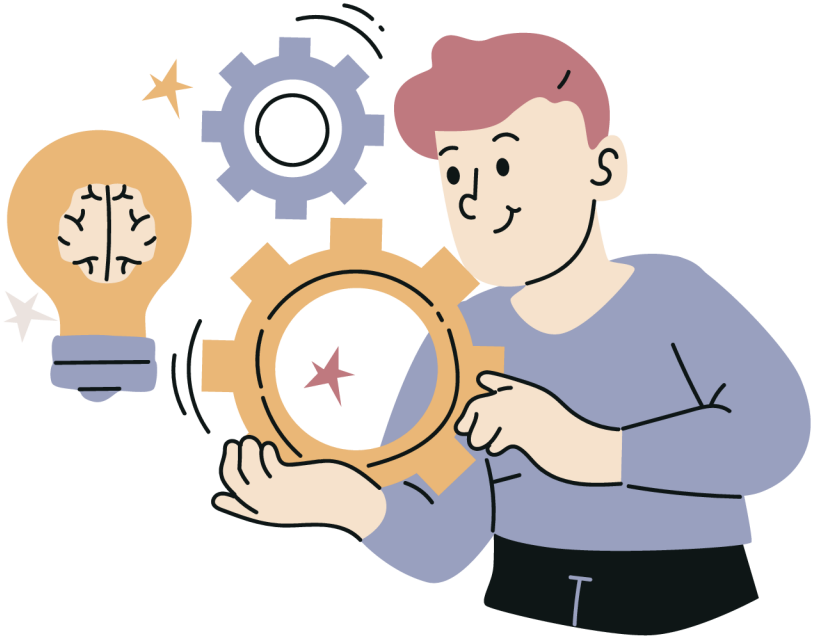
Time to try it out....



How about you get down to some **practical work?**

Let's see if we can **simulate** the process of **nuclear fission!**





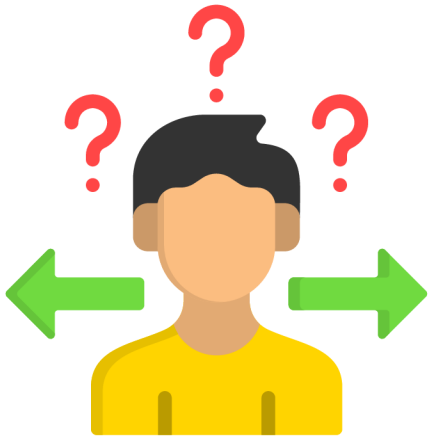
Co-funded by the European Union

You have certainly noticed...

- The interaction **potential energy** for the uranium-235 nucleus is ***minimum***
- After capturing the slow neutron, the **total energy** of the nucleus ***increases***
- Following the fission of the uranium-235 nucleus by capturing a slow neutron, energy equivalent to the difference in mass is released; *the result is* ***two lighter nuclei*** *that have kinetic energy equal to the reaction energy Q=200MeV and several high-speed neutrons (fast neutrons).*

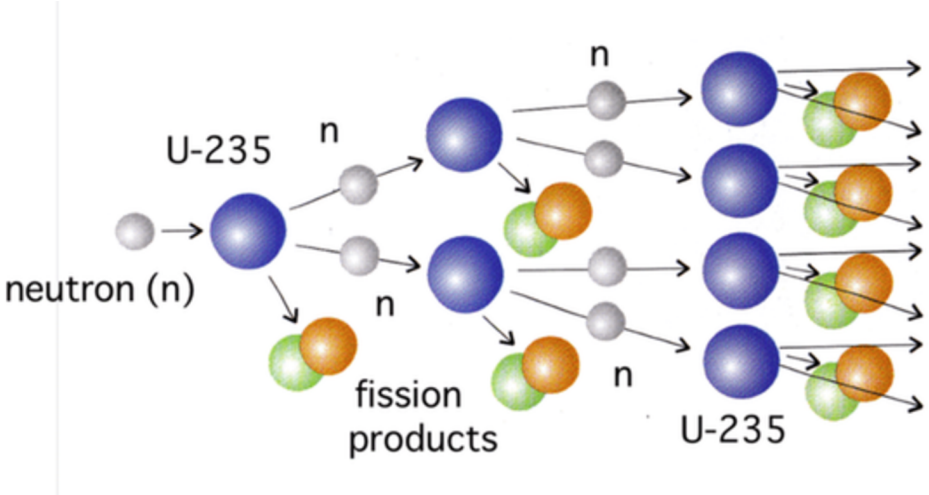
Co-funded by the European Union

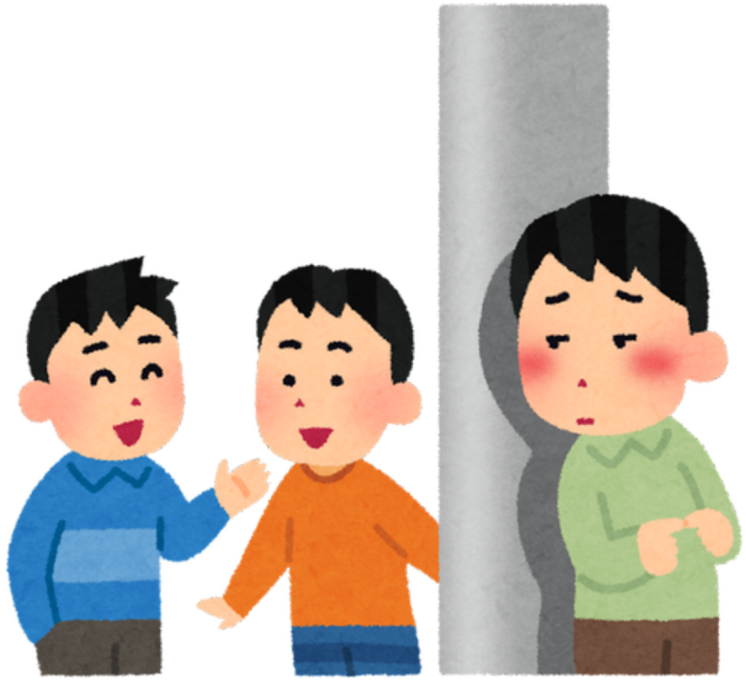
Time to try it out...AGAIN!



Ready for some more **practical work?**

Let's see if we can **simulate** the process of **fission chain reaction!**

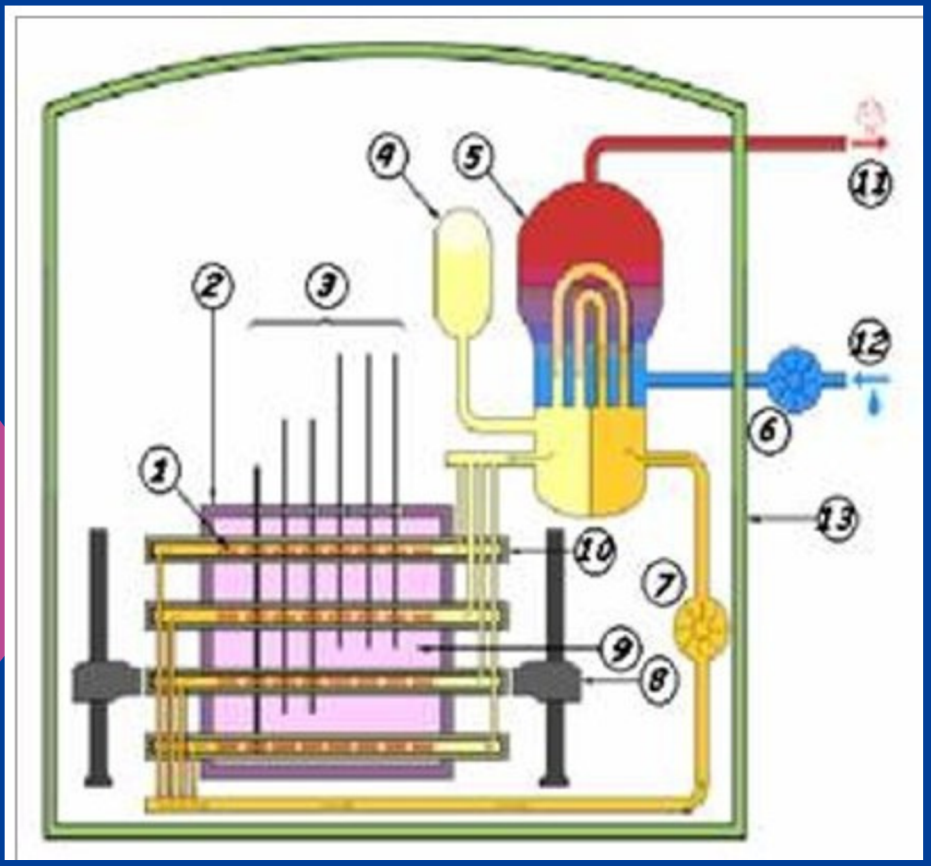




Co-funded by the European Union

Building a nuclear reactor

For the next activity, you will have to use your knowledge, as well as your technical skills. to build a nuclear reactor.



Components of a Nuclear Reactor

Nuclear Fuel:

Typically uranium-235 or plutonium-239, which undergoes fission when bombarded by neutrons.

Moderator:

A substance (like water, heavy water, or graphite) that slows down neutrons to increase the likelihood of fission

Nuclear reactor

Control Rods:

Made of materials like boron or cadmium, these rods absorb neutrons and help regulate the fission process. They can be inserted or removed from the reactor core.

Coolant:

A liquid or gas (often water) that removes heat from the reactor core and transfers it to a steam generator or directly to a turbine.

Containment Structure:

A thick, robust structure designed to contain any release of radioactive materials and protect the environment.

Steam Generator:

In some reactor designs, the coolant transfers heat to water, creating steam that drives turbines to generate electricity.

Turbine and Generator:

Convert the thermal energy from steam into mechanical energy, which is then converted to electrical energy.

.

M-STEM

Co-funded by the European Union

VAEV R&D

Colegio Séneca S.Coop.And

AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE

EURASIA INSTITUTE

INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN

City of Malmö

Co-funded by the European Union

Optimal conditions for a nuclear reactor to function normally

Stable Temperature

- The reactor must maintain a stable operating temperature. This ensures that the nuclear fission process occurs at a controlled rate, preventing overheating or excessive cooling.



Proper Moderator Function

- The moderator must effectively slow down neutrons to increase the probability of fission. The choice of moderator (e.g., water, heavy water, or graphite) should match the reactor design to optimize neutron economy.

Adequate Neutron Flux

- A sufficient number of neutrons must be present to sustain the fission chain reaction. This can be controlled through the arrangement of fuel, moderator, and control rods.

Co-funded by the European Union

Optimal conditions for a nuclear reactor to function normally

Effective Control Rod Positioning

- Control rods must be properly inserted or withdrawn to manage the reactor's reactivity. This ensures that the fission reaction remains steady and can be adjusted as needed.





Consistent Coolant Flow:

- The coolant must flow continuously and effectively through the reactor core to remove heat. The coolant's temperature and pressure should be maintained within specified limits to ensure efficient heat transfer.

Co-funded by the European Union

What could go wrong ?

Loss of Coolant Accident (LOCA)

Cause: A break or leak in the coolant system can lead to a rapid loss of coolant, compromising the ability to remove heat from the reactor core.

Reactivity Control Failure

Cause: Failure in the control rod mechanisms or malfunction of the neutron detectors can lead to improper regulation of the fission reaction.

Overheating of the Reactor Core

Cause: Inadequate coolant flow or failure of the heat exchanger can lead to overheating





Containment Breach

Cause: Structural failure in the containment building due to extreme pressure or seismic activity can lead to a release of radioactive materials.



Co-funded by the European Union

Let’s see what we have learnt!

Join in the following kahoot game and find out how much you know about nuclear fission, fusion, reactor.

Nuclear fission and nuclear fusion - MSTEM project







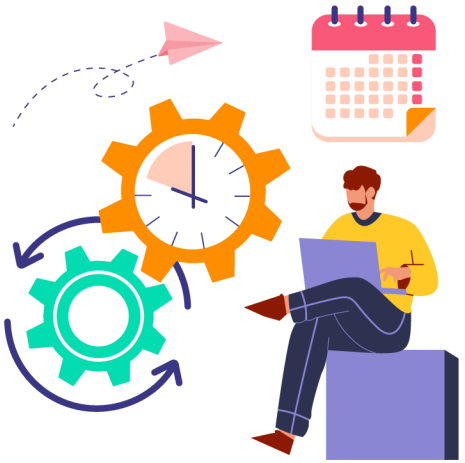
Homework Activity 1

You will have to **create a presentation** on the *effects of nuclear accidents*. To create the presentation, please use use a digital application of their choice.

You can get **some inspiration** by watching the following videos.
https://www.youtube.com/watch?v=0l7QFfsHBks
https://www.youtube.com/watch?v=Aza-2wopCFY

Homework Activity 2

You can form groups of 5 members and create a concept map regarding the impact of technologies on society and nature.



Co-funded by the European Union

Co-funded by
the European Union



Mathematics

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D
Colegio Séneca S.Coop.And
Agrupamento de Escolas de Barcelos
Eurasia Institute
Inspectoratul Școlar Județean Teleorman
City of Malmö

Lesson Plan - Mathematic

Learning Objectives:

By the end of this lesson, students will be able to:

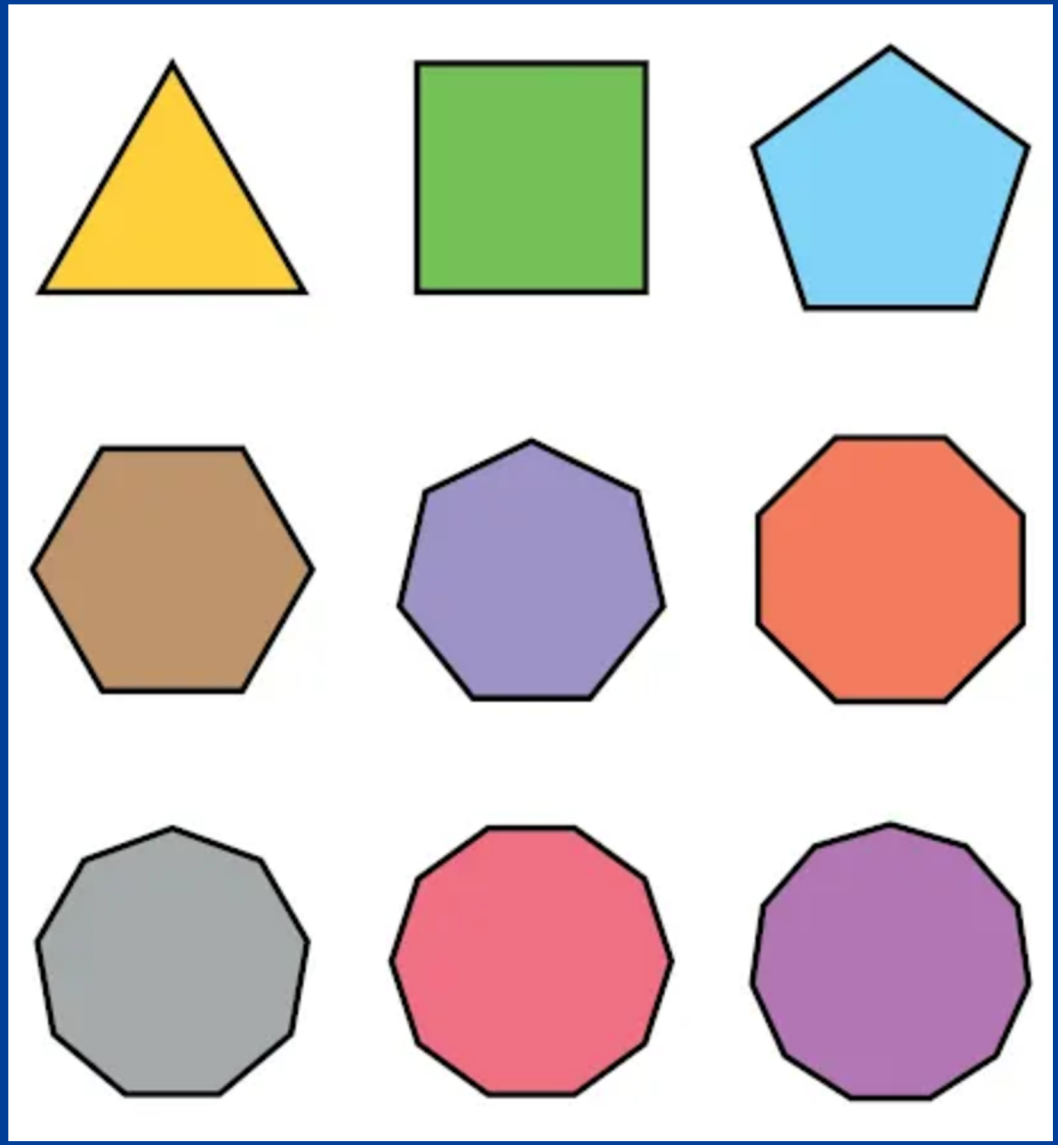
- Identify the different types of polygons based on the number of sides.
- Understand the concept of polygons, their properties and classifications.
- Explore how polygons are used in various areas of technology, engineering and science (STEM).
- Promote the use of technological tools to simulate and design polygons.

Co-funded by the European Union

What are Polygnos?

P

- Polygons are flat, closed geometric figures delimited by straight line segments.
- Some examples of polygons are triangles, squares, and rectangles.



Co-funded by the European Union

- **Types of Polygons: Triangles, Quadrilaterals, Pentagons, Hexagons, Heptagons, Octagons**
- **Properties of Polygons: Sides, Internal Angles, Diagonals**
- **Classification of Polygons: Regular and Irregular**

Types of Polygons

MATH MONKS

Triangle • Has 3 sides and 3 vertices • Has no diagonals • Sum of the interior angles is 180°	**Quadrilateral** • Has 4 sides and 4 vertices • Has two diagonals • Sum of the interior angles is 360°
Pentagon • Has 5 sides and 5 vertices • Has 5 diagonals • Sum of the interior angles is 540°	**Hexagon** • Has 6 sides and 6 vertices • Has 9 diagonals • Sum of the interior angles is 720°
Heptagon • Has 7 sides and 7 vertices • Has 14 diagonals • Sum of the interior angles is 900°	**Octagon** • Has 8 sides and 8 vertices • Has 20 diagonals • Sum of the interior angles is 1080°
Nonagon • Has 9 sides and 9 vertices • Has 27 diagonals • Sum of the interior angles is 1260°	**Decagon** • Has 10 sides and 10 vertices • Has 35 diagonals • Sum of the interior angles is 1440°

M-STEM

Co-funded by the European Union

Strategies and Activities

1. Introduction (10m)

- Start with a brief review of geometric figures, highlighting polygons.
- Explain that polygons are flat figures formed by straight line segments that meet at points called vertices.
- Present examples of polygons in everyday life (architecture, product design, civil engineering) and how they are important for building stable and efficient structures.



Co-funded by the European Union

2.Main Lesson (25m)

Uses of Polygons in Daily Life

Architectural Design:

Designing Architectural structures and monuments is extremely important for engineers. If we carefully observe, almost every architecture is a product of geometric analysis done with precision and accuracy.

Example

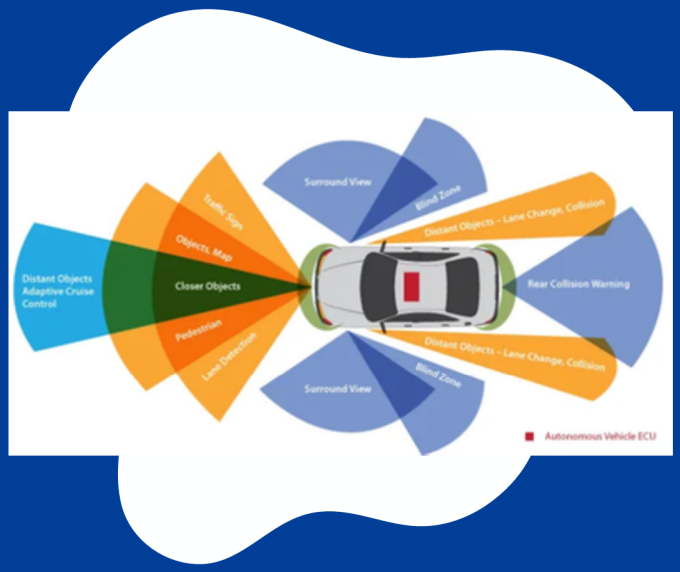


Co-funded by the European Union

Co-funded by the European Union

More Examples

DESIGNE GRAFIC; DESIGNE OF PRODUCTS; AUTOMATION OF VEHICLES;

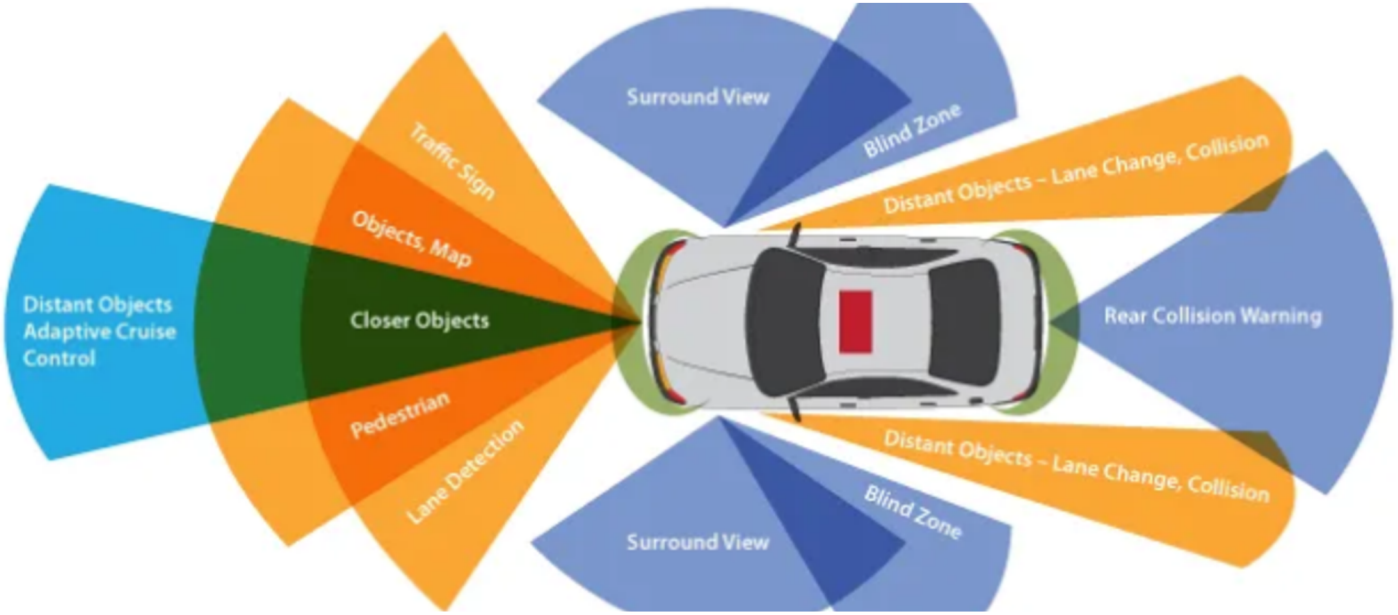






Co-funded by the European Union

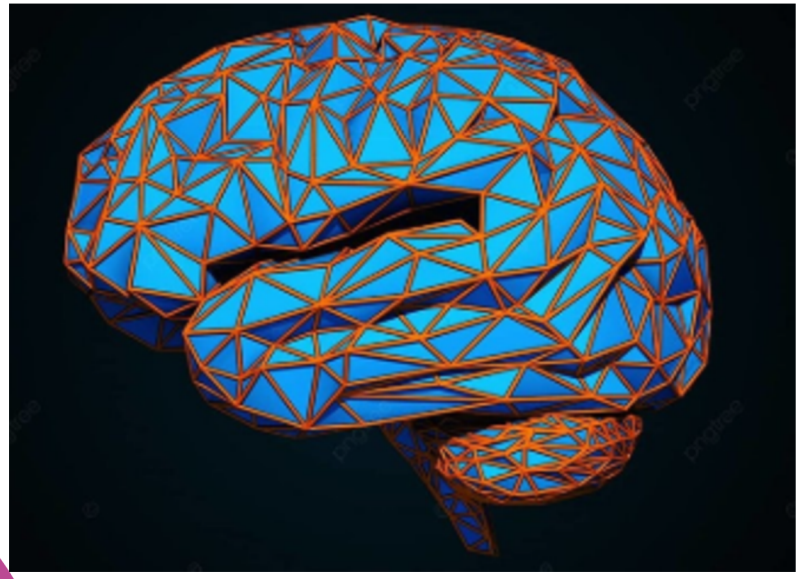
Perception in Self Driving Cars



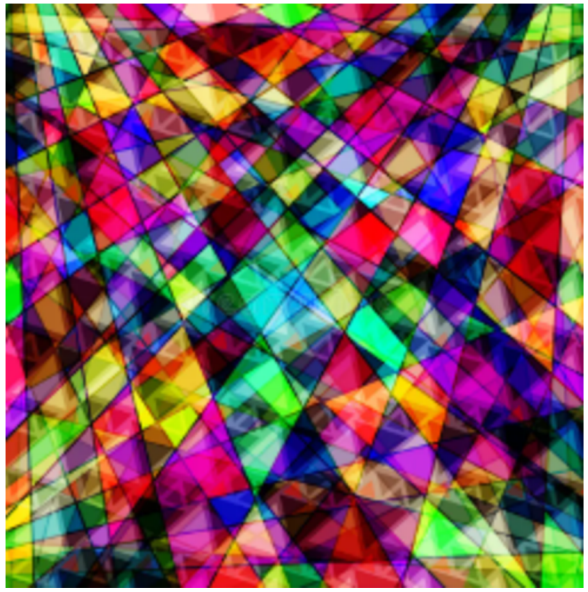
Automation of Vehicles

Co-funded by the European Union

Designe Of Products





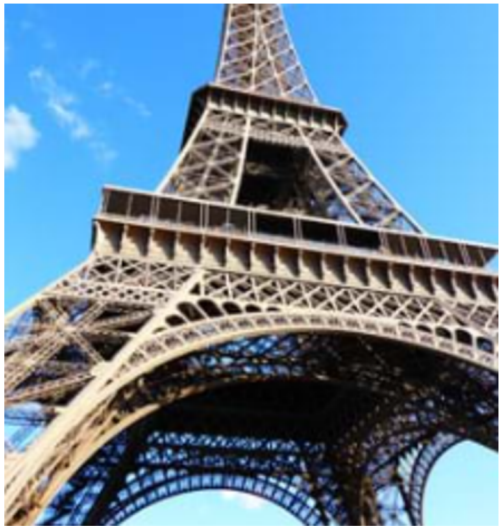


Logos; Polygon illustrations; Polygon Art

Co-funded by the European Union

Designe Of Products







Polygon Art; Polygons in engineering projects

Co-funded by the European Union

Engineering projects





Polygons in engineering projects

3.Practical Activity (20m)

- **Construction of Polygons:**

- Divide the students into groups and hand out materials (cardboard, ruler and compass).

- Each group must construct different polygons (triangles, quadrilaterals, pentagons, hexagons), drawing them and marking the vertices and sides.

-For each polygon, calculate and mark the sum of the internal angles.





Co-funded by the European Union

Co-funded by the European Union

Digital Exploration

Use programs like GeoGebra to have students draw polygons digitaUse programs like GeoGebra to have students draw polygons digitally, visualizing how angles and properties change as they change sides.lly, visualizing how angles and properties change as they change sides.





Practical Activity - Objectives

The teacher aims to help students apply geometry in a practical way, simulating the use of calculations and technologies to solve construction problems. It also aims to encourage teamwork and the communication of ideas to solve a real problem.





Co-funded by the European Union

Conclusion (10m)

- **Presentation of Projects:** each group presents its construction to the rest of the class, explaining the choices made in terms of geometric shapes and calculations performed.
- **Discussion:** What did you learn about how geometry is used in real constructions? How has technology helped in the design and problem-solving process?

Co-funded by the European Union

Homework:

Research how they think geometric concepts can be applied in other fields, such as science and engineering. With practical examples.

Evaluation/ Assessment:

Students are assessed based on: - Participation in practical activities.

- In the application of mathematical concepts in constructions and calculations.
- Creativity in applying concepts in 3D modeling.
- Clarity and precision in project presentations.

Co-funded by the European Union

Lesson resources: •

Tablets, computers or smartphones with geometric modeling software (GeoGebra, Tinkercad).

• Paper and pen for initial sketches and calculations.

• Projector for demonstrations and visualizations.



Co-funded by the European Union

Resources used to create the lesson:

Books: - "How to Solve It: A New Aspect of Mathematical Method" - George Pólya Publisher: Princeton University Press

Geogebra Link: https://www.geogebra.org

MIT OpenCourseWare - Mathematics Link: https://ocw.mit.edu/courses/mathematics/

Desmos Link: https://www.desmos.com

STEM Resource Center (NCTM) Link: https://www.nctm.org

Co-funded by the European Union

Co-funded by
the European Union



Sciences

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D
Colegio Séneca S.Coop.And
Agrupamento de Escolas de Barcelos
Eurasia Institute
Inspectoratul Școlar Județean Teleorman
City of Malmö

Lesson Plan - Sciences

Learning Objectives:

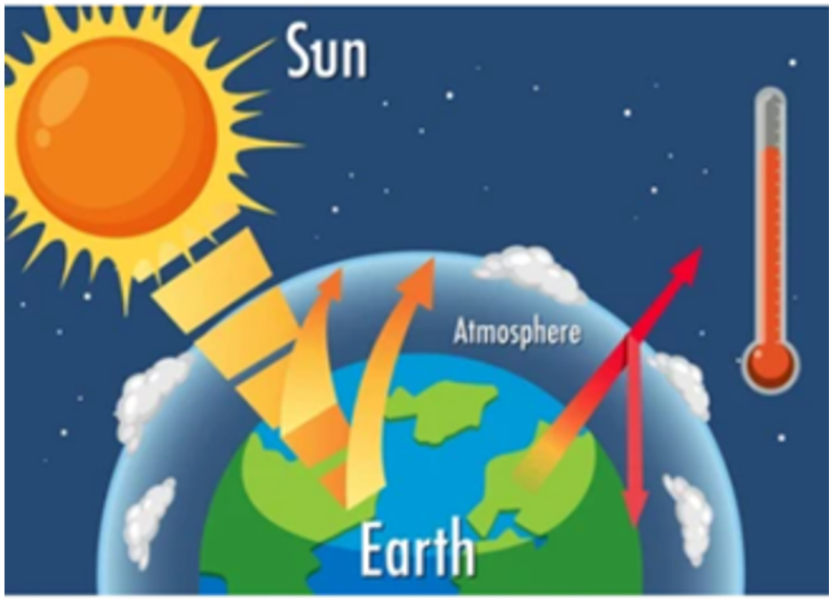
By the end of this lesson, students will be able to:

- **Understand the causes and consequences of climate change on the planet.**
- **Explore data on climate change and its relationship with factors such as temperature and gas emissions.**
- **Use technological tools to analyze and propose solutions to mitigate the impacts of climate change.**
- **Foster the ability to work with scientific data and simulations**

Co-funded by the European Union

Main Causes of Climate Change

- Greenhouse effect
- Deforestation effect
- Pollutant gas emissions







Co-funded by the European Union

• Global Effects of Climate Change:







Co-funded by the European Union

Strategies and Activities

1. Introduction (10m)

- Start the class with a brief introduction to what climate change is, showing some examples to students.
- Ask students what they know about global warming and its consequences. Let them reflect on how human actions are contributing to the problem.
- Use images or short videos of extreme weather events (such as hurricanes, droughts, floods) to illustrate visible impacts and generate discussion.



Co-funded by the European Union

EXEMPLES OF WEATHER EVENTS

Hurricanes and their effects





Co-funded by the European Union

Co-funded by the European Union

More Examples

DRAUGHTS AND FLOODS





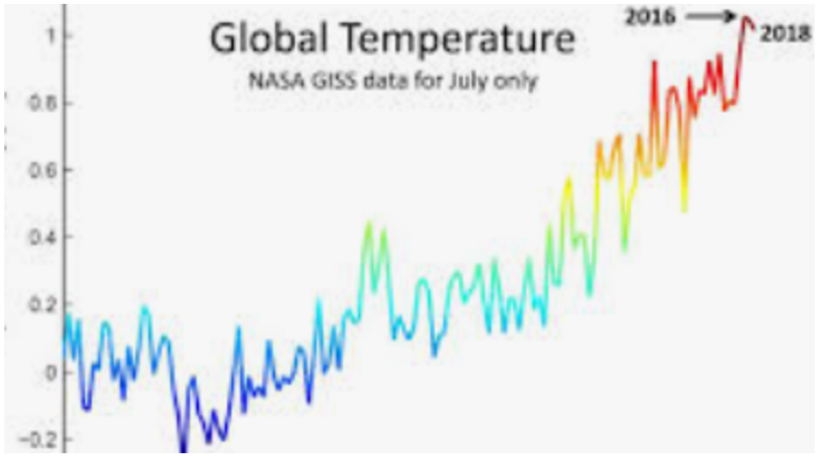
Co-funded by the European Union

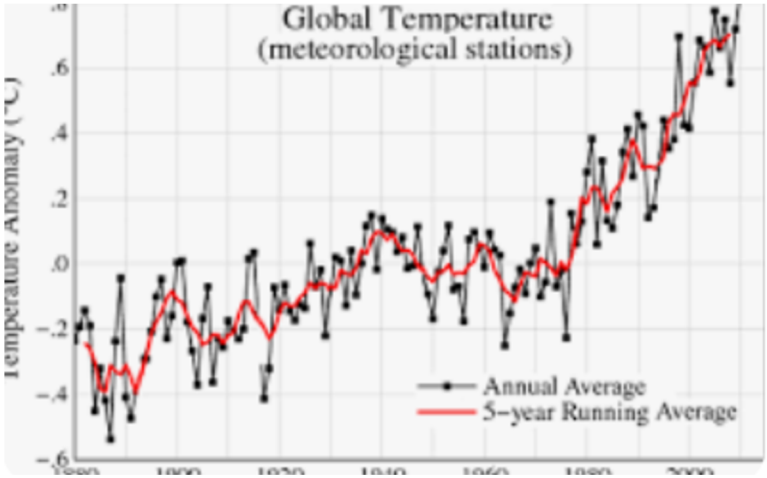
Developement:40m

Part A: Scientific Research and Data Analysis: 10m

Climate Data Exploration:

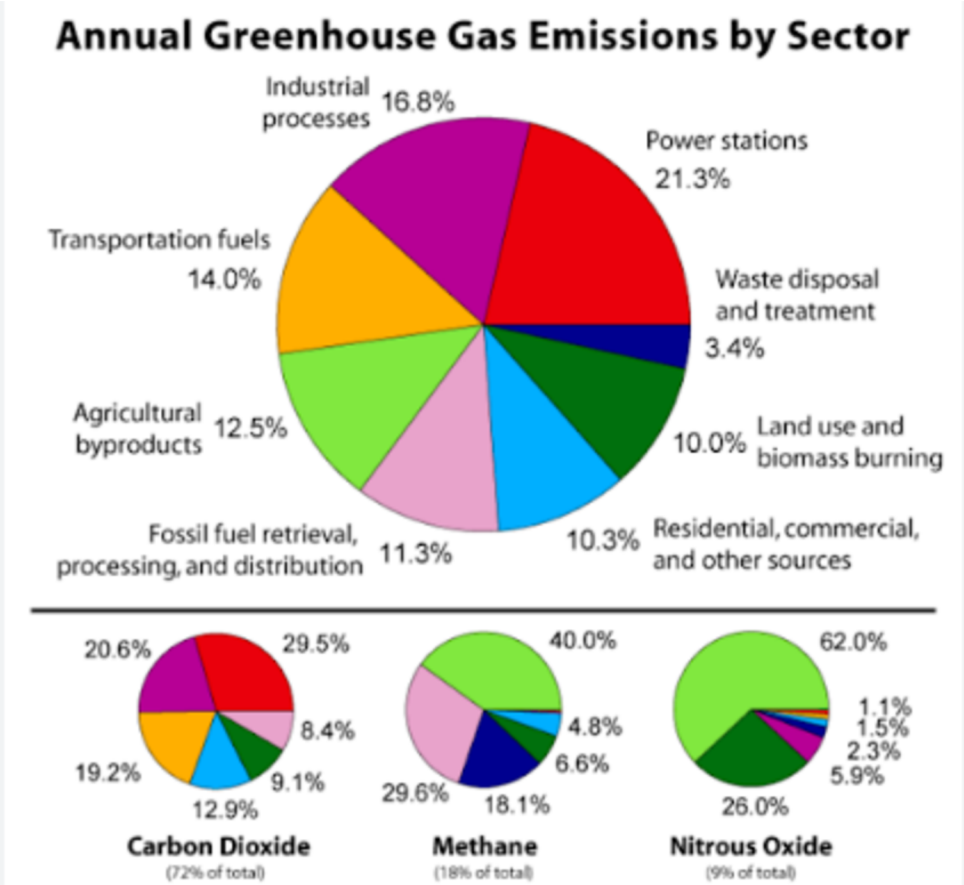
- Present students with graphs and charts showing the increase in global temperature over the past 100 years.
- Show how scientists monitor these changes using data from satellites and weather stations.

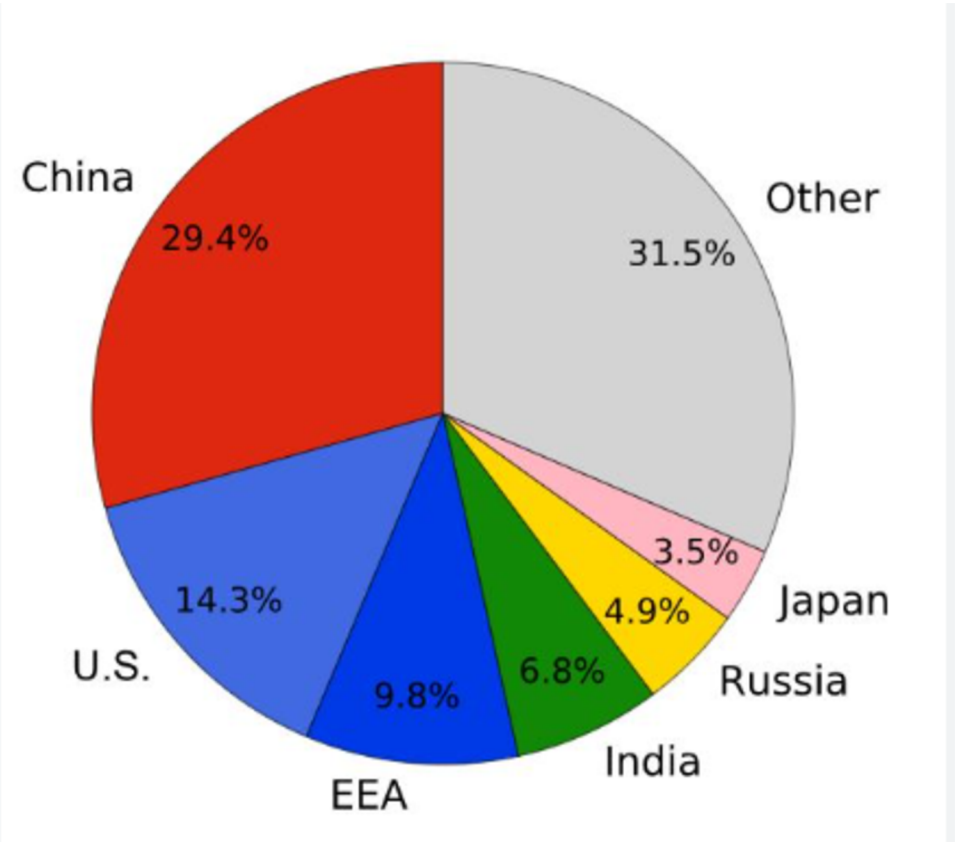




Co-funded by the European Union

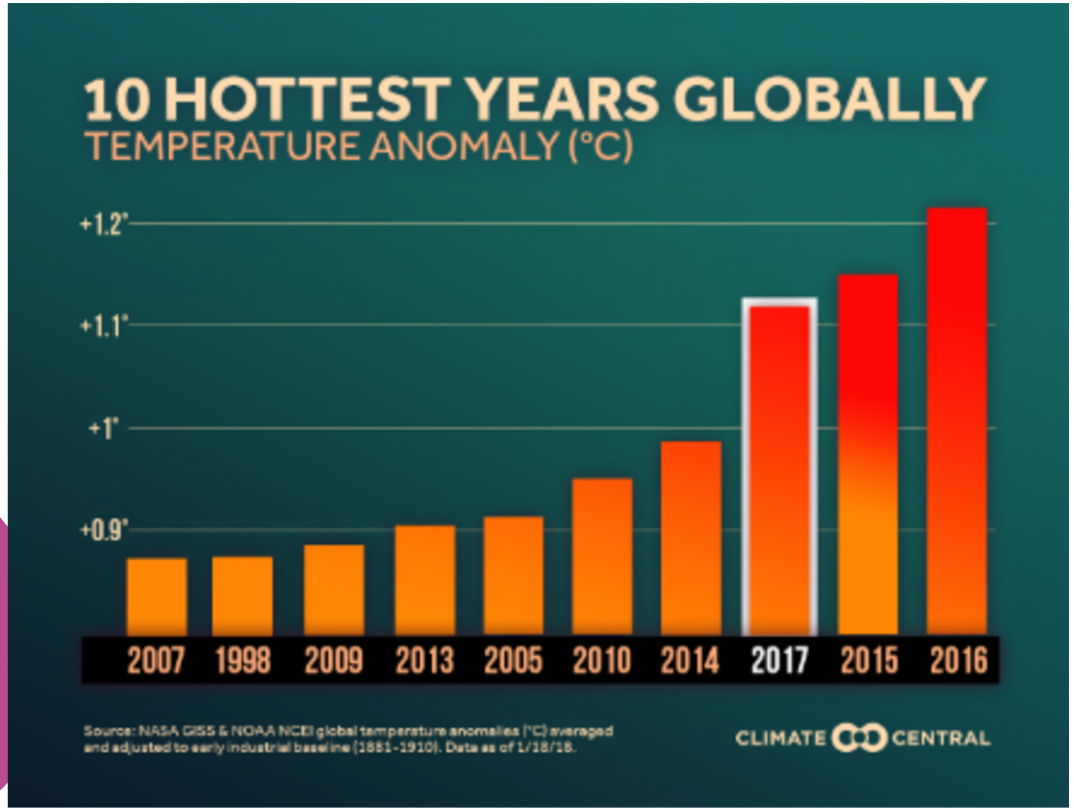
Graphs and Charts

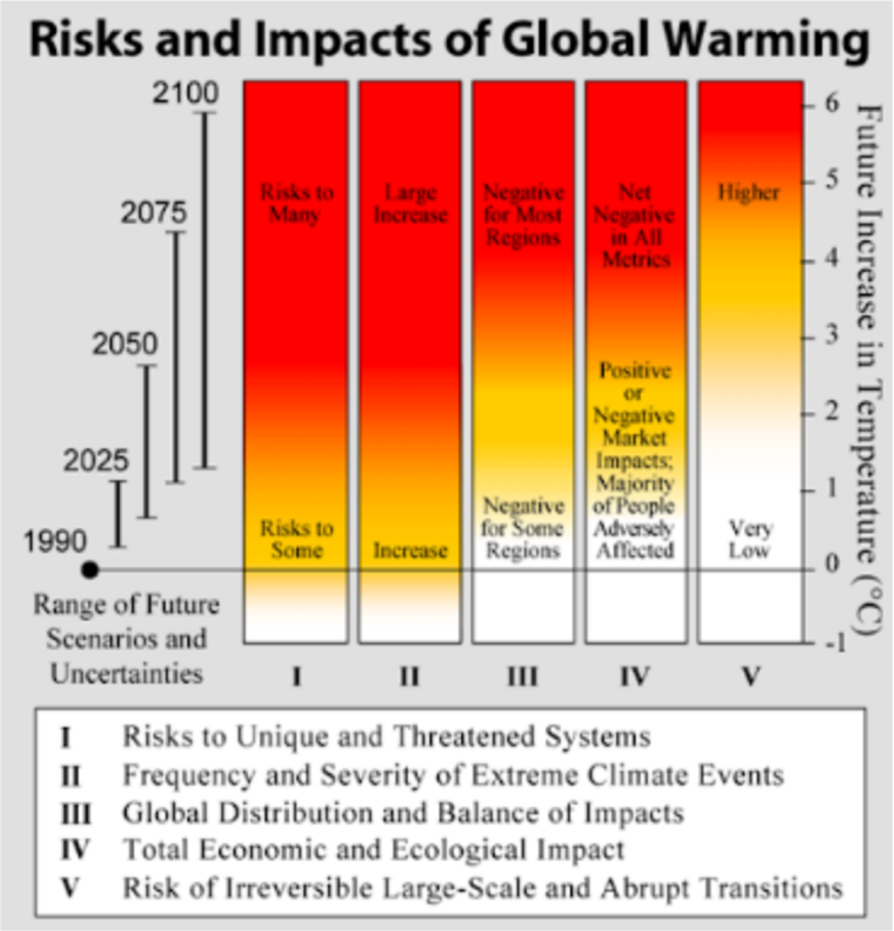




Co-funded by the European Union

Graphs and Charts





Co-funded by the European Union

Group Activity: 10m

- Divide students into groups and assign each group a set of climate data (average global temperature, CO2 levels, sea level variation, etc.).
- Students should create graphs and charts to visualize the data and identify patterns of change.
- Ask them how these changes might affect different regions of the world.



Part B: Technological Solutions and Engineering Projects :20m

- **Exploration of Green Technologies:**

- Introduce the concept of green technologies, such as solar panels, wind turbines and electric cars, and how they can help mitigate climate change.

- Show videos or animations about how these technologies work and how they contribute to reducing carbon emissions.





Co-funded by the European Union

Co-funded by the European Union

Green Technologies



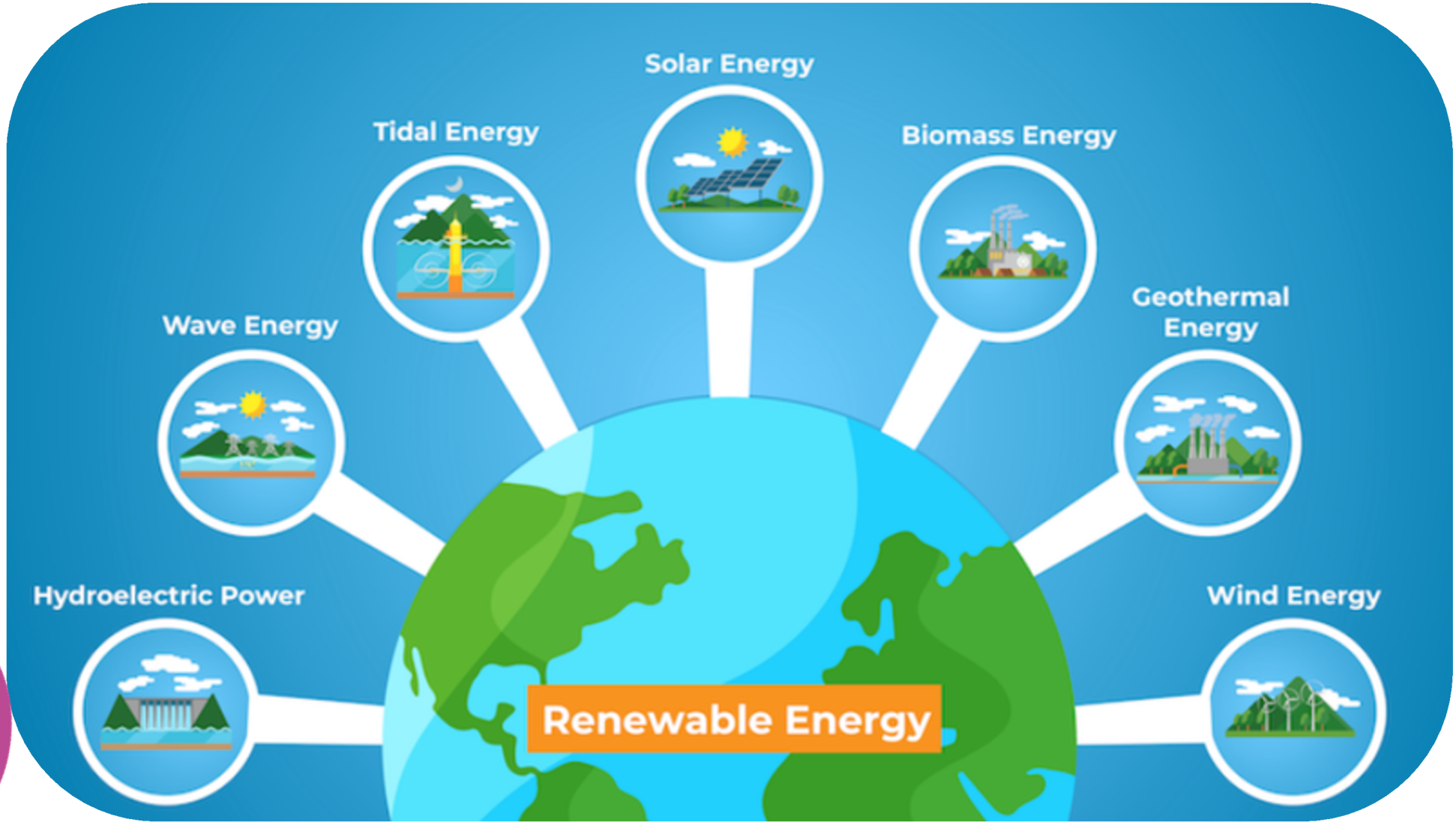
Green Technologies





Co-funded by
the European Union

Renewable Energy



Co-funded by the European Union

Practical Activity in Groups: (15m)

- Each group will be responsible for designing a technological or structural solution to help combat the effects of climate change.
- They should think about how technology can be used to reduce CO2 emissions, generate renewable energy or improve the energy efficiency of buildings.

- Using paper, recycled materials or modelling software such as Tinkercad, groups should create a model or mock-up of the solution they have developed.
- This could be an idea such as a sustainable house, a small wind turbine or a homemade solar panel.

Co-funded by the European Union

Practical Activity in Groups: (15m)

Sustainable houses - Projects



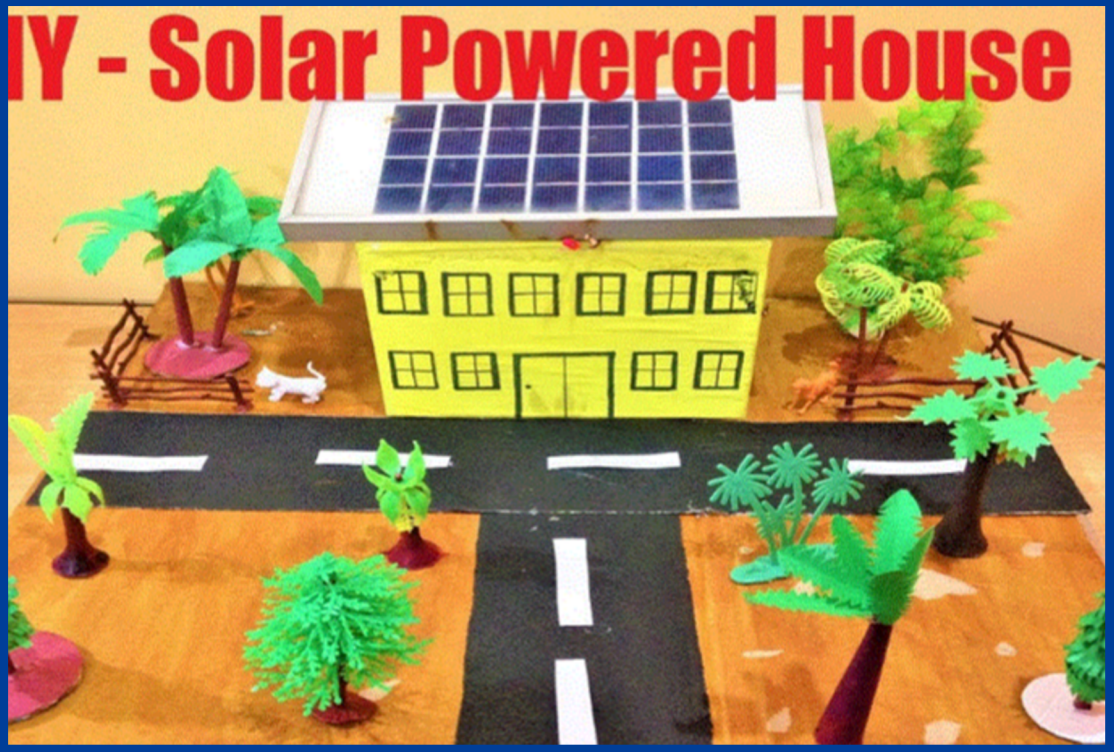


Co-funded by the European Union

Practical Activity in Groups: (15m)

Small wind turbine or a homemade solar panel- Projects.





Co-funded by the European Union

Conclusion and Reflection:

Presentation of Projects:

- Groups present their solutions to the rest of the class.
- They should explain how their idea can help mitigate the impacts of climate change and how technology was used in the process.



Co-funded by the European Union

Conclusion and Reflection:

- Conclude with a discussion of how science, technology, and engineering can work together to combat climate change.
- Ask students what they can do in their daily lives to contribute to sustainability and environmental preservation.



Co-funded by the European Union

Assessment:

Participation:

- Evaluate student participation in data analysis and technological solutions development activities.

Creativity in the Project:

- Evaluate the creativity and feasibility of the solutions presented by the students

Data Analysis:

- Check students' ability to interpret climate data correctly and draw relevant conclusions.

Collaboration:

- Observe how students work as a team to develop their solutions and how they communicate their ideas.

Co-funded by the European Union

Resources:

- Computers or tablets with access to spreadsheet software (Excel or Google Sheets).
- Internet access for researching climate data and educational videos.
- Recyclable materials for building prototypes (paper, pens, scissors, glue).
- Projector for presentations and viewing graphics and videos.

Co-funded by the European Union

Bibliography:

Websites and Online Resources:

National Geographic - Climate Change
Link:https://www.nationalgeographic.com/environment/climate-change

The Guardian - Climate Change
Link:https://www.theguardian.com/environment/climate-change

Documentaries and Videos:

"An Inconvenient Truth"(2006)Directed by: Davis Guggenheim

"Before It's Too Late"(2019)Directed by: Werner Boote

Co-funded by the European Union

Let's take care of our planet. It's the only one we have ...



Co-funded by the European Union

Co-funded by
the European Union



Sustainable Technology

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D
Colegio Séneca S.Coop.And
Agrupamento de Escolas de Barcelos
Eurasia Institute
Inspectoratul Școlar Județean Teleorman
City of Malmö

Learning objectives

The primary goal of this lesson is to help students understand how sustainable technologies reduce environmental harm while improving everyday life. By the end of the session, students will be able to define what sustainable technologies are, identify real-world examples such as green buildings, energy-efficient devices, and smart urban systems, and recognize how these innovations support a healthier planet. Through a hands-on Metaverse simulation, they will explore a virtual eco-friendly city and observe key sustainability features in action. This immersive experience is especially valuable for learners who find abstract technical concepts difficult to grasp. The lesson will also encourage students to reflect on how these technologies could be used in their own communities or homes, fostering creativity, problem-solving, and environmental responsibility. Overall, students will develop the foundational knowledge and curiosity needed to understand sustainability in a practical, accessible, and engaging way.

Co-funded by the European Union

Introduction

Technology plays a big part in our daily lives, from the homes we live in to the streets we walk on. It affects how we use resources and the way it impacts the planet. Sustainable technologies are new ideas and tools that help meet our needs while protecting nature and saving resources for the future. In this lesson, students will learn how things like green buildings, energy-efficient appliances and smart grids can help cities become cleaner and healthier. They will also take a virtual tour of an eco-friendly city in the Metaverse to see how these ideas work in real life.

Key Points:

- **Definition of sustainable technologies:** Technologies that reduce environmental impact and use resources efficiently
- **Why It Matters**: Cuts pollution, saves energy, and supports healthier communities
- **Big Ideas:** Green building design, efficient heating/cooling, and circular-economy practices

Co-funded by the European Union

Green Building Techniques

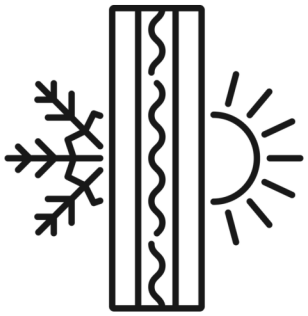
Buildings can consume up to 40% of a city's energy and produce a huge share of its carbon emissions. Green building techniques aim to change that by optimising materials and systems—from walls that insulate so well you need less heating, to roofs covered in plants that cool the air. Let's explore three core strategies:



Co-funded by the European Union

Green Building Techniques

- **High-Performance Insulation:** Uses materials like rigid foam, mineral wool, or aerogel to reduce heat transfer.



- **Passive Solar Design:** Orients windows and walls to capture winter sunlight and shade summer heat, cutting heating/cooling loads by up to 30%.



- **Living Roofs & Walls:** Plant-covered surfaces that absorb rainwater, provide insulation, and create wildlife habitats.



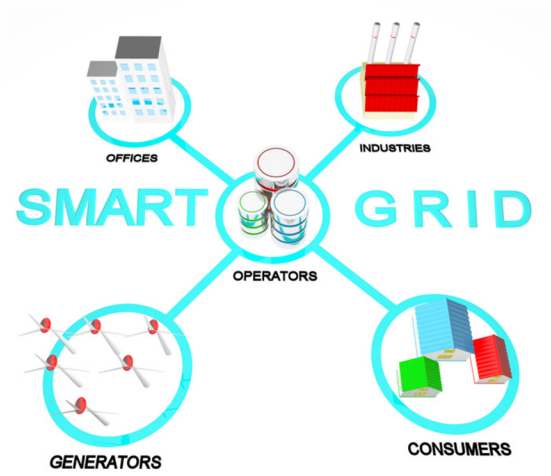
Technical Tidbit:

- A “**Passive House**” standard limits annual heating demand to 15 kWh/m²·yr, compared to 150+ in typical buildings.

Co-funded by the European Union

Energy-Efficient Appliances & Smart Grids

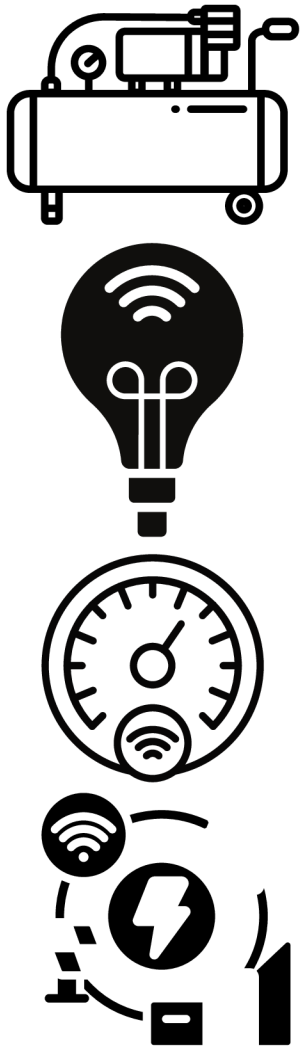
Beyond the building shell, the devices inside play a big role. Energy-efficient appliances use advanced motors and electronics to do more work with less power. Meanwhile, smart grids leverage digital sensors and two-way communication to balance electricity supply and demand in real time. Together, they shrink our energy footprint and keep the lights on when renewables fluctuate.





Co-funded by the European Union

Energy-Efficient Appliances & Smart Grids



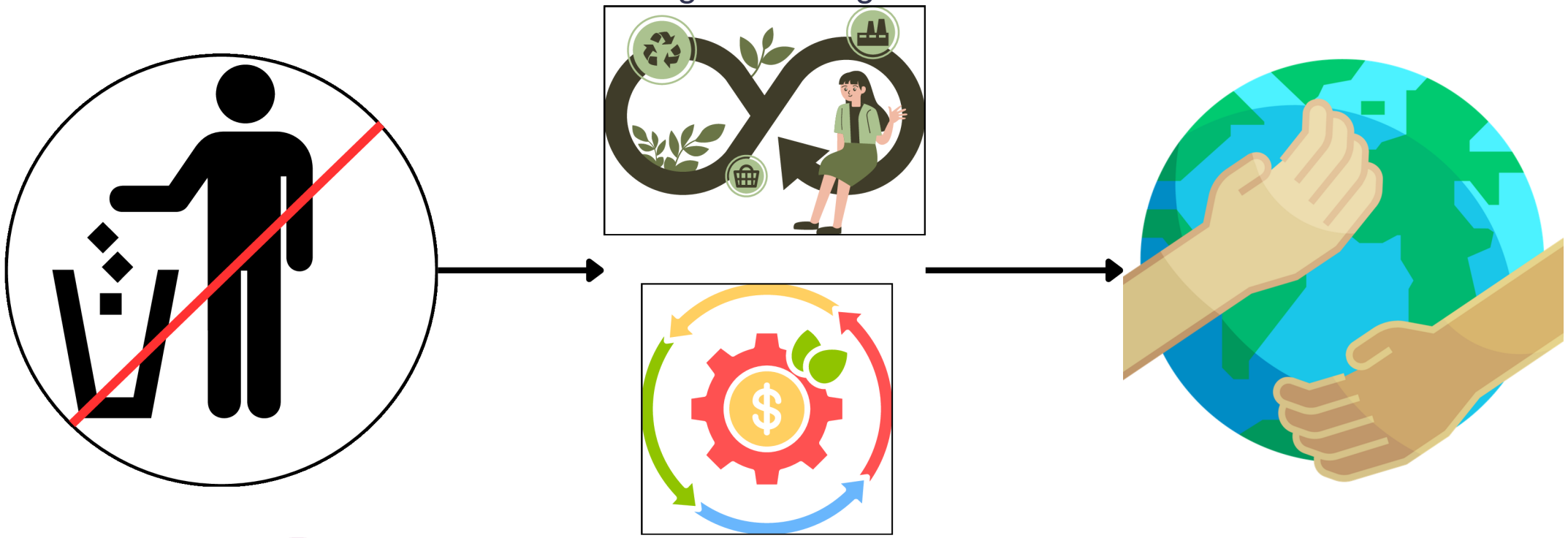
- **Efficient Motors & Compressors:** Modern refrigerators and air-conditioners can be 30–50% more efficient than older models.
- **LED Lighting:** Converts 80% of electricity into light (vs. 20% for traditional bulbs).
- **Smart Metering:** This technology tracks household energy use by the hour, enabling time-of-day pricing to shift consumption away from peak hours.
- **Grid Automation:** Uses sensors to detect outages instantly and reroute power, improving reliability.

Technical Tidbit: *A study by the National Renewable Energy Laboratory found that smart-grid controls could cut peak demand by up to 15% in major cities.*

Co-funded by the European Union

Circular Economy Practices

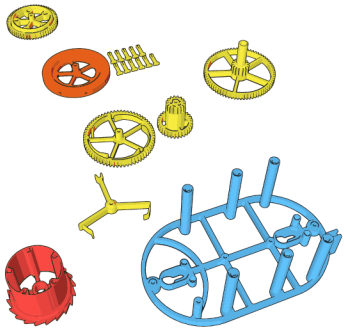
Traditional ways of using resources often follow a take, make and throw away pattern. This creates a lot of waste and uses up energy. The circular economy works differently by making products that can be reused, repaired or recycled. This helps turn waste into something useful. In our Metaverse city, students will see how things like building materials and electronics can be used again and again.

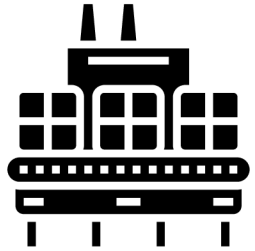


Co-funded by the European Union

Circular Economy Practices

- **Design for Disassembly:** Products are built to easily separate and reuse parts.
- **Material Recovery:** Systems (e.g., automated sorting) that reclaim metals, plastics, and glass.
- **Sharing Platforms:** Toy libraries, tool shares, and clothing swaps that extend product lifespans.





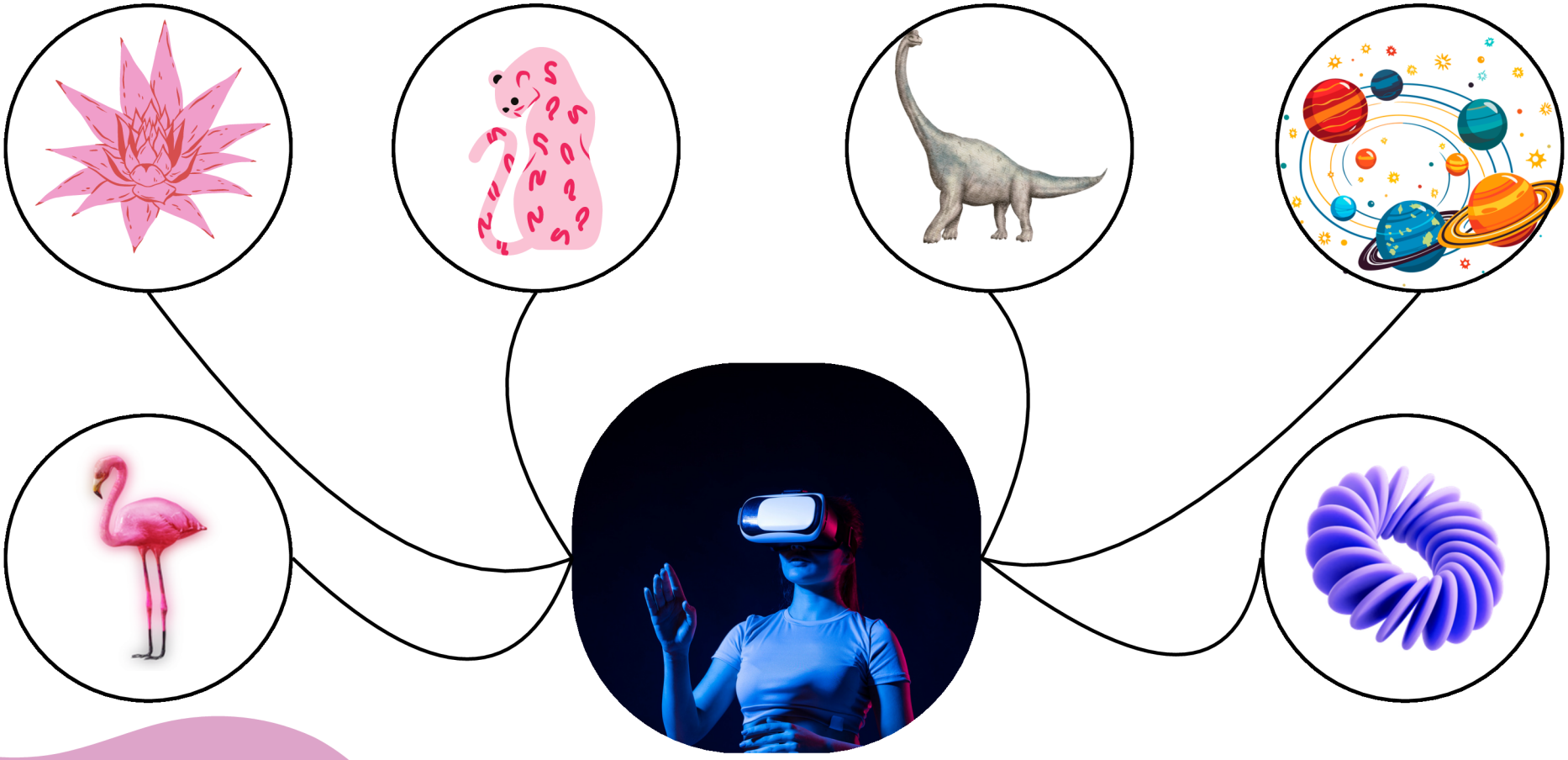


Technical Tidbit: *The Ellen MacArthur Foundation estimates a circular approach in the EU could reduce CO_2 emissions by 48% and save €600 billion annually in material costs.*

Co-funded by the European Union

Metaverse Activity – Virtual Eco-City Tour

Now it’s time to enter the Metaverse! In your VR headsets, you’ll explore a virtual city where green buildings, smart grids, and circular loops come to life. As you navigate, look out for interactive hotspots that explain each sustainable technology in simple terms.



Co-funded by the European Union

Metaverse Activity – Virtual Eco-City Tour

- **Enter "Eco-City" World:** Launch the VR app and select "Virtual Eco-City."
- **Green Building Block:** Walk up to a model house, click the "i" icon to see how passive design works.
- **Smart Grid Hub:** Stand on the platform to view real-time energy flow graphs and learn how the grid balances solar & wind inputs.
- **Circular Market:** Interact with vending machines that demonstrate material recycling, you can "deposit" virtual waste and watch it become new products.
- **Group Check-In:** Return to the central plaza and share one new insight with your classmates.

Conclusion & Classroom Challenge

Today, we looked at how sustainable technologies, such as green buildings and the circular economy, are helping to shape the cities of the future. For your next task, imagine you are the mayor of a city.

- Which technology would you choose to introduce first, and how would you convince people in your community to support it?
- Use what you learned in class and during the Metaverse activity to write a short and simple proposal.

Questions to discuss:

- Which sustainable tech excited you the most—and why?
- What challenges might you face in real life?
- How could you involve friends and family in your project?

Co-funded by the European Union

Debate Questions

- Should every new school be required to meet a green-building standard?
- What matters more in a house—thick insulation or rooftop solar panels?
- Is it better to recycle plastics or stop making them in the first place?
- Can a virtual city tour teach us more than visiting a real eco-building?

Co-funded by
the European Union



Flowers, Pollens and Allergies

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D
Colegio Séneca S.Coop.And
Agrupamento de Escolas de Barcelos
Eurasia Institute
Inspectoratul Școlar Județean Teleorman
City of Malmö





Co-funded by the European Union















Learning objectives

- Recognize thedifferentparts ofaflower
- Identify the pollen-producing organ
- Understand the role of pollen and how it is transported
- Link the mode of pollen transport to its allergenic potential

Co-funded by the European Union

Engagement activity



Hay fever making your life a misery? Try these 20 tips from doctors and allergy experts

Sarah Phillips

Thu 10 Apr 2025 11.00 CEST

Share 193

Composite: Guardian Design; Oscar Wong; Unclepodger/Getty Images

What do you know about the origin of hay fever ?

Co-funded by the European Union

Stamens in flowers

Wikipedia

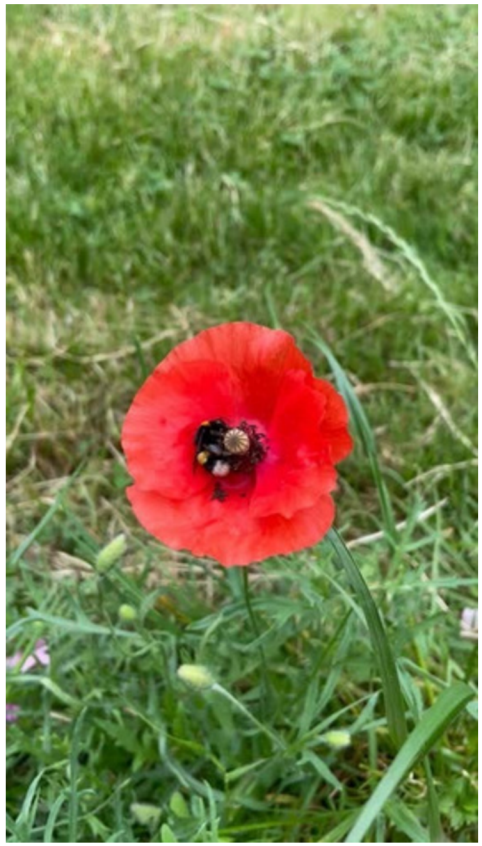




Co-funded by the European Union



Poppies

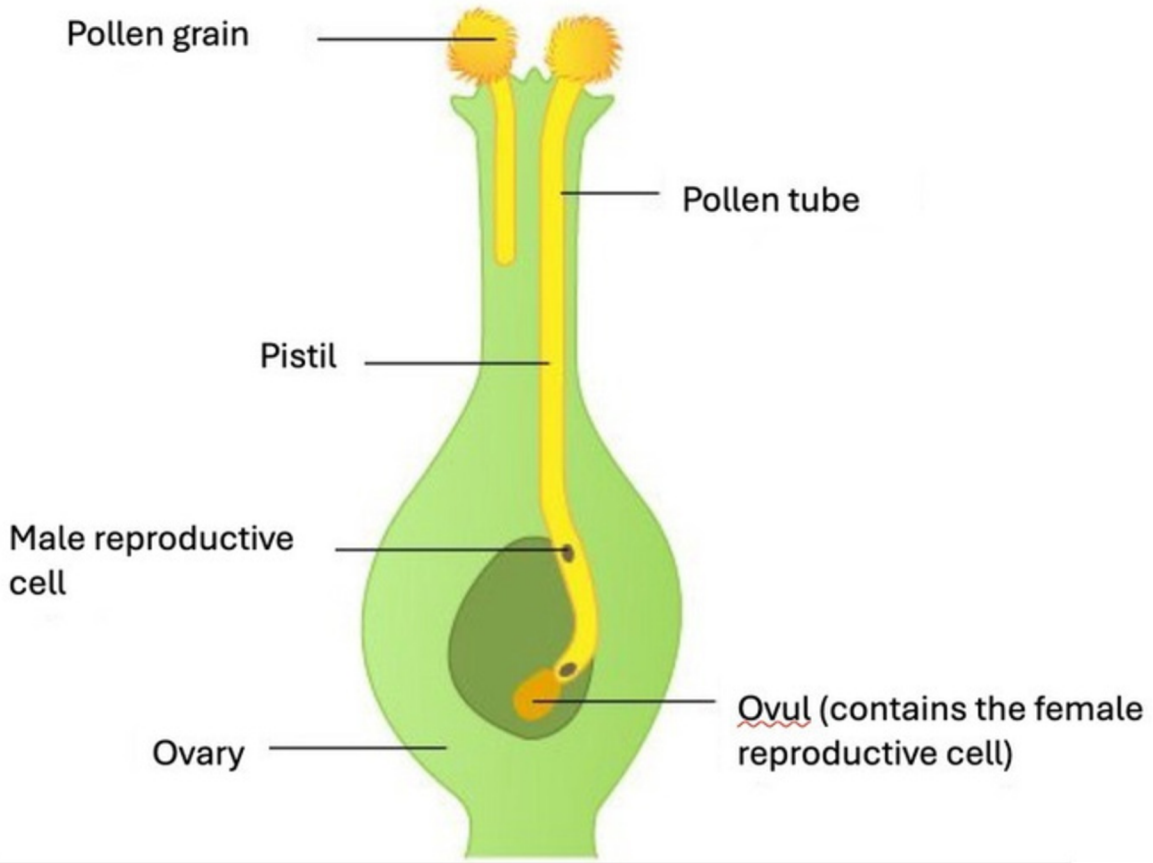


White-tailed bumblebee visiting a poppy



Bee in a flower

Wikipedia



What happens to a grain of pollen deposited on the pistil?

Adapted from maxicours.fr

Co-funded by the European Union



Pine in the wind



Shaking a tree

Pictures from Wikipedia

Co-funded by the European Union

The alder

Alder, male and female flowers









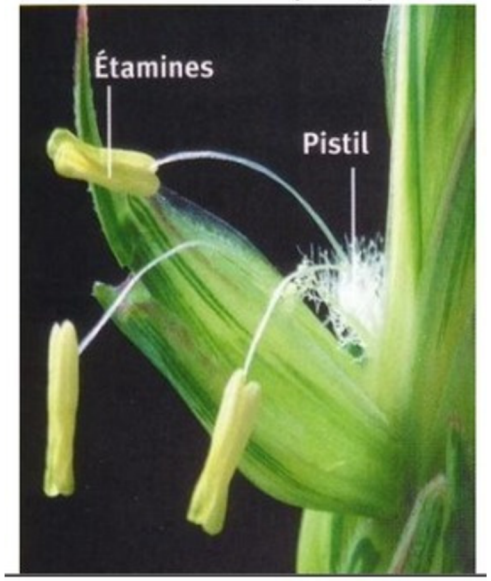
Alder in the wind

Pictures from Wikipedia

Co-funded by the European Union

Observation of wheat flower





Co-funded by the European Union

Grasses flowers





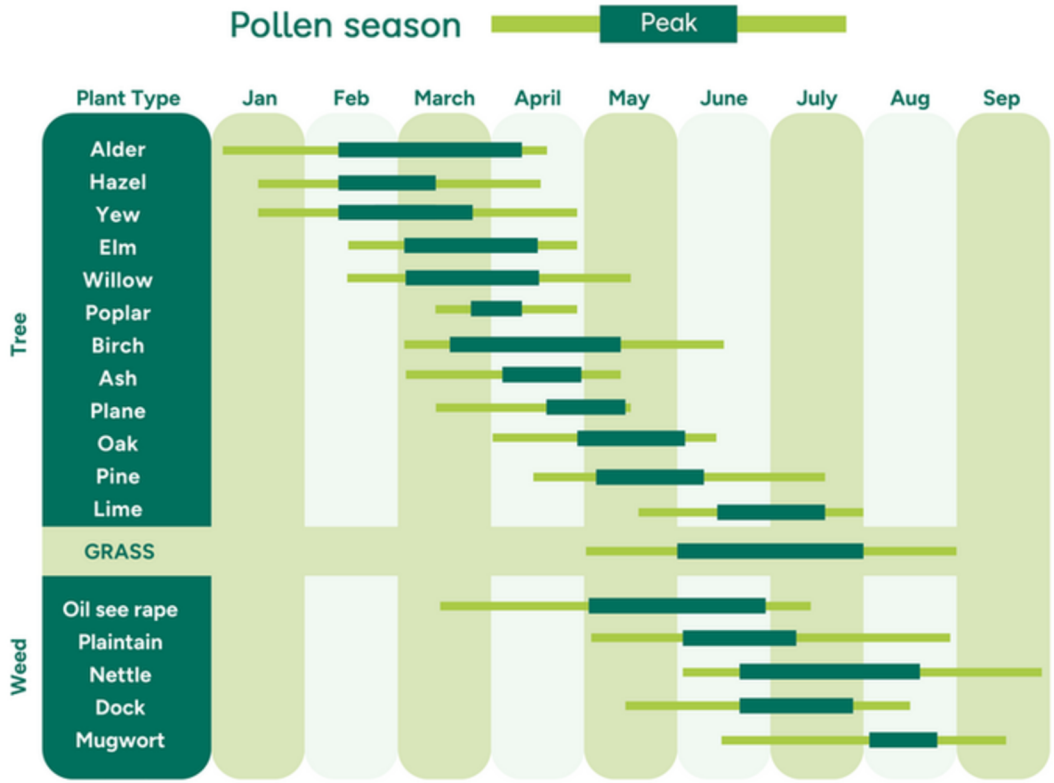




Pictures from Wikipedia

Co-funded by the European Union

The most allergenic pollens throughout the months



Co-funded by the European Union

RV activity

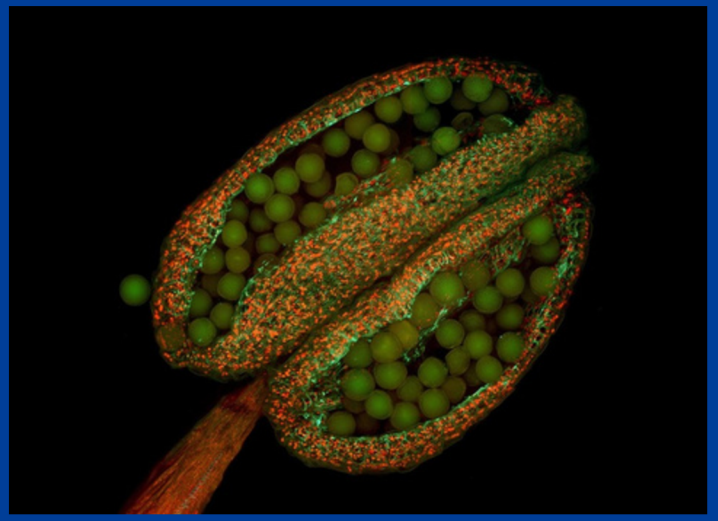
- DISSECT A FLOWER
- LOCATE THE POLLEN



Dissection of a flower



Stamens



Pollen grain in the stamen





Co-funded by the European Union















Evaluation

Search, extract and use useful information
Communicate your actions, results and choices in writing and orally, using precise language and appropriate tools.

Depending on the teacher's objectives, it is possible to assess group work, speaking skills, etc.

Co-funded by
the European Union



Renewable Energy

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D
Colegio Séneca S.Coop.And
Agrupamento de Escolas de Barcelos
Eurasia Institute
Inspectoratul Școlar Județean Teleorman
City of Malmö





Co-funded by the European Union















Learning objectives

This lesson introduces students to renewable energy sources and their importance in building a sustainable future. They will learn about different types of renewable energy, including solar, wind, hydro, geothermal and biomass, and understand how each one works in different situations. The lesson encourages students to think critically and make comparisons, while also giving them the chance to explore a virtual renewable energy facility through a Metaverse-based simulation. Real-life examples will be discussed to help students see how renewable energy is used around the world and why it matters.

Co-funded by the European Union

Introduction

Energy powers almost everything we do, from lighting our classrooms to charging our devices and cooling our homes. However, most of the energy we use today comes from burning coal, oil or gas, which can harm the planet. Renewable energy comes from natural sources that do not run out, such as sunlight, wind and flowing water. In this lesson, students will learn what makes these energy sources important, why they matter for a healthier Earth, and how they can explore a virtual renewable energy site using a Metaverse simulation.

Key Points:

- **Definition of renewable energy:** Renewable energy is energy that comes from natural sources that do not run out, like the sun, wind and water.
- **Why it matters:** Reduces pollution, fights climate change, and protects wildlife
- **Today's sources:** Solar (sun), wind, hydro (water), geothermal (heat from Earth), biomass (plants)

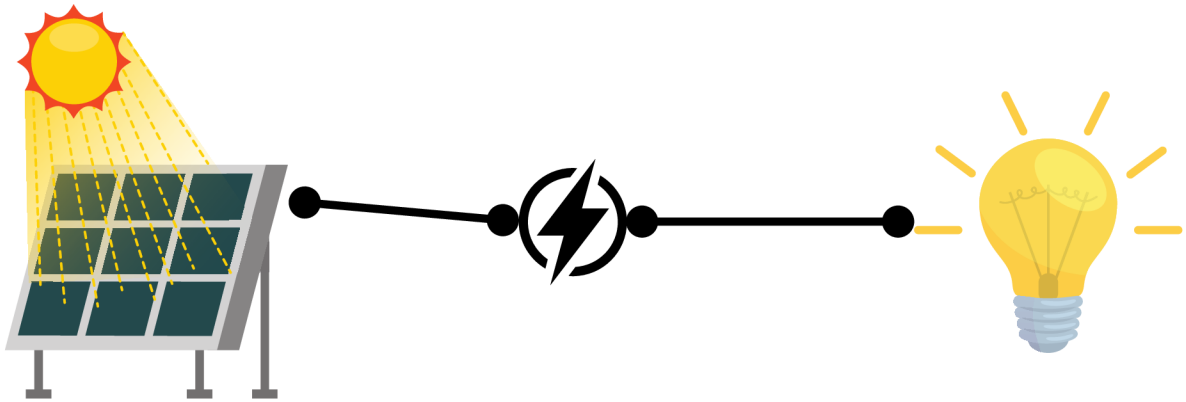
Co-funded by the European Union

How Solar Energy Works

Each renewable source converts a natural force into electricity or heat. While the science can be tricky, the basic ideas are easy to picture: solar panels “catch” sunlight, wind turbines spin when air blows past, and hydroelectric dams let flowing rivers turn giant wheels. Let’s break down each one in simple steps.

Solar Energy (Sunlight → Electricity):

- Sunlight hits photovoltaic (PV) cells on a panel
- PV cells knock loose electrons in a silicon layer
- Flowing electrons become electric current you can use

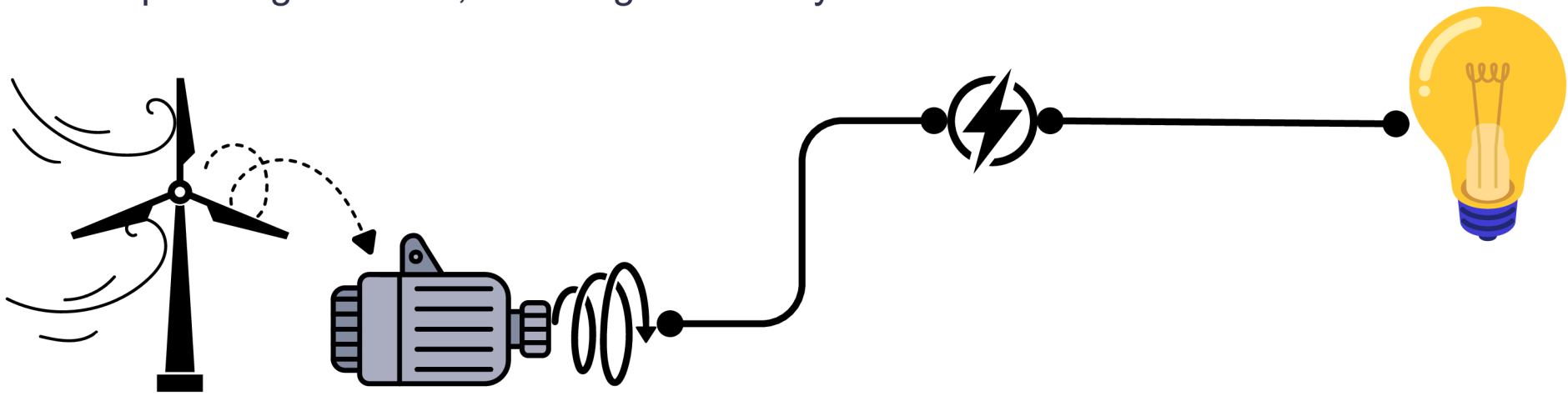


Co-funded by the European Union

How Wind Energy Works

Wind Energy (Air → Motion = Electricity):

- Wind pushes turbine blades, making them spin
- Blades turn a shaft inside the turbine
- Shaft spins a generator, creating electricity

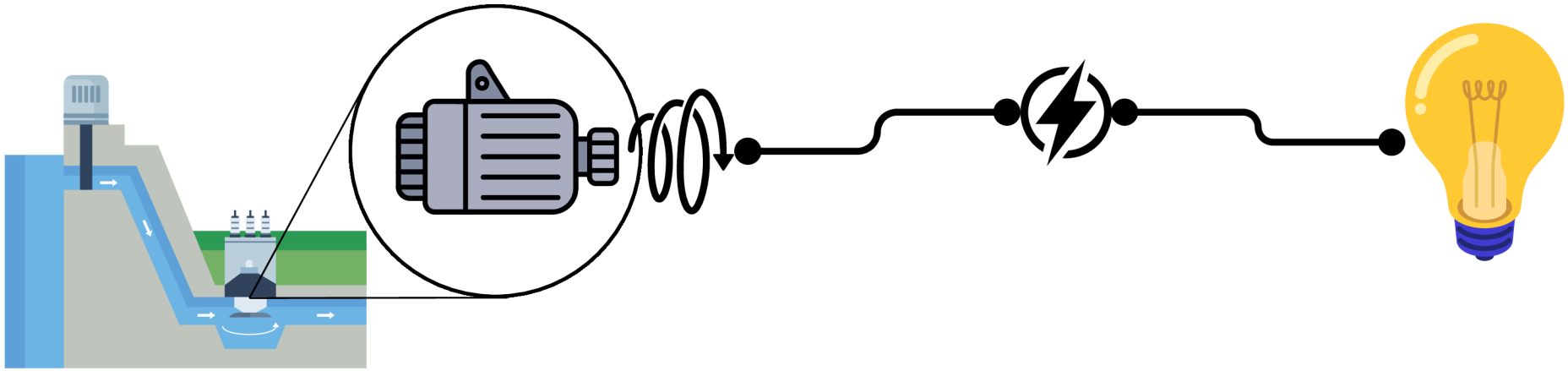


Co-funded by the European Union

How Hydro Energy Works

Hydro Energy (Water Flow → Mechanical = Electricity):

- Water flows through a dam's turbine
- Turbine spins and turns a generator
- Generates clean electricity for towns

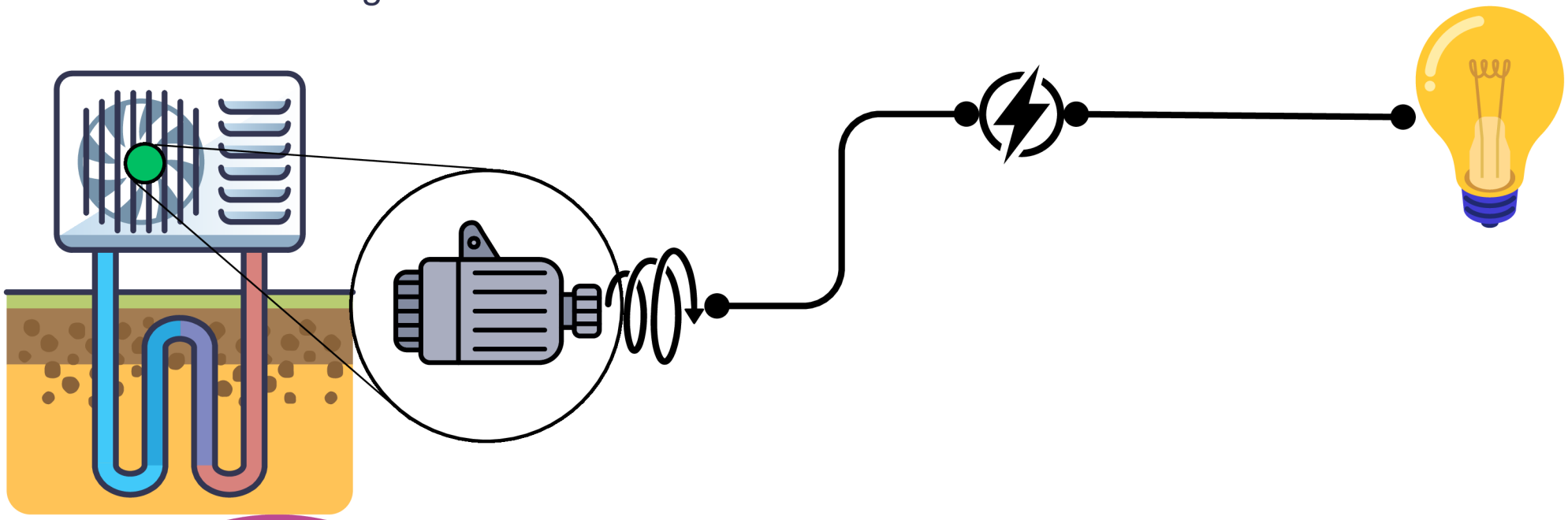


Co-funded by the European Union

How Geothermal Energy Works

Geothermal Energy (Earth's Heat → Steam = Power):

- Hot rocks deep underground warm water into steam
- Steam rises and spins turbines
- Turbines drive generators

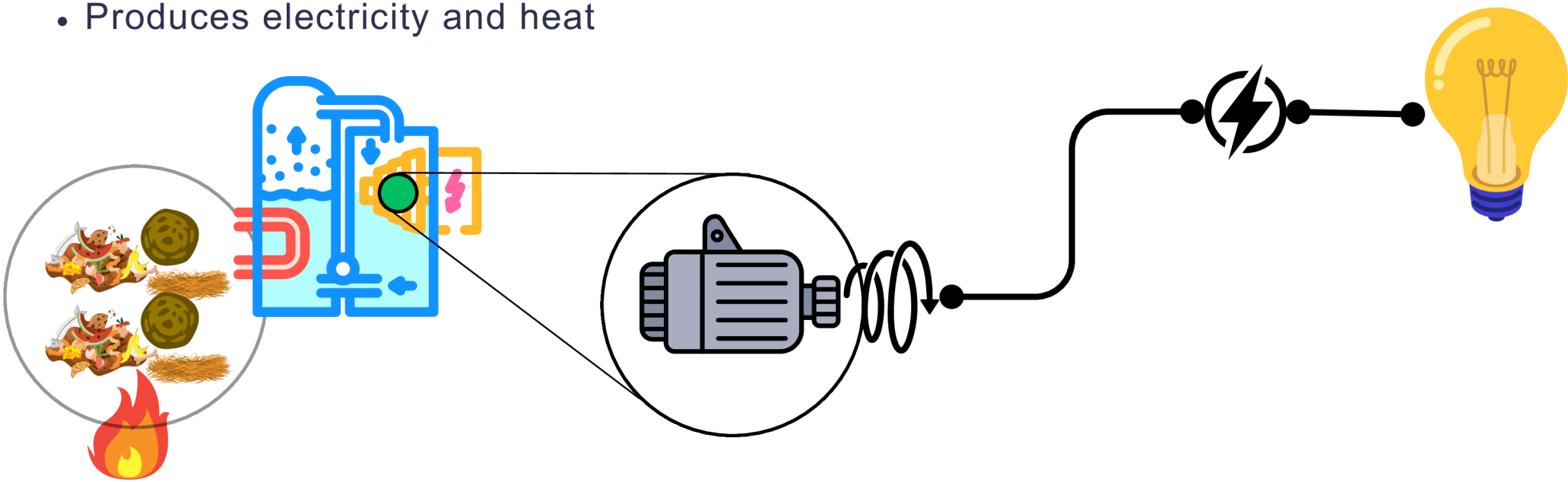


Co-funded by the European Union

How Biomass Works

Biomass Energy (Organic Matter → Heat/Electricity):

- Plant waste is burned or digested into gas
- Heat from burning or biogas powers a boiler or engine
- Produces electricity and heat



Co-funded by the European Union

Solar

Sunlight is free and abundant; panels last 20–30 years	Cloudy days produce less power; panels need lots of space

Wind

Wind is limitless; turbines can be on land or offshore	Wind speed varies; some people think turbines are noisy

Hydro

Very reliable; dams can store water for power on demand	Dams can flood habitats; high upfront cost

Geothermal

Works day and night; very low emissions	Only in certain “hot spot” areas; drilling can be expensive

BioMass

Makes use of plant waste; can replace wood burning	Burning releases CO_2; must manage forests sustainably

Co-funded by the European Union

Real-World Applications & Innovations

Around the world, people are inventing clever ways to harness renewables. From solar-powered schools in Africa to floating wind farms in the North Sea, these innovations show how renewables can power homes, businesses, and even vehicles.

Examples:

- **Solar Schools:** Rooftop panels on school buildings cover up to 50% of electricity needs *(**Source:** IPCC 2022)*
- **Community Wind Gardens:** Small wind farms owned by local cooperatives reinvest profits in the town *(**Source:** IRENA 2021)*
- **Run-of-River Hydro:** Low-impact turbines in mountain streams that leave fish passages clear *(**Source:** NREL 2020)*
- **Enhanced Geothermal Systems:** Injecting water into hot dry rocks to create new steam fields *(**Source:** UN SDG Report 2023)*
- **Bioenergy Villages:** European towns use farm waste to heat homes and power streetlights *(**Source:** Ellen MacArthur Foundation 2021)*

Co-funded by the European Union

Metaverse Activity Instructions

Now let's step into a virtual world! In the Metaverse simulation, you'll explore a 3D wind farm complete with spinning turbines and control panels. This hands-on experience helps you see how engineers and scientists monitor and adjust renewable systems in real time.

Task Steps:

1. Log In: Put on your VR headset and enter the "Green Horizon" world.
2. Tour the Turbine: Walk up to a turbine base and read on-screen labels explaining each part (blades, shaft, generator).
3. Control Panel: Use the virtual touchscreen to adjust wind speed and watch how power output changes.
4. Data Check: Find the digital meter showing kilowatts produced—note the reading in your field journal.
5. Group Discussion: Return to the virtual meeting area and share one surprise you encountered.

Co-funded by the European Union

Conclusion & Community Challenge

We've learned what renewable energy is, how each type works, and why it matters for our planet. Now it's your turn to think like an engineer and a community leader: which renewable source would you choose for your town? Consider cost, environment, and space. In our final discussion, you'll share your choice and explain how it could benefit local families and wildlife.

Wrap-Up Questions:

- "Which energy source fits our region best—and why?"
- "What challenges might we face in building it?"
- "How could students get involved in a school green project?"

Co-funded by
the European Union



Mammoths, Pollens and Climate

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö





Co-funded by the European Union















Learning objectives

- Use scientific pollen databases
- Discover the climate change that took place around 11
- 700 years ag
- Discover the origin of pollen

Co-funded by the European Union

Engagement activity





What do you know about mammoths ?

All students know about mammoths, wich disappeared from Europe around 10,000 years ago. This is the starting point for scientific research that will help us understand how scientists were able to identify climate change (and perhaps other factors) as the main cause of mammoths' extinction.

Co-funded by the European Union

Scientific pollen database



Click to join Pollen database

1. Choice of the site where the peat or lake sediments core was taken.
2. Depending on the age of the pupils, select more or fewer species of plants.

Co-funded by the European Union

How to obtain sediment or peat cores ?

Drill into lake sediments



Click to watch the presentation

Drill into peat



Co-funded by the European Union

What pollen change is associated with global warming 11,700 years ago?

Thanks to Dr Jane Bunting (University of Hull) and Dr Mike Simmonds (University of Reading) for their contributions to these example pollen assemblages.

Late Glacial (14000-11,7000 years ago) - Tundra

- Cyperaceae – High
- Poaceae – High
- Artemisia – High
- Betula – Low
- Pinus – Low

Early Holocene (11,700-10,000 years ago) - Dense Mixed Woodland

- Betula - High
- Pinus - High
- Corylus – Mid

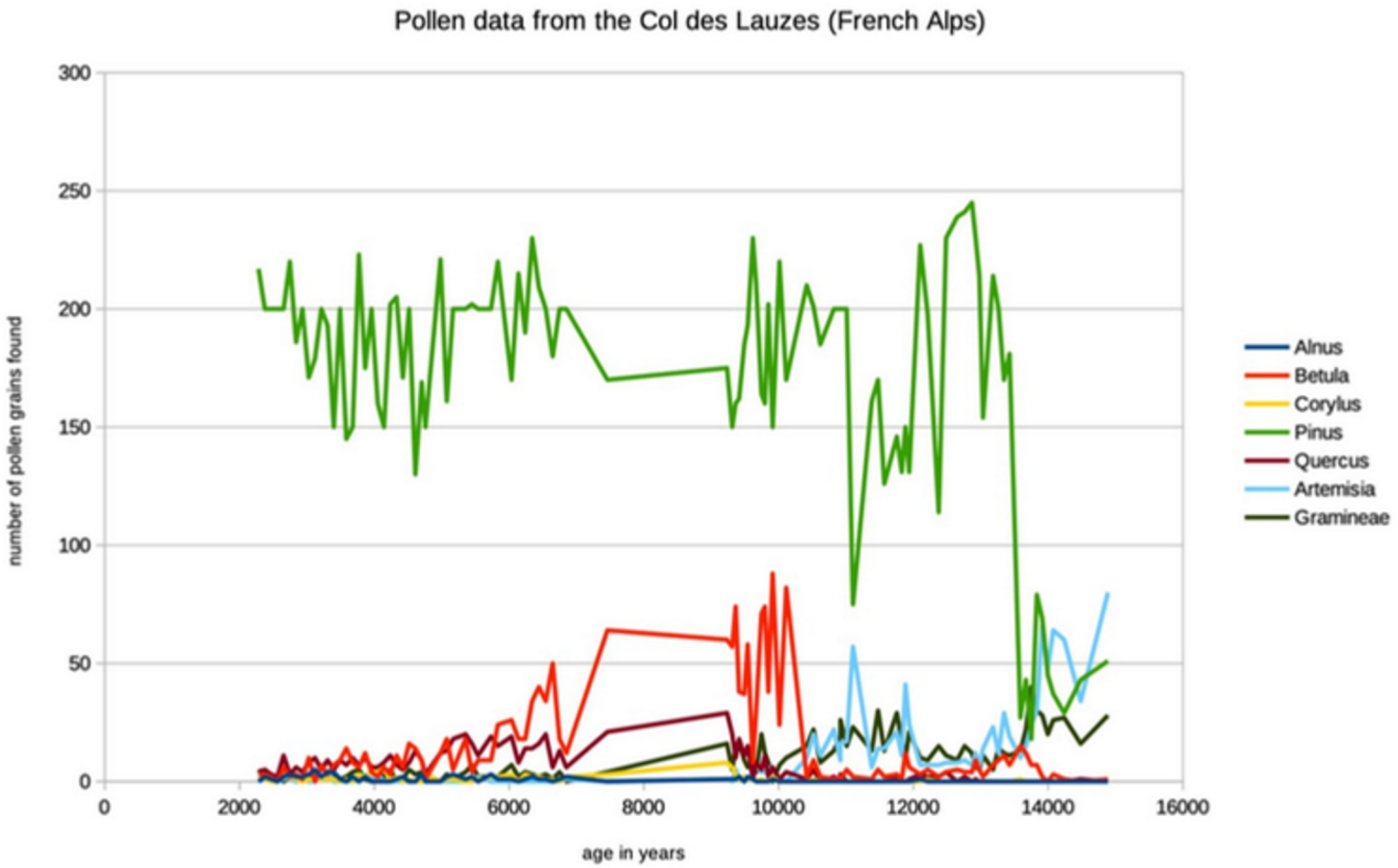
Early-Mid Holocene (10,000-6000 years ago) - Slightly more open Deciduous Woodland

- Corylus - High
- Quercus - High
- Alnus - High
- Betula - Mid
- Pinus - Low
- Poaceae – Low

Click to watch the presentation

Co-funded by the European Union

Simplified pollen diagram of the Col des Lauzes (French Alps)



Alder in the wind

Co-funded by the European Union

VR activities

- **Handling** different species of pollens
- **Locate** the site of pollen production in a flower
- **Serious game**: For 1 minute, pollen grains are shown to the student one at a time, who must throw it into the lake or abin to recreate the typical pollen association of a cold climate or a temperate climate.

Co-funded by the European Union

Evaluation

- Communicate your actions, results and choices in
- writing orally, using precise language and appropriate tools.

Depending on the teacher's objectives, it is possible to assess group work, speaking skills, etc.

Co-funded by
the European Union

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE



2023-1-FR01-KA220-SCH-000151516

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

CC BY NC SA

Co-funded by
the European Union

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE



2023-1-FR01-KA220-SCH-000151516

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

VAEV R&D
Colegio Séneca S.Coop.And
AGRUPAMENTO DE ESCOLAS DE BARCELOS
EDUCAÇÃO PÚBLICA DE QUALIDADE
EURASIA INSTITUTE
INSPECTORATUL ȘCOLAR JUDEȚEAN TELEORMAN
City of Malmö

CC BY NC SA