STEAM EDUCATION DEVELOPS IN 21ST CENTURY SCHOOLS

2020-1-BE02-KA229-074698

STEAM EDUCATION GUIDE BOOK- LESSON PLANS

November 2025

...el Gallego

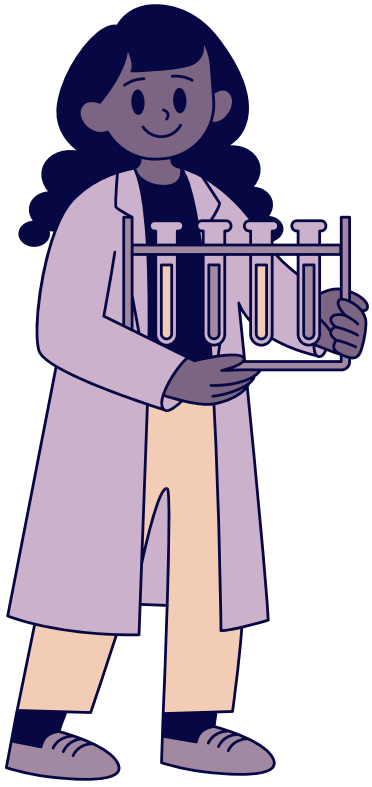
2020-2023

PROJECT INFO

Today's society needs more people with a STEM profile. To encourage young people to choose for STEM training courses and careers,
the Flemish Government worked out the STEM action plan (2012-2020) with 8 objectives:

- Make STEM education more attractive
- Support teachers, trainers and supervisors
- Improve the process of study and career choice
- More girls in STEM courses and professions
- Bet on excellence
- Adjust the training offer
- Encourage sectors, companies and knowledge institutions
- Improve the social appreciation of technical professions.

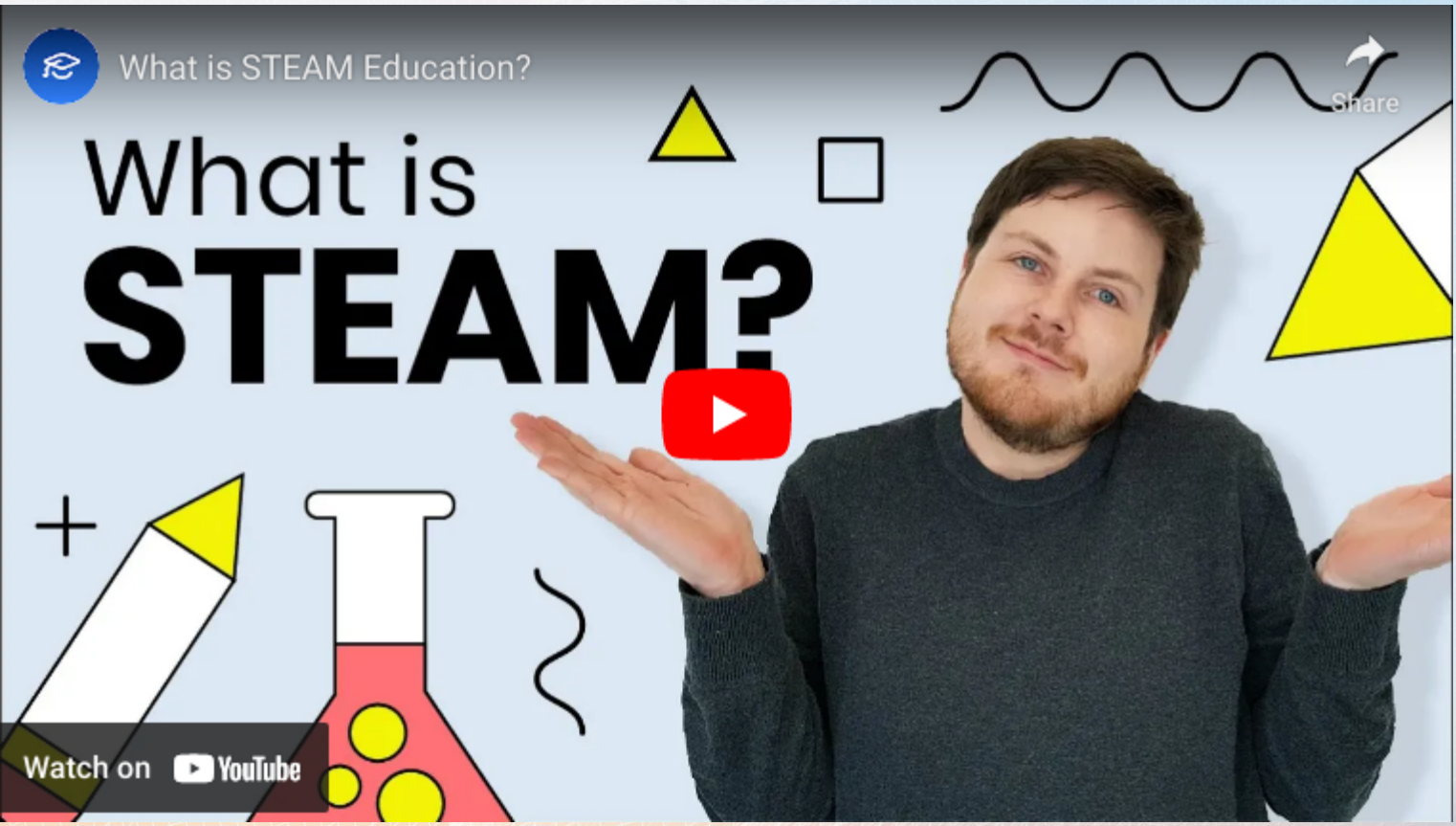
In 2020 there are several reasons for drawing up a new STEM action plan. We live in one knowledge society of
which technology is increasingly an integral part and STEM is interwoven in many aspects of our daily lives. That is
why it is important that all citizens be included in this story (“STEM literacy”), in addition to the demand from the
labor market towards more inflow into STEM profiles at different qualification levels (“STEM specialization”).



According to EU estimates, employment in the STEM professions is expected to grow nearly twice as fast as the
average for other jobs, and it is estimated that by 2025 there will be a shortage of more than half a million workers in
the field of Information and Communications Technology (ICT).

According to the "Strategic framework - Education & Training 2020 (ET 2020)" the EU's goal is to reduce the number
of European students with insufficient skills in the field of mathematics and science, to less than 15% by 2020 ".

WHAT'S STEAM & STEM ?



Why Is STEAM Important?

In our everyday lives, we can see, touch and use hundreds or maybe thousands of products, apps, and devices that became real thanks to STEM. Some of them are really easy to spot: for example, STEM helps us connect with people from all over the world through the Internet, phones, etc.STEAM Education provides the framework used for connecting the growing network of educational disciplines, businesses, and communities to create adaptable citizen-involved, globally-responsible, reality-based programs.

"Millions saw the apple fall, but Newton asked 'Why'"

Bernard Baruch, Philanthropist & Statesman

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PARTNER SCHOOLS

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Co-funded by the Erasmus+ Programme of the European Union

STEAM
SCIENCE | TECHNOLOGY | ENGINEERING | ARTS | MATHEMATICS

STEAM EDUCATION

is an approach to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding student inquiry, dialogue, and critical thinking.-

STEM vs. STEAM

Before there was STEAM, there was STEM. The key innovator credited with updating STEM to STEAM by adding the arts is Georgette Yakman, an engineering and technology teacher who was the founding researcher of the STEAM educational framework in 2006.

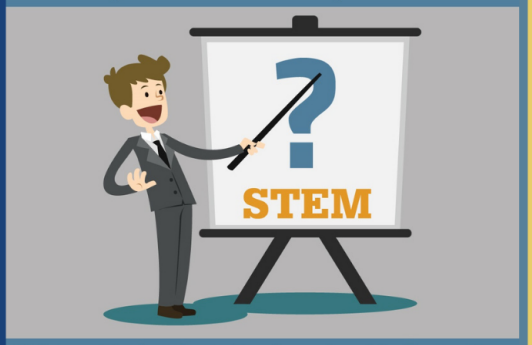
"STEAM is about more than converging the fine arts and design thinking into STEM fields. The liberal arts are, the 'who & why,' the reasoning, to the 'what & how' of STEM."

STEAM EDUCATION FOR FUTURE

Teaching STEM is about using hands-on experiences, providing students with tools to unravel and enhance their potential to impact the future. STEM teaching objectives need to be adapted and updated, in order to advance STEM education and initiate problem-solving through science.

Future STEM students will be guided from an even earlier age into understanding and using technology in a class context. The educator's challenge in class already entails teaching students that technology is a tool to develop problem-solving capabilities, both in a team and during independent study. Educators, can for example employ project-based learning in order to identify the tasks that will enhance students' interpersonal skills and abstract thinking.

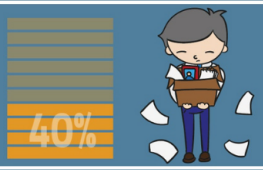
Why is STEM important?



Science Technology Engineering Mathematics

75% of the fastest growing occupations require STEM skills

40% of current jobs will no longer exist in the future

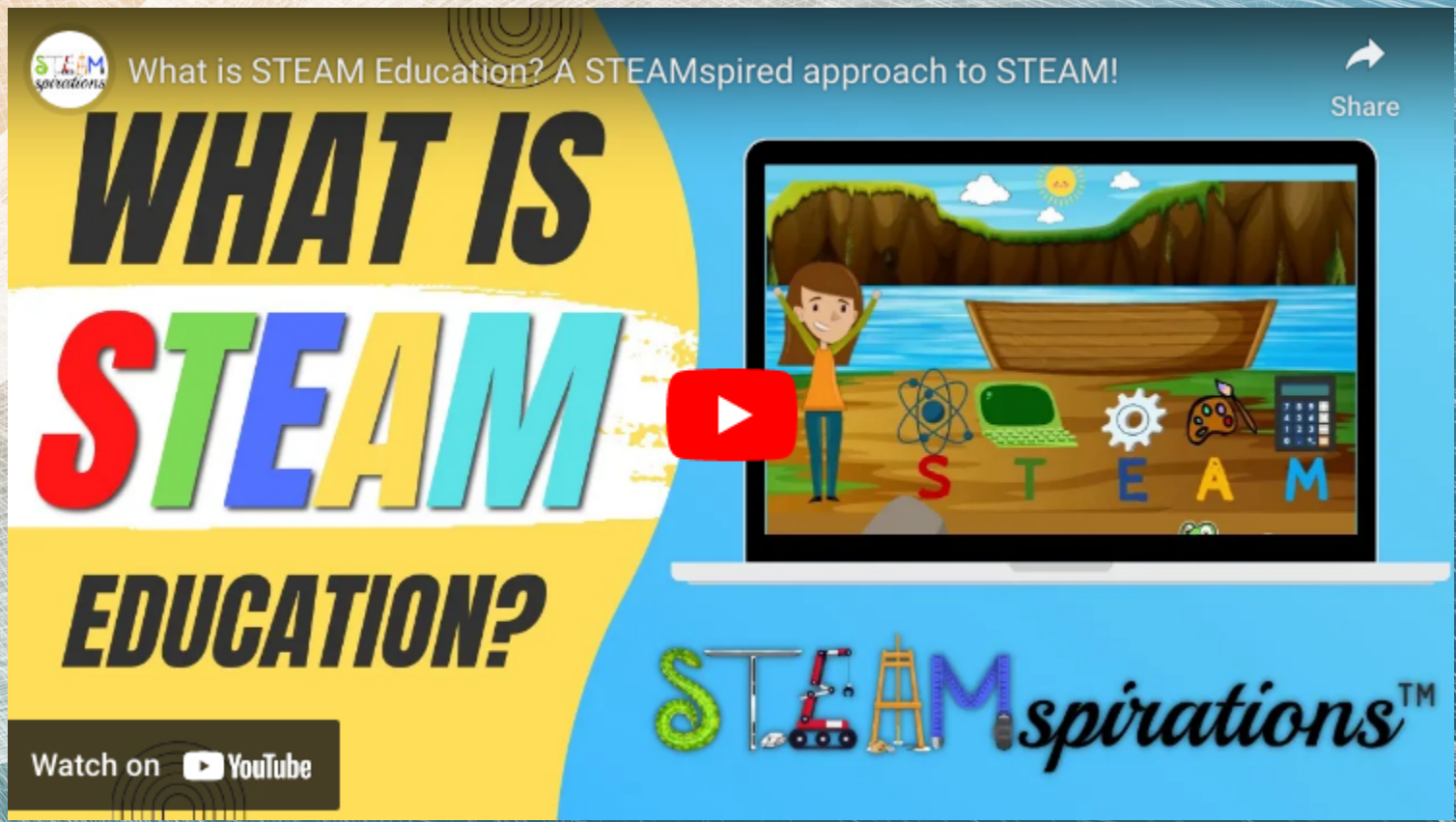


"Creativity is the secret sauce to science, technology, engineering and math (STEM). It is a STEM virtue."
Ainissa G. Ramirez, PhD, former engineering professor at Yale University

STEAM CAREERS

HERE'S A LIST OF 25 STEAM CAREERS THAT ARE EXCITING FOR STUDENTS TO EXPLORE:

- MECHANICAL & CIVIL ENGINEER
- ARCHITECT
- WEBSITE/APP DESIGNER
- MODERN URBAN PLANNER
- ORTHOPEDIC TECHNOLOGIST
- BIOMEDICAL ENGINEER
- PRODUCT DESIGNER
- ANIMATOR
- FORENSIC PSYCHOLOGIST
- SOUND ENGINEER
- VIDEO GAME DESIGNER
- MEDICAL ILLUSTRATOR
- ASTROPHYSICIST
- AUDIO DEVELOPER
- GRAPHIC DESIGNER
- BROADCAST TECHNICIANS
- FASHION DESIGNER
- INTERIOR DESIGNER
- PHOTOGRAPHER
- SPORTS ANNOUNCER
- PILOTS
- ASTRONAUT
- CONSERVATORS
- ARCHEOLOGIST
- SCIENTIFIC IMAGING



WHAT'S SCIENTIX?

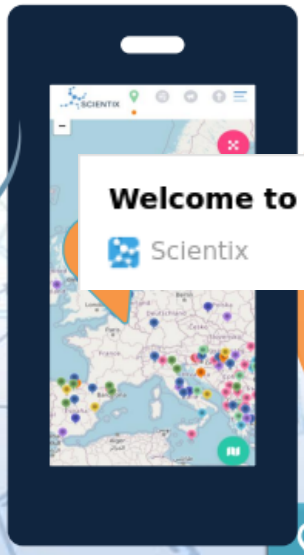
HOW CAN WE USE IT?

SCIENTIX
The community for science education in Europe

https://www.scientix.eu/home/welcome

THE SCIENTIX CAMPAIGNS: SHARING STEM KNOWLEDGE WITH THE WORLD, AND EACH OTHER!

SCIENTIX STEM DISCOVERY CAMPAIGN



- Scientix organises multiple campaigns all year round to
new resources
its YOUR teaching
plans, resources,
- During the campaigns, join events, webinars and workshops to get inspired and learn
- Follow the Scientix social media channels to stay up to date with the latest STEM Education development in Europe!

https://www.scientix.eu/events/campaigns/sdc23

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SCIENTIX

STRENGTHEN YOUR TEACHING AND DEVELOP NEW SKILLS WITH SCIENTIX

Scientix offers a range of continuous professional development opportunities for teachers.
Strengthen your teaching, learn new skills, and develop your STEM knowledge with Scientix!

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+
WORKSHOPS
+
MASSIVE OPEN ONLINE COURSES
+
THE CAREER ADVISERS NETWORK

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SCIENTIX

THE STEM SCHOOL LABEL

- The STEM SCHOOL LABEL is **Europe-wide** accreditation and support service for schools
- It provides **Guidance for schools** to improve their STEM activities and teaching
- Offers high visibility for your school at national and European level
- With a STEM SCHOOL LABEL, signal to other schools that you are willing to share **your STEM-teaching expertise!**

https://www.stemschoollabel.eu/

STEM School Label — Powered by Scientix

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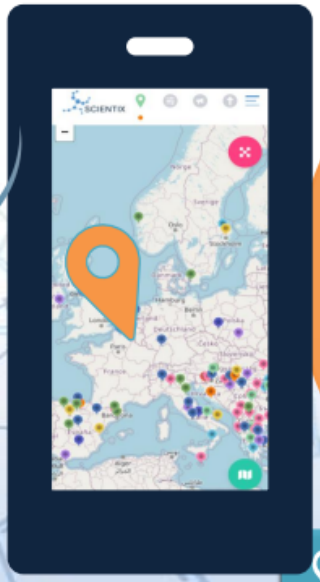
SCIENTIX
The community for science education in Europe

THE SCIENTIX CAMPAIGNS: SHARING STEM KNOWLEDGE WITH THE WORLD, AND EACH OTHER!

SCIENTIX STEM DISCOVERY CAMPAIGN



- Scientix organises multiple campaigns all year round to showcase projects, STEM topics, events, and new resources
- Every year, the STEM Discovery Campaign puts YOUR teaching on the map by sharing your activities, lesson plans, resources, etc.
- During the campaigns, join events, webinars and workshops to get inspired and learn
- Follow the Scientix social media channels to stay up to date with the latest STEM Education development in Europe!

https://www.scientix.eu/events/campaigns/sdc23

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SCIENTIX
The community for science education in Europe

https://www.scientix.eu/documents/10137/0/Scientix4-newteacher-slides-final.pdf/86565ff0-8992-5714-e6d6-a512f7a05ed3?t=1679058981356

THE SCIENTIX CONFERENCES

- A major **international networking event for STEM education**, with hundreds of teachers, policymakers, researchers and project managers, held every few years
- Teachers can join, present, or even submit papers for the conference, so keep an eye out for calls and registration!

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http://www.scientix.eu/conference

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For more information: Go to https://www.scientix.eu/ or email scientix@eun.org

SCIENTIX HAS REPRESENTATIVES IN YOUR COUNTRY!

Scientix Ambassadors: They represent Scientix in schools and national teachers' associations, on conferences and workshops, and can advise teachers how to get involved in European collaboration in STEM. They also assist in developing and testing various tools and services of Scientix and ensure the pedagogical quality of the Scientix repository.

National Contact Points (NCPs) provide an important link between Scientix at a European level and activities taking place in your country. NCPs also monitor and analyse national initiatives in science education policy and practice, to be published on the Scientix website, providing an overview of the national initiatives taking place across Europe.

http://www.scientix.eu/in-your-country

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The community for science education in Europe

HOW CAN YOU JOIN SCIENTIX?

- Register on the Scientix portal
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- FB group “Science Teachers in Europe”
- Instagram @scientix_eu
- http://www.scientix.eu/newsletter
- For more information: Go to https://www.scientix.eu/ or email scientix@eun.org

LESSON PLAN

Prepared By
Bahar KAZIK
from Turkiye

CLIMATE CHANGE in My Mind

Abstract:

The aim of this learning scenario is to raise awareness about climate change. In recent years, many countries have been facing with natural disasters and suffering from the effects of extreme weather condition. In this learning scenario, students will try to figure out the causes and effects of climate change. First, they will learn the difference between the phrases “weather” and “climate”. After, they will get informed about the different climates in the continents of our planet and different results of climate change in each continent. Finally, they will try to come to a solution on what should be done and how to prevent climate change.

Subject :
English, Science, Environmental studies, Geography, Art, Music, ICT

Topic(s) within the subject :
The continents on the planet, their significant features, the difference between climate and weather, types of climate, climate change, how to raise awareness about climate change, how to take aim at climate changeAge of students 12-15

Preparation time : 45 min (1 lesson)
Teaching time: Five 45-minute lessons

Online teaching materials:
https://www.youtube.com/watch?v=vH298zSCQzY
https://www.youtube.com/watch?v=nEJqvRRrCDE
http://www.passporttoknowledge.com/polar-palooza/f4/
https://www.youtube.com/watch?v=2T-A3s_DPO4
https://pasarelapr.com/images/world-map-countries-black-and-white/world-map-countries-black-and-white-13.jpg? (map of continents)

Offline teaching material
Crayons, art papers, scissors, ruler, marker, whiteboard, cardboards, glue, pictures, stickers

Integration into the curriculum:

Science: Enviromental awarenss 6th & 7th grade
English: Watching videos in English, singing songs related to climate change, making posters,
Art: Painting printable word map with crayons
Technology: Creating videos, power point presentations preparing online posters
Music: Performing “Take aim at climate change” song.

Objectives of the lesson

●Understand the scientific issues relevant to climate change, such as temperature, the carbon cycle.
● Identify the greenhouse effect based on prior knowledge, class discussion, and viewing diagrams.
●Brainstorming sessions and class discussions related to the impact of the greenhouse effect and global warming.
●Hypothesize about the effects of global warming on the climate and the world's populations.
●Complete a Venn diagram, padlet that compares various points of view on global warming issues.
●Critically reflect on global warming and support this viewpoint with reasons, facts, and examples gathered during lesson activities.
●Collaborate and communicate effectively by drawing posters and supports the point of view about global warming issues.

Results of the lesson

By the end of the lesson students will:
●take positive action, demonstrating a desire to change their behavior and reduce their carbon footprint.
●create online posters to raise awareness against climate change.
●write letters to school council and head teachers to start raising awareness on climate change in schools.
●prepare works of art.
●perform a song in English.

Trends:

Inquriy Based Learning, Collaborative learning, Learning by doing,

21st century skills:

Critical thinking - students will have to come up with effective solutions to the problems that may arise throughout the project and analyse situations critically
Collaboration- students will be working in groups of 4
Communication - both oral and written communication will be used in the project to present the findings and also to interact with peers
Media and technology literacy - several ICT tools and QR codes will be used in the project and the students will have to learn how to handle them correctly
Productivity - students need to have ready several products the by the project’s end

Name of activity	Procedure	Time
What's the difference between climate and weather?	Students will watch a video on from NASA Channel showing the difference between climate and weather in a short animation movie: https://www.youtube.com/watch?v=vH298zSCQzY After the video, students will take a quiz in their native language to see the exact difference.	10
What's Climate Change?	In recent years, many countries have been facing natural disasters and suffering from the effects of extreme weather conditions. Students will watch the video of climate change https://www.youtube.com/watch?v=nEJqvRRrCDE The teacher draws a mind-map on the board asking these questions to help students combine with Climate Change. What is it? Where is it happening? What is causing it? Can we prevent it? What can we do to change? Students will come up answers to these questions in 5 groups (6 students).They will try to find out about Climate Change	10
Meeting with the Experts	The students will also have webinar with EU Climate PACT Ambassadors for 40 min and they will ask for their ideas in order to fight against Climate Change	40

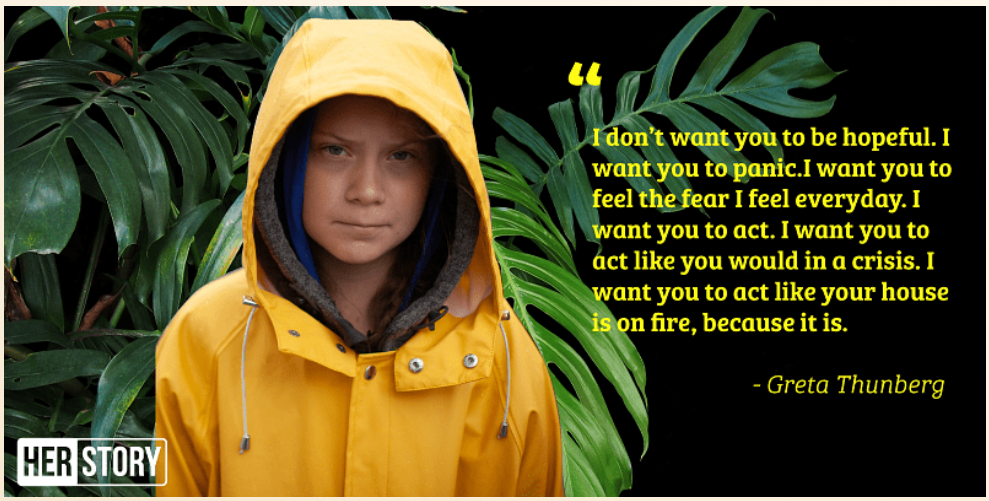
What are the reasons and results of climate change?	The teacher will hand out printable word map to the groups of students that came together in the 1st activity: Students should paint and write the names of the continents and oceans in the map. Each group will talk about the climate of one continent and also significant effects of climate change that the continent is suffering now. In the following part of the lesson, students will use stem resources. Students will search for climate change on visuals in Stem. They will share their findings about the changes in the Earth's climate that have been happening for billions of years. They will also convert the links from the site to QR codes. After getting the QR codes, they will print them and hang on the bulletin board about Environment at school, so the other students and parents in the school . Teacher will also use the presentation in order to emphasis the climate change in detail. The teacher will share a website including data and info graphics on climate change facts: https://visme.co/blog/climate-change-facts/ Climate risks Historical carbon emission rates The shrinkage of the Arctic ice The rise in temperature anomalies Climate change facts and how they relate to food Fast growing African cities face worse climate risks Global temperature change between 1850 and 2017 Warming stripes visualize rising temperatures CO2 emission by nations Climate change facts Carbon-dioxide emission Climate change today infographics	20 + 20
Students' opinions and solutions about climate change	The teacher divides students into six groups and asks them: Write a letter or report on the issue, (e.g.: the school councilor responsible head teacher) Create online photo cards, presentations. They will show the effects of extreme weather conditions causing climate change, the greenhouse effect and the temperature change of Earth over time Create a school board to raise awareness Make banners and demonstrate them at school against climate change to raise awareness Perform the song, which the teacher displays on smart board with lyrics about climate change	25

Assessment

Students will be given a quiz including topics such as: weather and climate. This can be done at the end of the lesson.

Student feedback

Students gave feedback to each other during the lesson by discussing their thoughts. They showed each other their works. They liked working in cooperation and they were very interested in facts displayed by documentaries and animations. At the end of the lesson, they became more conscious about climate change.



Lesson plan

School: Colegiul Național *Nicu Gane* Fălticeni

Teacher: Rădulescu Liliana

CECRL B1

Date : 22.02.2023

Class : 9th

Lesson topic: Ocean pollution

Type of Lesson: teaching / learning / assessment

Aim of the lesson: The main aim of the project is to educate teenagers to protect the environment. Students are encouraged to get involved with responsibility to reduce pollution.

General skills covered :

1. Receiving oral messages
2. Receiving written messages
3. Oral interaction

Specific skills :

1. Recognise details in clear and simple messages and announcements
2. Participate in verbal interactions
3. Identify information needed from lists or simple texts

Educational objectives:

1. to change our behaviour towards the environment
2. to cultivate interest in maintaining the health of the environment
3. to raise awareness of the effects of global climate change
4. changing daily habits to protect the environment
5. promoting environmental education
6. stimulating students' creativity

Teaching strategy:

1. Methods and procedures: conversation, explanation, exercise, observation
2. Teaching aids: textbook, worksheets, video projector, laptop
3. Forms of organisation of the activity: face-to-face, individual, group

Assessment: formative

Time: 50 minutes

STEAM elements

1. Science:

Documents / questions about pollution, health

2. Technology:

Using laptop to view presentations with information and thematic images

Using the phone to photograph polluted areas and make a scrapbook of environmental activities

3. Engineering:

Building a model of the Green City message

4. Art:

André Rieu Amazing Grace Music Audition (https://www.youtube.com/watch?v=WTclgU0LdFQ)

5. Mathematics:

Correct reading / writing of numbers

Running the activities

Phase / Duration	Scroll	Teacher activity	Student activity	Class organisation	Material used
Phase 1/ 2 min.	organizational moment	-saluted -attendance -situational conversation *What activities did you do over the weekend?*	-prepare documents - answer questions	front-end activity	
Phase2 / 3 min.	ground-truthing	check theme	-oral presentation of the theme -correct any mistakes	front-end activity	student notebooks
Phase3/ 5 min.	ice-breaking activity " icebreaker "	presents the *Shopping List* game	-answering questions	front-end activity	Annex 1/ 1
Phase 4 / 2 min.	presentation of the lesson topic presentation of objectives	-announces the theme and objectives -write the title of the lesson on the board	-write the title of the lesson on the notebooks -are careful in presenting objectives	collective activity	notebook blackboard

Phase5 / 5 min.	directing learning	-ask students to listen to the song Breathe (Mickey 3d) and identify the lexical field of the noun *nature*	-listen carefully to the requirement -answer the question	collective activity	https://voyagerloin.com/post/top-10-chansons-engag%C3%A9es-pour-planete Annex 2 /1
		-propose a worksheet to students and explain the requirement	-listen carefully -answer questions	individual activity	Annex 2 / 2
Phase 6 / 25 min.	deepening knowledge	-organize students into groups (five groups) -propose a worksheet to students and explain the requirement	-listen carefully -gets informed -answer questions (each group will answer one question)	group activity	https://climate-pact.europa.eu/about/climate-change_ro http://www.mmediu.ro/categorie/schimbari-climatice/1 https://www.meteoromania.ro/anm/images/clima/SSCGhidASC.pdf Annex 2 / 3

Phase 7 / 5 min.	evaluation	propose an exercise	-solves the exercise	individual activity	Annex 2 / 4
Phase 8 / 3 min.	theme	-propose a theme -explain the requirement	-listens carefully to the teacher's instructions	collective activity	Annex 2 / 5

Annex 1

The Shopping List Game

Aim: - knowledge and self-knowledge - development of language, creativity and imagination.

Materials needed: writing instrument, shopping list - A4 sheet.

How to proceed: Pupils are given a shopping list on which different things (concrete objects) are written down. Each pupil chooses two objects from the shopping list and writes their name next to the chosen objects. Then pass the list around so that each pupil chooses two items from the list. At the end, the students have to decide what they could do with those 2 chosen items if they were on a desert island. Examples of objects: pen, water bottle, glasses, locker, car, credit card, diary, book, bag, lighter, photo album.

Annex 2

1. **Listen carefully to the song Breathe and identify the lexical field of the noun *nature*.**
2. **Read this article carefully and answer the questions:**

Ocean plastic pollution has reached 'unprecedented levels' in 15 years, study finds

The phenomenon is likely to accelerate if nothing is done to remedy it. Plastic pollution in the world's oceans has reached "unprecedented levels" for 15 years, warns a study, which urges the world to conclude the international treaty, expected by 2024, supposed to save the planet from this waste. The study, published this Wednesday in the American journal *PLOS One*, estimates that 170,000 billion pieces of plastic on the surface of the oceans, mainly microplastics, have been largely discharged into the sea since 2005. The total weight of this pollution represents 2.3 million tons, the study estimates.

A very rapid increase since 2005

The results are based on plastic samples taken at more than 11,000 stations around the world, over 40 years, from 1979 to 2019. The scientists found no clear trend until 1990, then fluctuations between 1990 and 2005. But in- Beyond that date, "we are seeing a very rapid increase, due to rapid production growth and a limited number of release control policies," Lisa Erdle, one of the authors, told AFP.

In the middle of the ocean , this pollution comes mostly from fishing gear and buoys, while clothing, car tires and single-use plastics often pollute closer to shore. Their presence threatens animals, which become entangled in the larger pieces or ingest microplastics that then travel up the food chain to humans.

Limit plastic waste

If the trend continues, plastic use is expected to nearly double from 2019 in G20 countries by 2050, to 451 million tonnes per year, according to a recent international report. After the war, in 1950, there were only two million tons produced on the planet. Waste has certainly decreased at times between 1990 and 2005, in part thanks

to effective policies, such as the 1988 MARPOL convention, to put an end to discharges by ships. But recycling , even in the wealthiest countries, has not been enough to stem the problem.

For the past year, 175 countries have agreed to put an end to this pollution by drawing up a binding treaty by the end of 2024 under the aegis of the United Nations . The next negotiating session is scheduled for May in Paris. For the authors, this treaty must be ambitious enough to reduce the production and use of plastic, but also better manage its elimination. "The recovery of plastic in the environment has only a limited effect, and the solutions must therefore focus on limiting plastic releases", further indicates the study.(https://www.20minutes.fr/planete/4027265-20230310-pollution-plastique-oceans-atteint-niveaux-precedent-depuis-15-ans-selon-etude)

1. In which publication/on which website did this article appear?
2. What is the topic of this article?
3. In which section / sections can we find this article?
4. True or false? Justify your choice.

   a. According to one study, glass pollution in the oceans has increased over the past fifteen years.
   b. The weight of plastic waste in the oceans is two million three thousand tonnes.
   c. In order to carry out this study, waste in European sites was checked.
   d. Ocean pollution is caused by objects such as nets, floats, trawls, dredges.
   e. In the absence of effective measures and policies, the use of plastic will be folded.
   f. Recycling can lead to less ocean pollution.

3. **Answer the following questions:**
   1. What is climate change?
   2. How is climate change felt in Romania?
   3. What are the consequences of climate change?
   4. How can we adapt to the effects of climate change?
   5. What activities can we do to reduce pollution?

4. **Actor Robert Redford believes *the environment should be included in national security issues. Defending our resources is as important as defending our borders.* What is your opinion on this statement?**

5. **Make a mock-up of the *Green City* message.**

STEAM in history lessons

1. What is STEAM?

Most of us have heard of the acronym STEM that is related to the initials in English of these four key areas: Science, Technology, Engineering and Mathematics. The coining of the term STEM is generally attributed to the National Science Foundation in the USA in the 1990s. Since then educational projects, as well as industry and government initiatives, that use and promote STEM have arisen all over the world, to try and address challenges in education, in industry and in daily life, with a multidisciplinary approach.

Some years later, the concept of STEAM began to be conceptualized, (again believed to be from the USA), by linking traditional STEM subjects with art, the arts, and creative thinking. As such the A in STEAM is from the English Art or Arts, and can include any area of the arts, humanities and design. STEAM has evolved around the world as a method to improve science, technology and mathematics education, and as an approach to designing more holistic learning models to teach creative and critical thinking, support project based learning, and develop a more participatory and collaborative education system.

2. How can we use it?

STEAM Approaches aim to engage: Creativity, Curiosity**,** Change of Attitude to Learning**,** Collaboration Skills**,** Confidence**,** Communication, Creative Thinking. These are all something that history teachers aim to achieve during their classes.

Richard Roche Sean Commins, a professor of neuroscience and one of the *fathers* of STEAM educations supports the idea that Science and art have something very important in common: they both seek to reduce something infinitely complex to something simpler. History is replete with stories of where art and science converge and intersect, encircle each other and occupy the same space at the same time. They represent the reciprocal relationship of these two routes towards self- knowledge along which we navigate – of art underpinning science and science enriching art. They can be considered signposts to connections between these parallel roads. Roads which once were one, and which are converging once more.

3. The History lesson. The classical way

School name: Colegiul National „Nicu Gane”, Fălticeni

Teacher: Irina Zaharia

Date: 25.05. 2023

Class: a IX-a A

Topic: History

Learning unit: Medieval Europe

Subject: Medieval society. The knights: Chivalry and Honor

Lesson type:teaching-learning

Didactic strategy

Teaching methods: history book, notebooks, classic and digital board, power point presentations

Forms of teaching: frontal, individual, teamwork.

Learning methods: conversation, explanation, active learning, solving problems, role play, 5 minutes essay

Specific competences

2.1. The use of specialized terms in the description of a historical event/process
2.2. Narrating a historical event/process, using information from historical sources
3.2. Description of the role of some personalities in the unfolding of historical events
4.2. Using multimedia resources for learning purposes

Operational competences

O1 – defining the historical terms feudalism, fief, feudal hierarchy, senior, vassal, feudal domain, vassal tribute, census, tithe;

O2 – identifying the manner in which one could become a knight;

O3 – mentioning the main features of the chivalric code;

O4 – specifying the main occupations of a knight;

O5 – description of the conduct of a tournament;

O6 – creating a historical account of the importance of knights in the Middle Ages with the help of multimedia resources;

Bibliography:

- **C. Felezeu**, Didactica istoriei, Ediţia a II-a, Presa Universitară Clujeană, Cluj-Napoca, 2004;
- **L. Căpiţă, C. Căpiţă-**Tendinţe în didactica istoriei, Piteşti, 2005;
- **M. Manolescu**, Evaluarea şcolară, Ed. Meteor Press, Bucureşti, 2006;
- **Owen Weldon,** Cavaleri și castele, Ed. Rao, București, 2013;
- **Andrea Hopkins,** O zi din viața unui cavaler, Ed. Litera, București, 2015;
- Cavaleri și fortărețe, Ed. Rao, București, 2010;

Lesson plan

Operational competences	Lesson moments	Content elements	Teaching activities	Learning activities	Learning methods	Evaluation
	a) Organizational moment		Note the absences. Prepare the learning resources.			
O1	**b) Evaluation. Revitalizing the knowledge necessary to acquire the new lesson**	Feudal domain	Through the questions asked, the teacher verifies the previous lesson. ➢ Specify what was the social and political system specific to the Middle Ages? ➢ Mention the most important wealth of medieval people. ➢ Specify the structure of the feudal hierarchy	They will answer the questions related to what was taught in the previous classes, fixing their knowledge better. ➢ They will specify the existence of feudalism ➢ They will mention the possession of as large areas of land as possible ➢ The social categories that were part of the feudal hierarchy will be mentioned.	Conversation Conversation	Oral evaluation

			➢ What are the main component parts of the feudal domain? ➢ What were the obligations of the peasants to the noble? ➢ How can the ceremony of vassal homage be described? ➢ Describe a medieval castle	➢ They will mention the main component parts of the feudal domain ➢ They will mention census and tithe ➢ They will mention what are the most important parts of paying vassal tribute ➢ They will describe a medieval castle	Conversation	Oral evaluation
	c) Announcing the new lesson, its teaching-learning plan, what the student should know and do at the end of the lesson	Announcing the new lesson and its objectives: "Chivalry and Honor"	Write the title of the lesson on the board: "Chivalry and Honor"	Students pay attention to the teacher and express their opinions.	Conversation	

O2	**d) Acquiring new knowledge**	**Becoming a knight**	The teacher mentions that there are certain stages a young man had to go through to become a knight	Students listen to the teacher's explanations and solve the exercise on the worksheet with the help of a historical source (Appendix 1)	Learning through discovery Conversation Explanation	Observing the class
			The teacher presents the students with the main stages of the investiture ceremony	Working in pairs, students will try to recreate the investiture ceremony	Role play	Formative evaluation
O3		**The code of chivalry**	The teacher mentions the existence of a code of honor that every knight was obliged to respect	Based on historical sources, the students identify the main features of the chivalric code. (Appendix 2)	Interactive blackboard	
O4, O5		**Knights occupations**	The teacher mentions the different occupations of the knights	Listen to the teacher's explanations and analyze the historical sources that will allow them to identify the main occupations of the	Explanation Historical visual sources	Formative evaluation

O6		**The importance of knights in the Middle Ages**	The teacher asks the students questions about the importance of knights in the Middle Ages	knights(Appendix 3) Based on visual sources, students describe the conduct of a tournament Using visual sources, students create a short essay expressing their opinion about the importance of knights in the Middle Ages	Working with historical sources Problem solving 5 minutes essay	Observing the class
1 **2** **3** **4** **5** **6**	**e) Feed-back**		The teacher suggests that the students read their completed essays	Guided by the teacher, the students present the results of their work to their colleagues		Final evaluation
	Homework **Student grading**		Using all learning methods and tools to answer the following question: "Imagine that you have traveled back in time to the Middle Ages and that you are a famous knight. Describe a day in your life?"	Students take notes		

4. **The history lesson. The STEAM way**

Activity 1. Talk knight!

Description of activity: Students will explore communication skills through a series of STEAM activities and investigations, and then make their own language tools to help understand how we can support people with communication challenges. They will create an imaginary sign and words language used by knights in the Middle Ages.
Learning outcomes: the sense of sight, the structure of human communication skills, the importance of language and of observation in art and science, creative approaches to understanding communication issues andhelping people who face challenges in that part of life- DIY knight language through words and signs.
Resources required: Paper, colouring pencils, a few small mirrors are useful to have.There are several options for the sign board - e.g. a hole puncher and paper to punch out your knight alphabet. Alternatively,we can use peg boards and pegs, or use buttons or play dough as spots on paper.
Learning space: Any learning space is suitable, we can organize the classroom in a way suitable for team work, with space for drawing
Key Competencies Activated: Literacy, Multilingual, Personal, social and learning to learn, Cultural awareness and expression
Knowledge: Literacy, Understanding Fundamental concepts, Communication and Application
Skills: Literacy skills, Problem solving skills, Thinking and working scientifically, Design and making skills, Creativity skills, Communications Skills
Attitudes: Understanding, Reasoning, Collaborative, teamworking, Empathy, Agency
Steps involved: 1. Download the powerpoint presentation to show the students

2. The first section is an introduction to sight, language, and a fun observation game about Middle Age people
3. Then the students either individually with a mirror draw their own face and hands, or team up in pairs and draw their partners face and hands -taking time to observe carefully and draw what they see
4. Then a short quiz on the functions of language
5. Finally we explore what happens when you can’t speak - how do you communicate? Students will make their own sign board with the knights alphabet in combat out of simple materials!

5. Discussion on eyes, sight, observation skills, language and how we can help and support people with challenges regarding their communication skills.

Activity 2. Building a battlefield

Description of activity: Build a three-dimensional model of a battlefield using electricity kits and/or recycled or everyday materials. In this way, pupils learn basic concepts about electricity and sustainability. They can recreate knights appearance, their weapons, their harnesses, their horse. The battlefield can be a simple plain or it can a be a forest, hills, even a town siege.
Learning outcomes: to list and use the electrical components necessary to assemble the moving knights, to design and implement a model of a city according to historical criteria, to describe how to carry out the process of connecting the components, to describe the functioning and benefits of the terrain for the battle outcome
Resources required: Students' logbooks, mini electric motors, Battery, Recycling materials, Electrical circuit scheme, Scissors, glue, colours, etc.
Learning space: We can arrange the desks in islands to facilitate the construction of the artefact and collaboration between peers.
Key Competencies Activated: Mathematics, Science,technology, art, geography and engineering
Skills: Connect, Cut, Design circuits, Design and build an artefact
Soft Skills: Problem solving, Collaborate and share, Self-evaluate
Steps involved: 1. Introduction to the functioning of electrical circuits and experimentation with mini electric motors needed in order to made the knights move on the battlefield;
2. Introduction to the medieval battlefields 3D recreations;
3. Plenary discussion on the historical aspects of the project;
4. Presentation of the challenge from an interdisciplinary point of view;
5. Planning of the map of the city under siege or the battlefield in groups (in the logbooks) according to sustainability criteria: draw the project, list the materials and indicate the arrangement of the historical figures;
6. Collection of useful recycled materials for the construction ofthe three-dimensional model;
7. Construction of the model with the collected materials and electricity kits provided by the teacher;
8. Presentation of the models to the other groups;
9. Plenary discussion to highlight strengths and weaknesses;
10. Self-evaluation in the logbooks

Lesson project

Date: 10.11.2022
Subject: Physics
Class: 10 A
Profile/Specialization: Real/Mathematics-IT
Lesson title: *Thermal machines*
Lesson type: Lesson of forming capabilities in order to acquire new knowledge
Learning unit: *Thermal engines*
Learning unit chapter: Lesson 1/Evocation - Anticipation
Lesson duration: 50 minutes
Teacher: Ioan Marcel CIURUŞ

General competences:

1. Understanding and explaining several physics phenomena, technological processes, functioning and using common technical products;
2. Experimental and theoretical scientific investigation applied to physics;
3. Communication;
4. Protecting own self, the others and the environment.

Specific competences/*Optimal level performance indicators*:

1.3. Sinthesizing proof obtained from scientific investigations in order to offer grounds for an explanation/generalization
i.3.2. *Using graphs, quantitative relations and conventions in communication in order to sustain conclusions and arguments;*

2.2. Cause-effect type explanation, using appropriate scientific language, of several simple physics phenomena identified in nature and in various technical applications. ***i.1.2*** *Describe and explain from a causal point of view all the physics phenomena they have studied using classifications and generalizations.* ***i.3.1*** *Cause-effect type explanation, using appropriate scientific language, of several simple physics phenomena identified in nature and in various technical applications;*

3.1. Extracting relevant scientific data from own observations and/or various sources/ ***i.3.3.*** *demonstrate awareness of several points of view on the same issue;*

4.1. Using several quanta and principles, theorems, laws, physics models in order to answer with arguments to problems/issues of application and/or reasoning/***i.1.3.*** *using quantitative relations among different physics quanta, analysing the relations from a dimensional point of view;*

4.2. Using several simple models from physics domains to solve simple problems/issues/ ***i.1.4*** *exemplify, explain and critically consider a variety of the phenomena and concepts they have studied.*

Didactic strategies: structured investigation, triphase ERR model, in *flipped classroom* variant.

Methods and procedures: conversation, brainstorming, think-work in pairs - communicate, think – work in pairs – work in fours - communicate, cluster, VENN diagram as table/cluster, virtual experiment.

Set-up:
- frontal (bringing knowledge up-to-date, using knowledge in a new context, discussing homework results);
- in groups (solving tasks and communicating results);
- individually (assessing knowledge, drawing conclusions).

Learning means: *G Suite for Education* platform, PC, videoprojector, projection screen, pptx presentation, blackboard, chalk, scale models of thermal engines (on steam, Otto, Diesel-fueled)**.**

Assessment forms: analyzing the way of cooperation among work groups, observing the way of presentation and argumentation of ideas, analyzing answers, homework.

Bibliography: TURCITU D., ONICIUC D., CERNĂUȚEANU A., OLARU G., *Fizică, manual pentru clasa a X-a*, Editura Radical, Craiova – 2005, STRAZZABOSCHI S., POPESCU M., SANDU M. TOMESCU V., *Fizică, manual pentru clasa a X-a*, Editura Crepuscul, Ploiești – 2005, Suport de curs/*Programul naţional de dezvoltare a competenţelor de evaluare a cadrelor didactice din învăţământul preuniversitar (DeCeE)*, acreditat C.N.F.P., decizia nr. 46/12.04.2009, Suport de curs/ Programul de formare continuă, *Metode eficiente de învățare a fizicii*, acreditat/echivalat prin Ordinul ministrului/decizia nr. 3365/29.04.2014, Suport de curs/ Programul de formare continuă, *Învățarea științelor – Abordări metodologice moderne*, furnizat de Centrul de Evaluare și Analize Educaționale, în cadrul proiectului ,,Consolidarea și extinderea predării fizicii bazate pe IBL", decembrie 2018.

Lesson progress:

1. **Organizational stage:** (3 mins.)

- **Attendance check.**
- **Organizing work groups** – Students are grouped in fours and sub-groups of two.

2. **Discussing homework** (10 mins.)

- Students are requested to present the tasks of the topic for the current class (Annexes/Worksheet 1).
- Discussing homework starts with debates on the consequences of the first principle of thermodynamics.
- *The* cluster graphic organizer is used./Worksheet 1

3. Drawing attention/Announcing lesson title and enunciating the question under investigation

(3 min.)

- Students are announced that they are about to get involved in a new lesson which is largely based on their homework, a lesson in which they will develop competences in scientific research, team work, collaboration, presentation of results achieved and argumentation of personal opinions in front of the audience;
- It is stated that students` tasks in the classroom will be reversed with the ones from home (*flipped classroom*). To this end, during the lesson, they will be able to take photos.
- The topic is announced and the question under investigation is enunciated**.**

Thermal machines

~ Can we travel by a thermal machine? ~

(Answer "Yes!" or "No!")

4. Succesion of the main stages of the topic ***Thermal machines***: (33 mins.)

E*vocation (****E****RR)*

- Among the machines presented in the homework, based on **1/14** slide from the **pptx** presentation, the following are identified: refrigerator, heat pump, thermal engine and their main components are emphasized. The purpose for which they were created is highlighted. */Frontal*

R*ealizarea sensului (*E***R***R)*

- According to the tasks these machines fulfil, the objects from *The cluster* diagram are grouped, becoming a cluster-type VENN diagram. (Annexes/Worksheet 2)/Group work (***think – work in pairs - communicate***).
- Based on the VENN diagram as cluster (worksheet 2), the following are analyzed: refrigerator, heat pump and thermal engine.
- Students are distributed worksheet 3. It is to be filled in individually, based on the discussions related to slides **3-13.**
- The way the students have acquired the new notions is evaluated by identifying the three classes of thermal machines, based on the characteristics from the **3/14** slide of the **pptx** presentation. Initially, the class is set up in groups (***think – work in pairs – work in fours - communicate***). Then, a group presents the results they have got. **Finally, together, following the debates, they reach the correct answer.**
- The law of conservation of energy corresponding to each class of machines is written, **slides no. 5, 6, 7.**
- It is emphasized that, with thermal engines, the complete conversion of mechanical work into heat is not possible. The notion of **perpetuum mobile of second kind** is defined.
- Based on the energy conservation in the case of thermal engines and the notions acquired during gymnasium and highschool related to the loss of energy while using different machines, the expression of thermal efficiency of thermal engines is established and interpreted. The reasoning is repeated in the case of heat pumps and refigerators, **slides no. 8 - 13**.
- Students are requested to express their opinions regarding the question: ”When referring to heat pumps and refrigerators, why is the notion of efficiency used and not performancve, as in the case of thermal engines?”.
- Students complete and hand in **worksheet 3**.

R*eflecție (ER****R****)*

- Students are requested to define the following notions: thermal machine, refrigerator heat pump and thermal engine, definitions enunciated in **worksheet 3**, and discuss these definitions.

- **Conclusions:**
    - The devices/machines which, when functioning, produce a periodic conversion of heat into mechanical work or mechanical work into heat are called **thermal machines**.
    - Thermal machines fall into three types: thermal engines ($L>0$, $Q_1>0$), refrigerators ($L<0$, $Q_2>0$) and heat pumps ($L<0$, $Q_1>0$).
    - The idea is outlined that making a thermal engine which fully converses heat into mechanical work (not lose energy) is not possible. Such an engine was called ***perpetuum mobile of second kind***.
- **The following question is asked again:** ”*Can we travel by a thermal machine?”*

5. Homework (1 min.)

- Make a list with the definitions of the newly acquired terms.
- On your notebooks, write the diagrams corresponding to the three types of machines, write the law of conservation of energy for each thermal machine as well as the relation which characterizes the energy efficiency/performance of the machine.

6. During next class:

- Discussing tests and homework;
- New lesson: *Thermal engines*. During the activities, students will be adressed the question: *”Is it possible for us to make a perpetuum mobile of second kind?”*

Annexes:

<u>Worksheet 1/</u> Students` assigned homework

Give examples of devices used by members of your family whose functioning involve **simultaneously** the following physical values: U, L and Q.

Reccomendation: *While solving this task, refer to the first principle of thermodynamics.*

Possible answers, *(frontal analysis)***:**

- Refrigerator, cooler, freezer;
- Air conditioner, heat pumps;
- vehicles on gas/Diesel fuel, motorbikes on gas, petrol lawnmower, petrol chainsaw, petrol sprayer;
- ~~Heating station.~~

<u>Worksheet 2/</u> Work method: *THINK – WORK IN PAIRS – COMMUNICATE*

Group the devices from worksheet 1 (objects from the Cluster diagram), according to the purpose they were made and state the respective purpose.

Nr. crt.	**Device name**	**Purpose for which they were made**	**Class they belong to**
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			

<u>Obs.:</u> - In the class, theVENN diagram is made as a cluster.
- It is to be filled in together with the teacher.

Possible answers:

No.	**Device name**	**Purpose for which they were made**	**Class they belong to**
1.	Refrigerator	Cooling usable area (building)	Refrigerators
2.	Freezer		
3.	Cooler		
4.	Heat pump	Heating usable area (building)	Heat pumps
5.	A.C.	Maintaining the temperature in an usable area (building) within optimal limits	Refrigerators Heat pumps
6.	Vehicles on gas	Carrying out mechanical work on exterior environment	Thermal engines
7.	Vehicles on Diesel fuel		
8.	Petrol lawnmower		
9.	Petrol chainsaw		
10.	Petrol sprayer		

Worksheet 3/ Thermal machines

Based on the analysis of the phenomena presented in slides 3-13, fill in the table below and define: refrigerators, heat pumps, thermal engines and thermal machines.

Rezolvare:

No.	Device class	Common trait/traits	Differentiating traits
1.	**Refrigerators**		
2.	**Heat pumps**		
3.	**Thermal engines**		
Thermal machines			

Refrigerators -

Heat pumps -

Thermal engines -

Thermal machines -

Possible answers:

<table>
<tr><th>No.</th><th>Device class</th><th>Common trait/traits</th><th>Differentiating traits</th></tr>
<tr><td>1.</td><td>Refrigerators</td><td rowspan="3">- Cyclic conversions ($\Delta U=0$)

- t-din. system is a fluid.

- Are bithermal machines

- Exchange mechanical work with the exterior environment.</td><td>- ”Receive mechanical work”.
- Take the heat (usable heat, Q_1) from the cold thermostat (building, usable area).
- The temperature of the building becomes lower than the exterior environment`s.
- The usable energy (Q_1), is not a fraction of the received energy.</td></tr>
<tr><td>2.</td><td>Heat pumps</td><td>- ”Receive mechanical work”.
- Cedează căldura (căldură utilă, Q_2) termostatului cald (incintă, spațiul util).
- Temperatura incintei devine mai mare decât temperatura mediului exterior.
- Energia utilă ($|Q_2|$), nu este o fracțiune din energia primită.</td></tr>
<tr><td>3.</td><td>Thermal engines</td><td>Primesc căldură (Q_1), o transformă parțial în lucru mecanic.
Energia utilă (L), este o fracțiune din energia primită.</td></tr>
<tr><td colspan="4">Thermal machines</td></tr>
</table>

Refrigerators are thermal machines which, after the conversion of mechanical work into heat, lower the temperature of a building below the temperature of the exterior environment.

Heat pumps are thermal machines which, after the converision of mechanical work into heat, increase the temperature of a building above the temperature of the exterior environment.

Thermal engines are thermal machines which converse heat into mechanical work.

Thermal machines are machines/devices which periodically converse heat into mechanical work or vice-versa.

DIDACTIC PROJECT

Discipline: IT
Grade: 9th
Mathematics Informatics class
Date:
Content unit: C++ language instructions
Lesson theme: Alternative structure. The IF instruction
General skills:
Type of lesson: - transmission/acquisition of new knowledge
Venue: Classroom

Lesson duration: 50 min.

General skills:
- the correct use of the alternative structure in C++ programs;

Specific skills:
- identifying problems that can be solved with the help of alternative structures;
- acquiring and deepening the theoretical notions of the alternative structure.

Teaching strategies:

 Didactic principles:
- the principle of participation and active learning;
- the principle of ensuring the gradual progress of performance;
- the reverse connection principle;

 Teaching methods:
- oral communication methods: exposition, conversation;
- action methods: exercise, learning through discovery;

 Training procedures:
- the explanation in the learning stage;
- learning by discovery, by solving problems;
- the consolidation conversation in the knowledge fixation stage;

 Forms of organization: frontal;

 Forms of directing learning: directed by the teacher;

 Material resources:
-Informatics, Manual for the 9th grade, Mariana Miloşescu, EDP Publishing House, Bucharest 2008
Evaluation methods:

- initial assessment: oral questions;
- set of explanations;
- practical tests.

Course of the lesson:

1. Organizational moment: the absent students are recorded in the catalog, silence is established and I create the appropriate atmosphere for the didactic activity.
2. Capturing attention and awakening interest in the lesson. The purpose of the didactic activity is specified - the alternative instruction of the C++ language
3. Updating the acquired knowledge.
Teacher activity:
What is the alternative structure studied in pseudocode?
What are the shapes of this structure?
Students' activity: they answer the questions asked, carefully follow the answers of their colleagues and any additions made by the teacher.
4. Transfer of knowledge:
The alternative structure appears in practice in two variants, namely:
 Alternative structure: in this case only one of two blocks of instructions will be executed depending on the truth value of a logical expression
 Multiple alternative structure: in this situation, a block of instructions from several possible variants will be executed.
We hear statements like:

if I passed in all subjects **then**
i will go camping
else
I stay to learn.

There are three words that have a special role here: **IF, THEN, ELSE.** The sentence has three components, namely:
 a condition, transcribed by "I passed in all subjects", a condition that we will mark with C;
 an action transcribed through the message "I will go to camp", marked with B1, action associated with the word THEN, that is, it is executed if and only if "I passed all the subjects";
 an action transcribed by the message "I'm staying to learn", marked with B2, action associated with the word OTHERWISE, i.e. it is executed if and only if "I passed in all subjects"
The alternative structure is implemented in the C++ language by the **IF** statement.
General form of the instruction:

```
if (condition)
        instruction1;
        else
        instruction2;
```

The principle of execution:
- the condition is evaluated;

- if its value is true (different from 0), instruction 1 is executed;
- if the value is false (equal to 0), instruction 2 is executed.

Remarks:

1. of the two instructions, only one will be executed, depending on the condition;
2. instruction1 and instruction2 can be compound instructions (group of instructions that are executed in a block and enclosed in braces)

In practice, the if instruction can also be used with the variant of a null path:

if (condition)
    instruction;

Exercises:

1. Write a C++ program that calculates and displays the maximum of two integers a, b read from the keyboard.

```
#include<iostream>
using namespace std;
int main()
{ int a, b, maxi;
cout<<"a="; cin>>a;
cout<<"b="; cin>>b;
if(a>b)
  maxi=a;
else
  maxi=b;
cout<<"maxi="<<maxi;
return 0;
}
```

2. Write a C++ program that reads from the keyboard two integers a, b and calculates and displays their sum if the numbers are even or their product otherwise.

```
#include<iostream>
using namespace std;
int main()
{ int a, b, max;
cout<<"a="; cin>>a;
cout<<"b="; cin>>b;
if((a%2==0)&&(b%2==0))
 cout<< a+b;
else
  cout<< a*b;
}
```

3. Write a C++ program that calculates and displays the maximum of three integers a, b, and c read from the keyboard.

```
#include<iostream>
using namespace std;
int main()
{int a,b,c,maxi;
cout<<"a="; cin>>a;
cout<<"b="; cin>>b;
cout<<"c="; cin>>c;
if(a>b)
  if(c>a)
    maxi=c;
  else
```

```
    maxi=a;
else
  if(c>b)
    maxi=c;
  else
    maxi=b;
cout<<"maxi= "<<maxi;
return 0;
}
```

4. Write a C++ program to solve the equation of the first degree: ax+b=0, the values of a and b are read from the keyboard and are real values. All cases will be discussed.

```
# include<iostream>
using namespace std;
int main()
{ float a,b,x;
cout<<"a="; cin>>a;
cout<<"b="; cin>>b;
if(a==0)
   if(b==0)
      cout<<"Exista o infinitate de solutii!";
   else
      cout<<"Ecuatie imposibila!";
else
 { x=-b/a;
  cout<<"Solutia ecuatiei este "<<x;
 }
return 0;
}
```

5. Operationalization of knowledge (ensuring the reverse connection)

- the results obtained are highlighted;
- the students who answered are highlighted and noted;

6. Evaluation

- the students' ability to solve proposed problems is analyzed
- students' ability to use expressive language correctly is appreciated

7. Homework:

Write a program to solve the second degree equation: ax2+bx+c=0, the values of a, b, c are read from the keyboard and are real values. All cases will be discussed

LESSON PLAN

Discipline: Chemistry

Grade: 12th C

Date: 9.12.2022

Learning unit: The laboratory experiment between the past and the present in the context of the application of the knowledge acquired during the four years of study

Lesson title: Recapitulation

Type of lesson: Recapitulation and knowledge systematization lesson

Time: 50 minutes

Coordinating teachers: Liliana Oniciuc, Georgeta Despa

Within the ERASMUS project, the chemistry department organized a workshop that took place with 20 students from class XIIC and 20 students from other European countries, partners in this project.

The proposed experiments targeted notions and specific skills accumulated during the 4 years of high school.

General/specific skills:

Grade: 9th

2.1 Carrying out investigations to highlight some characteristics, properties, relationships.
2.2. Collecting information through qualitative and quantitative observations.
2.3. Formulation of conclusions using information from documentary sources, graphs, schemes, experimental data that respond to the formulated hypotheses.
4.1 Modeling concepts, structures, relationships, processes, systems
4.2 The correct use of terminology specific to chemistry,
5.1. Respect and application of personal and environmental protection rules

Grade: 10th

1.1. Description of the behavior of the organic compounds studied according to the class of belonging
2.1. Carrying out investigations to highlight some characteristics, properties, relationships
2.2. Formulation of conclusions that demonstrate cause-effect relationships
4.1. Processing written information, data, concepts, for their use in project-type activities
4.2. Systematic use of specific terminology in a variety of communication contexts
5.2. Justification of the importance of organic compounds

Grade: 11th

1.3 Explaining the behavior of some compounds in a given context,
2.1 Establishing predictions in order to highlight characteristics, properties, relationships

2.2 Evaluation of the extent to which the conclusions of the investigation support the initial predictions.
4.1 Processing a large volume of information and distinguishing between relevant/irrelevant and subjective/objective information

Grade: 12th
1.1 Classification of the studied chemical systems according to various criteria
1.3 Interpretation of the characteristics of the studied phenomena/systems, in order to identify their applications
2.1 The use of investigation in order to obtain explanations of a scientific nature
2.2 Evaluation of the validity of the conclusions of the investigation
4.1 Appropriate use of scientific terminology in describing or explaining phenomena and processes

Teaching methods:

Heuristic conversation; The laboratory experiment; Systematic observation; The dialogue; Explication.

Teaching aids:laptop; laboratory sheets.

DIDACTIC SCENARIO

Stages of the lesson	Time	Specific skills	The content of the lesson		Didactic methods	Didactic means
1. Organizing the class for the lesson and capturing the students' attention.	2 min		Activities of an organizational nature: checking attendance, ensuring discipline, preparing teaching aids, necessary materials.		Explication	
2. Updating knowledge.	7 min	1.1, 1.2, 2.1, 2.4, 3.1	Through the frontal dialogue, the knowledge about chemical reactions is synthesized using documentation sheets as supporting material. Appendices 1,2,3 List one experimental activity each made in the 4 years of high school. How can these reactions be symbolized?		Dialogue	
3. Announcing the title of the lesson and operational objectives.	2 min		The teacher announces the title of the lesson and writes it on the blackboard. Establish specific competencies.		Explication	
4. Presentation of tasks and learning situations.	2 min		The students are divided into 8 groups, each group receiving a worksheet. The teacher states that they will work on the lab sheets. Students read the requirements and do the practical activities.		Explication	Lab sheet Laptop
5.Directing learning Realization	35 min	1.1, 1.2, 1.3, 2.1, 2.4, 3.1	He proposes to carry out the experiments from the laboratory sheet. Monitors the performance of experiments and provides guidance It requests the presentation of conclusions and appreciates the answers received. Students write down	Students perform the experiments in the Lab Sheet Complete the worksheet	The laboratory experiment Explication	Lab sheets Utensils and chemicals
6. Retention and Transfer Insurance	2 min		The teacher checks the lab sheets.		Dialogue Explication	

Appendix 1

VARIATION OF METALLIC CHARACTER

Metallic character increases in periods from right to left and in main groups from top to bottom.

By arranging the metals of the main and secondary groups in descending order of metallic character (electropositivity), the "series of chemical activity of metals" was compiled, in which the hydrogen atom is taken as a benchmark.

K, Ba, Ca, Na, Mg, Al, Mn, Zn, Cr, Fe, Ni, Sn, Pb, H, Cu, Bi, Sb, Hg, Ag, Pt, Au.

<---------- ---------- ----

Increases the metallic character

This ordering explains the following chemical properties of metals:

-a metal is displaced from its calculations by all the metals located before it;

- a metal displaces from its compounds all the metals located after it;

- the hydrogen in the acids is displaced only by the metals located before it.

The main compounds of metals are bases (hydroxides).

Their general formula is: M(OH)n where n is the valency of the metal.

The strength of the bases varies in the same way as the metallic character.

Metals react readily with nonmetals such as oxygen and halogens, with acids, some salts and acid oxides.

Metal oxides are also basic. In the reaction with water they form bases and that is why they are called basic anhydrides.

Appendix 2

COMPLEX COMBINATIONS

Complex combinations are neutral species, in which a metal ion (called central ion) is linked by coordinative covalent bonds to neutral molecules or ions (called ligands).

In order for a metal ion to form complex combinations, it must meet the following conditions: it must have a small ionic volume and possess free orbitals in which it can accept the non-participating electrons of the ligand, thus establishing covalent coordinative bonds between the central ion and the metal atom nonmetal in the ligand.

Examples of complex combinations

Schweitzer reagent-tetraminocopper(II) hydroxide

- chemical formula: **$[Cu(NH_3)_4](OH)_2$**

-use: cellulose dissolution; when identifying the copper ion, in the qualitative chemical analysis.

Tollens reagent - diaminosilver hydroxide (I)

- chemical formula: **$[Ag(NH_3)_2]OH$**

-use: it is a weak oxidizing agent used to oxidize aldehydes and glucose; allows the identification of aldehydes, which are oxidized to carboxylic acids when the silver mirror is formed (the silver ion is reduced to metallic silver).

Appendix 3

PROTEIN

Proteins are macromolecular combinations formed by α-amino acid residues, joined by amide bonds.

Proteins are part of any cell, plant or animal.

The chemical elements that make up proteins are: C, H, O, N, S, often P and some metals (Fe, Mg, Ca, Cu).

Through total hydrolysis, proteins are transformed into a mixture of α-amino acids. In the hydrolysis processes or identified about 20 amino acids constantly present.

Protein classification

Depending on the solubility in water:

1. Insoluble, fibrous or scleroproteins:

- Keratin: from wool, hair, nails

- Collagen: basic component of the skin

- Fibrin: from silk thread.

2. Soluble, globular:

- Hemoglobin: the red blood protein

- Albumins: the proteins in the egg white

- Glutens: the proteins in grains

Depending on the products resulting from the hydrolysis reactions:

1. Holoproteins: by hydrolysis they form only amino acids

2. Heteroproteinsor proteins: which, in addition to the macromolecular chain, also contain non-protein groups (prosthetic groups):

- Phosphoproteins: milk casein

- Lipoproteins: contain glyceride residues

- Glycoproteins: contain sugar residues

- Metalloproteins: Contain metal atoms (eg respiratory pigments are Cu proteins).

Class XII C
Prof. OniciucLiliana
Prof. DespaGeorgeta

Laboratory work

I. METALLIC CHARACTER VARIATION

Name of experiment	Substances and utensils	How to work	Experimental observations	Chemical reaction equation	Conclusions
1.Reaction of sodium (Na) with water	Sodium (Na) distilled water phenolphthalein solution metal glue filter paper crystallizer glass wool	-remove a small piece of sodium from the oil bottle, put it on the filter paper and cut it with the knife; - put in a crystallizer distilled water and a drop of phenolphthalein, over which add a small piece of metallic sodium; - on top of the crystallizer we put a funnel;	- in the fresh cut, the sodium has a metallic sheen -in contact with air, after a short time, the metallic sheen disappears - the NaOH solution formed will stain deep carmine red.	**$2Na + O_2 = Na_2O_2$** **$2Na + 2H_2O = 2NaOH + H_2$**	-sodium reacts with cold oxygen; -the reaction is rapid, violent (even without heating), with the release of a gas, H2 (hydrogen).

2.Reaction of potassium (K) with water	potassium(K) distilled water phenolphthalein solution metal glue filter paper crystallizer glass wool	- remove a small piece of potash from the oil bottle with the metal pliers, put it on the filter paper and cut it with the knife; - put distilled water and a drop of phenolphthalein in a crystallizer, over which add a pinch of potassium; - on top of the crystallizer we put a funnel;	- potassium reacts with cold water more vigorously than sodium; - phenolphthalein colors more intensely than Na	**$2K + 2H_2O = 2KOH + H_2$**	- potassium hydroxide is stronger than sodium hydroxide; **In one group, the metallic character increases:** **-per2 Na ↓** **-per3 K ↓** **In a group, the strength of the bases increases:** **NaOH ↓** **KOH ↓**
3.Reaction of magnesium (Mg) with oxygen in air and water	-magnesium ribbon -phenolphthalein solution -metal glue -test tube	-grab the magnesium ribbon with the pliers and light it in the flame of the oven; -insert the powder obtained into a test tube of water in which you have put phenolphthalein;	-magnesium burns with a blinding flame turning into a white powder (magnesium oxide - MgO) -the resulting substance reacts with water and the phenolphthalein turns carmine red	**$2Mg + O_2 = 2MgO$** **$MgO + H_2O = Mg(OH)_2$**	-magnesium reacts with hot oxygen; -magnesium oxide is basic;

4.Reaction of aluminium (Al) with oxygen in air and water	-aluminum powder -phenolphthalein -metal glue -spiral -spatula -Berzelius glass	- using a spatula, sprinkle the aluminum powder into the flame; -in a Berzelius glass put a little water, a few drops of phenolphthalein solution and with a spatula introduce the aluminum powder	- aluminum powder burns with sparks -the solution does not color	**4Al + 3O2 = 2Al2O3** **Al insoluble in water**	-aluminum reacts with oxygen when hot and only in powder form; In a period, the metallic character increases: Na Mg Al Gr IA IIA IIIA ← ← ← -aluminum does not react with water; aluminum is protected by the Al2O3 layer.
5.Amphoteric nature of aluminium hydroxide $Al(OH)_3$	-aluminum chloride solution ($AlCl_3$); -sodium hydroxide solution (NaOH) - hydrochloric acid solution (HCl) - test tube	- In a test tube put 2 ml of $AlCl_3$ solution and then in small proportions NaOH solution until a white precipitate appears; - Pour half of the contents of the test tube into another test tube; - in one tube add HCl solution and shake and	-in both tubes, $Al(OH)_3$ precipitate is no longer observed.	**$AlCl_3$ +3NaOH = $Al(OH)_3$+ 3NaCl** **$Al(OH)_3$+ 3HCl = $AlCl_3$ + $3H_2O$** **$Al(OH)_3$+NaOH=Na[$Al(OH)_4$]** - sodium tetrahydroxoaluminate	- Al(OH)3 in reaction with HCl behaves as a base; - Al(OH)3 in reaction with NaOH behaves as an acid -Chemical substances that in reactions with acids behave as a base and in reactions with bases behave as an acid = amphoteric substances

		in the other tube add NaOH solution and shake.			

II.REACTIONS FORMING COMPLEX COMBINATIONS

Name of experiment	Substances and tools	How to work	Experimental observations	Chemical reaction equation	Conclusions
1.Obtaining Schweitzer reagent $[Cu(NH_3)_4]SO_4$	-copper sulphate solution ($CuSO_4$) - sodium hydroxide solution (NaOH) -ammonia solution (NH_3) -test tube	-pour 2 ml of dissolution into a test tube of copper sulphate, to which we add sodium hydroxide solution; -add ammonia solution to dissolve the precipitate	- a blue-green color precipitateis formed - it is noted that in the test tube, the color of the solution changes into a deep blue	$CuSO_4+2NaOH=Cu(OH)_2\downarrow+Na_2SO_4$ $Cu(OH)_2+NH_3=$**$[Cu(NH_3)_4](OH)_2$**	Complex ion $[Cu(NH_3)_4](OH)_2$ is a clear, dark blue solution
2. Obtaining Tollens reagent $[Ag(NH_3)_2](OH)$	-silver nitrate solution ($Ag\ NO_3$) -sodium hydroxide solution (NaOH) -ammonia solution (NH_3) -test tube	- pour 1 ml of solution into a test tube of silver nitrate, to which we add sodium hydroxide solution; -add ammonia solution to dissolve the precipitate.	- a precipitate is formed of brown colour. -it is observed that in the test tube, the solution turns colourless when ammonia solution is added	$2Ag\ NO_3 + 2NaOH= Ag_2O\downarrow+2NaNO_3 + H_2O$ $Ag_2O+4NH_3+H_2O=2[Ag(NH_3)_2](OH)$ diaminoargint(I) hydroxide	-Complex ion $[Ag(NH_3)_2](OH)$, Tollens reagent is a clear colourless solution

III. OXIDATION REACTIONS OF MONOSACCHARIDES

Name of experiment	Substances and tools	How to work	Experimental observations	Chemical reaction equation	Conclusions
The oxidation reaction of glucose with Tollens reagent	-Tollens reagent solution -glucose solution -test tube	-In a test tube add 3 ml of Tollens reagent (from the one prepared in the previous experiment), on top of which add 3 ml of glucose solution; -heat the test tube over the spirometer, stirring continuously.	- on the walls of the specimen is a layer of silver	$C_6H_{12}O_6+2[Ag(NH_3)_2](OH)$ = glucose = **$C_6H_{12}O_7$**$+2Ag\downarrow+4NH_3+H_2O$ Glycolic acid	- glucose oxidized to glycolic acid.

IV. PROTEIN IDENTIFICATION REACTIONS

Name of experiment	Substances and tools	How to work	Experimental observations	Conclusion
1.Preparation of protein solution	-egg whites -distilled water -2 Erlenmeyer glasses -pollen -thyme or cloth	- mix the white of a chicken egg with 100 ml of distilled water - filter the cloudy solution through a piece of gauze or cloth	- clear solution is obtained to be used in the following experiments	-the proteins in egg white are soluble in water.
2.Biuret reaction	-protein solution - sodium hydroxide (NaOH) solution - copper	- in a test tube we add 3 ml of protein solution, over which we add 3 mil of NaOH solution	- a violet color appears	-purple coloration is due to the formation of complex combinations of Cu_2^+ ions and -NH_2

	sulphatesolution ($CuSO_4$) -test tube	- heat the test tube over the spirometer until the protein precipitate dissolves -add 2 ml to the hot solution $CuSO_4$ solution		
3.Xanthoprotein reaction	- protein solution - nitric acid solution (HNO_3) conc. - ammonia solution(NH_3) - test tube-spiral	- in a test tube we add 3 ml of protein solution, over which we add a few drops of HNO_3; - heat the tube - cool the tube and add 1 ml NH_3	-after heating a yellow coloration appears -after cooling the color intensifies to orange	-the color is due to the formation of nitro derivatives

V. CHEMICAL EXPERIMENTS

Name of experiment	Substances and tools	How to work	Experimental observations
1 Lava candle	- graduated cylinder -distilled water -oil -food dye	- in a graduated cylinder put 5ml of distilled water, then 7ml oil and a few effervescent tablets	- the lava flow can be seen

	-effervescent tablets		
2 Chemical flag	- graduated cylinder -medicinal alcohol -oil -vinegar -methyl orange solution	- in a graduated cylinder put 5ml of medicinal alcohol, then 5ml vinegar and a few drops of methyl orange	-the appearance in layers of red, yellow and blue is observed
3 The volcano	- ammonium dichromate $(NH_4)_2Cr_2O_7$ -spatula -metallic tripod -asbestos sieve -spiral -capsule -metallic pliers	- in a capsule put 3 spatulas of $(NH_4)_2Cr_2O_7$ - the capsule is heated on the asbestos sieve	- strong sparks appear and grey-green volcanic ash forms Cr_2O_3.

INKSCAPE

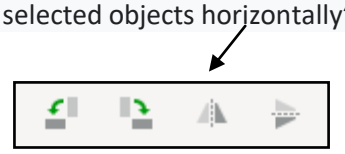
Inkscape is a Free and open source vector graphics editor for GNU/Linux, Windows and macOS.

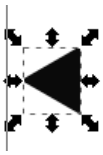
Objective: Use various Inkscape tools to create a pencil.

1. First, let's start by drawing the nib. To do this, click on the Polygon Tool icon to draw a triangle. Check the options: Regular polygon and three corners.

2. Then draw the polygon.

Then click on the arrow icon to  select the object and invert the object by clicking on the icon “Flip selected objects horizontally”.





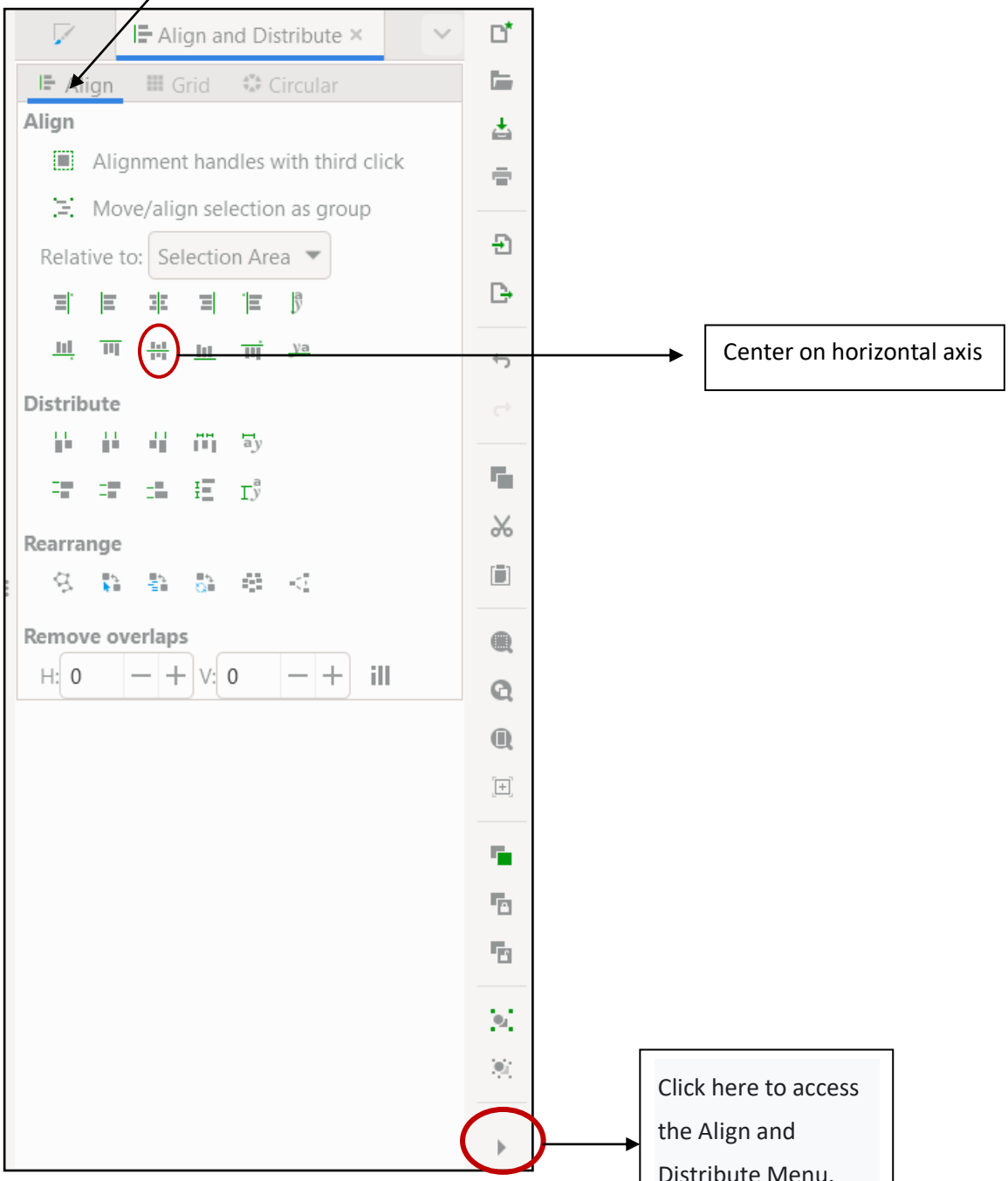
3. Decrease the height, then CTRL+D to duplicate the object. Use the CTRL key to change the scale, as shown in the image.

4. Paint the upper triangle light yellow and then lower the object, as shown in the image, thus creating the nib of the pencil.

5. Now make a red rectangle.

6. Group the pencil tip (Object-Group). And check its height, copy the height of the nib and go to the height of the rectangle and paste it. This is for both to be the same height.

7. Click on the icon “Align” and with the object selected, click on the center icon on the horizontal axis, so that the nib and the rectangle are well aligned.



8. Duplicate the rectangle with CTRL+D. Fill it with yellow color, and reduce its size, as shown in the image:

9. Let's make the eraser, first choose the color – bright pink and draw a circle. Check the height of the circle, if it is equal to the rectangle. If not, put the height of the rectangle in the circle. Place the circle as shown in the image

10. Send the circle behind the rectangle. (Lower the selection one step) 

11. You can create different pencils and try more tools.

STEAM Education Develops in 21st Century Schools

STEAM LESSON PLAN

Title: 3D Printing

Author: José Carreira | Luís Roque

Abstract

3D printing is an innovative technology that consists of printing three-dimensional objects previously designed on a computer, thus making it possible to create any type of object.

In the educational area, it is possible to make several 3D models of items that are studied in the most varied disciplines, such as Biology, Geography, Arts, among others.

Thus, students can more easily handle and visualize what teachers teach, as they experiment while building.

In summary, the application of this technology encourages involvement in the process, adaptation to change and problem solving on the part of students.

Keywords

#3DPrinting

Licenses

Summary table

Subject	*3D Printing*
Topic(s) within the subject	History; Printer; Software; Materials; The Process
Key real-life topic	Possibility to create any type of object
Age of students	*16 to 20*
Preparation time	*30 minutes*
Teaching time	*60 minutes*
Online teaching material	STEAM Impressão 3D.ppt
Offline teaching material	*Not applicable*

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Integration into the curriculum

Integrating 3D printing into the curriculum can be an excellent way to prepare students for 21st century skills.

It can be used in activities such as:

Design and manufacturing discipline;

3D printing club;

Interdisciplinary project;

Science fairs and exhibitions;

Technology classes.

Aim of the lesson

Teach the process of creating objects in 3D

Outcome of the lesson

Each student will have a 3D object created by themselves

Trends

Wider range of 3D printing use cases due to increasing technology maturity

Quality assurance as the foundation of industrial 3D printing

Sustainability in additive manufacturing

Metal 3D printing as a rising trend

21st century skills

Creativity; Collaboration; Technology literacy

Activities

Name of activity	Procedure	Time
Concepts	History of 3D printing. Software and materials used. The process of creating objects.	15
Demonstration	Demonstration of using the TINKERCAD software.	15
Creation	Practical activity in the TINKERCAD application to create keyrings with the student's name	30

Assessment

It is valued the fact that the student was able to create the object.

Student feedback

Questionnaire to be applied at the end of the learning scenario.

STEAM Education Develops in 21st Century Schools

STEAM LESSON PLAN

Title: Using Robotics to Learn Programming

Author: Cláudia Barata

Main Goal

At the end the student must be able to:

- program, read and write instructions by reading sensors and actuators.

The student must feel that this objective has been achieved with activities that stimulate their:

- interest and satisfaction;
- critical and creative spirit;
- effort and persistence.

1º Organize the workspace and identify the materials for carrying out the activities:

Arduino Uno

USB cable

Breadboard

Led's

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Resistors

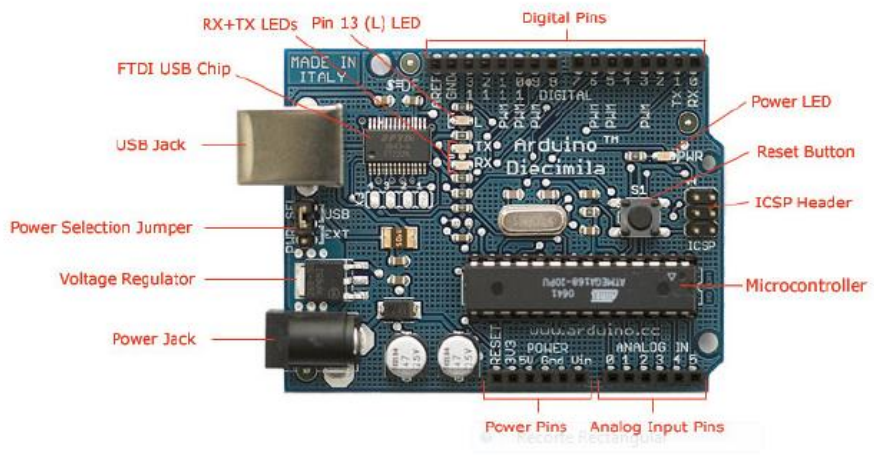
Light sensor

Bell

Ultrassonic Sensor

Button

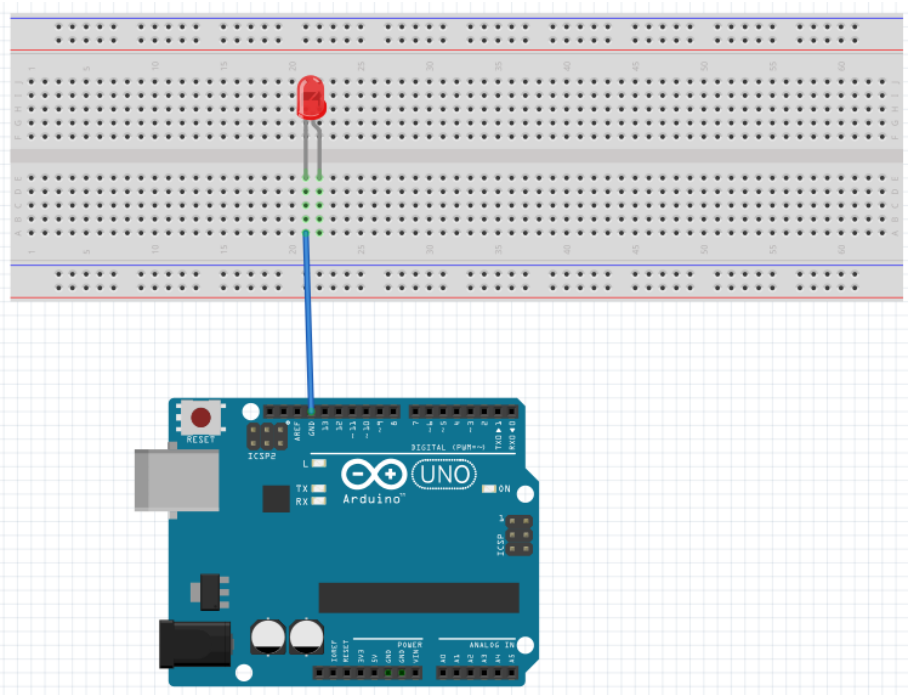
Cables



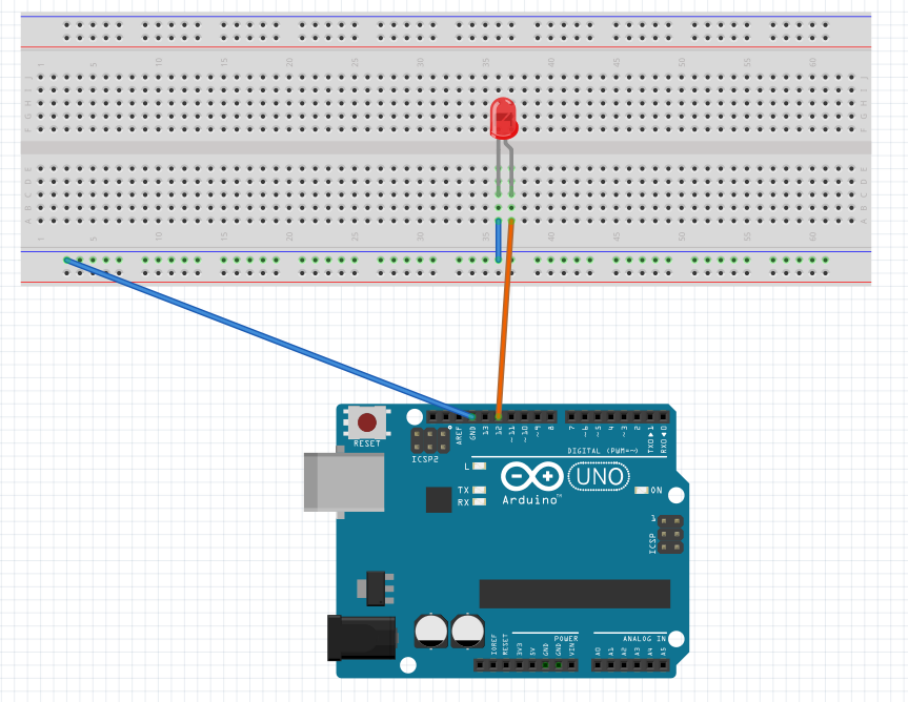
2º Turn on the light - when you press the L key and turn it off when you press the D key

Note: Assembly of the structure (always with the connection cable to the computer disconnected)

2.1. Ground wire connection (GND)



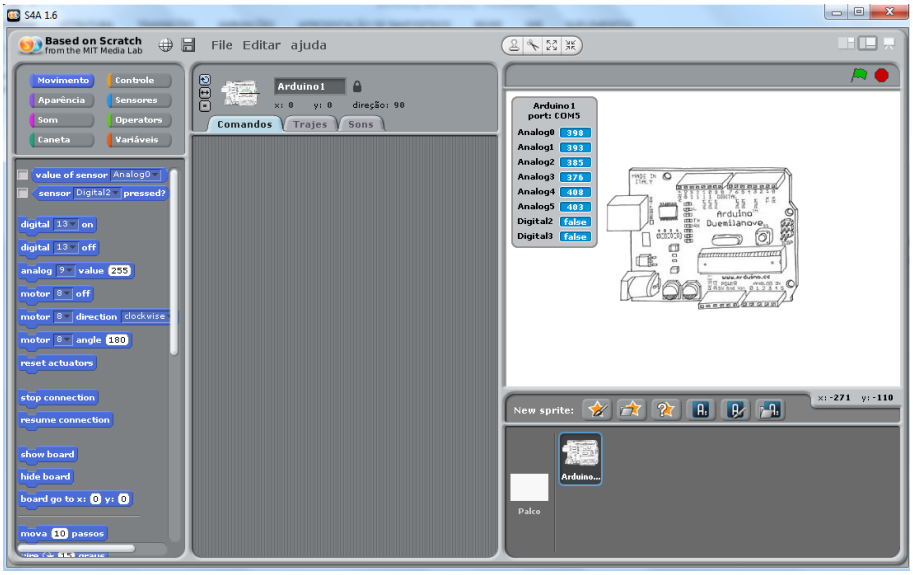
2.2. Pin 12 connection



2.3. Connecting the USB cable to the computer

2.4. Open the Software – Scratch for Arduino (S4A)

Interface

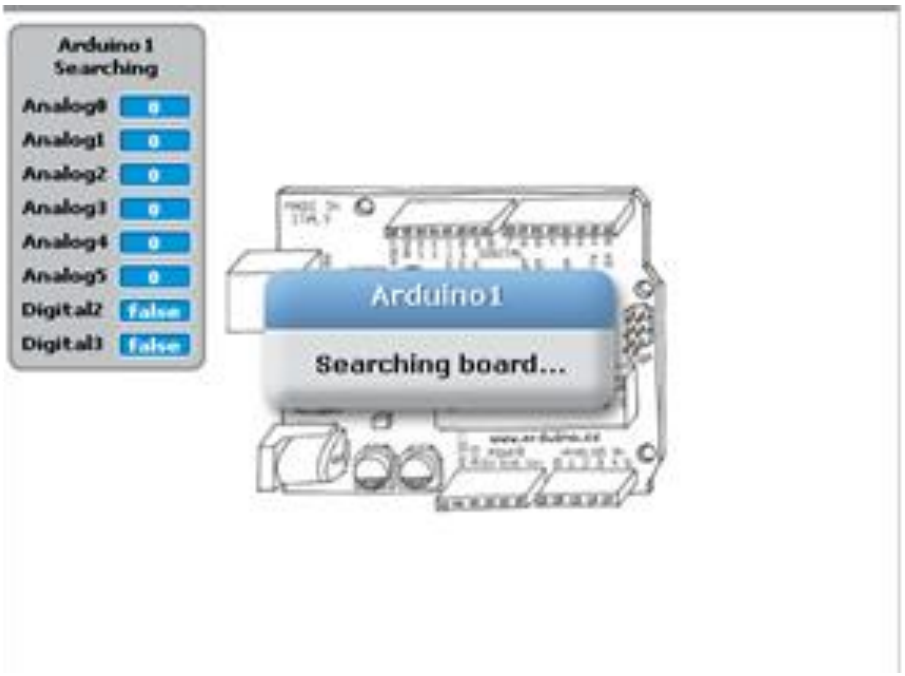


2.5. Check if the connection to the Arduino board is correct

2.6. If the connection was successful, the S4A program screen will appear as shown in the image above

or

If, after waiting a few seconds, you find the following figure:

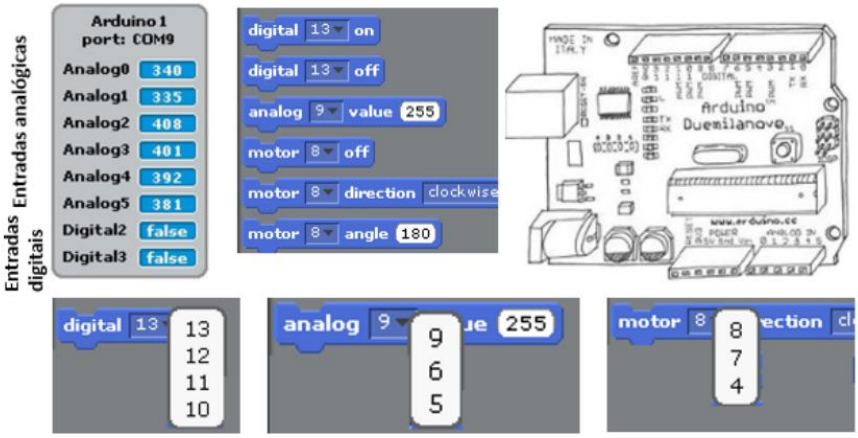


- It is because, the board is not well connected.

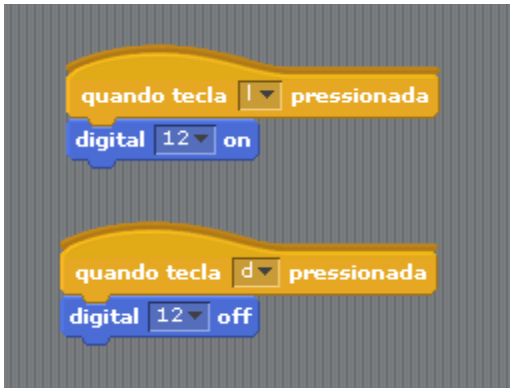
To check the card's connection to the PC's port:

- Open the Control Panel;
- Slide manager;
- Ports – check if there is a port connecting to the Arduino;
- Trick: Unplug the USB cable and plug it back in to see if any ports are added;
- Back to S4A.

Analog and digital signal



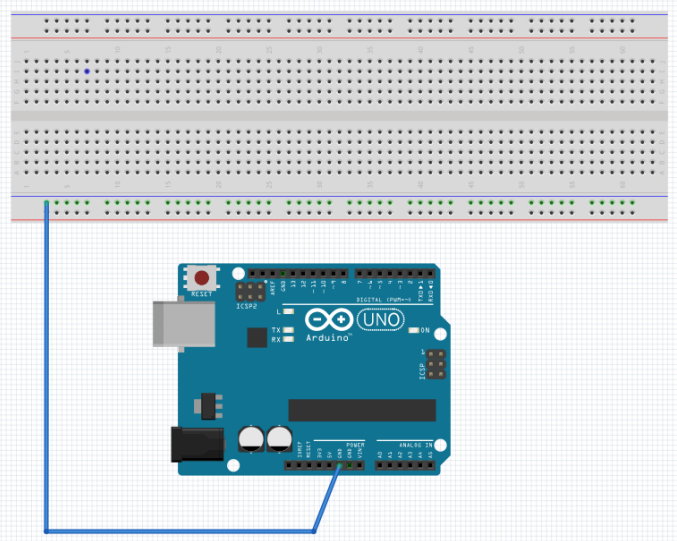
2.7. Program



3. Flash two lights at once - Ground wire connection (Pin GND)

Problem: We have a problem because we only find 2 GND pins on the arduino board and if we put several components we need several GND pins.

Resolution: We make a connection between a GND pin and the breadboard on the blue horizontal line. Thus, all pins of the blue horizontal line are fed with GND.



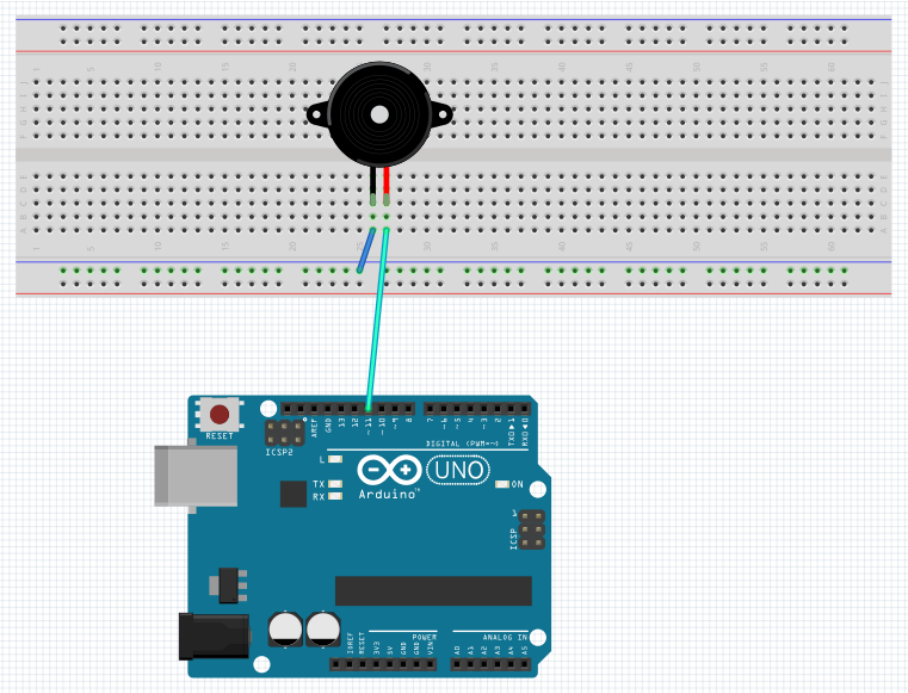
4. Flash two alternating lights

5. Flash three alternating lights

6. Sound the horn when the red light flashes

6.1. BreadBoard connection to the GND pin

6.2. Buzzer Link

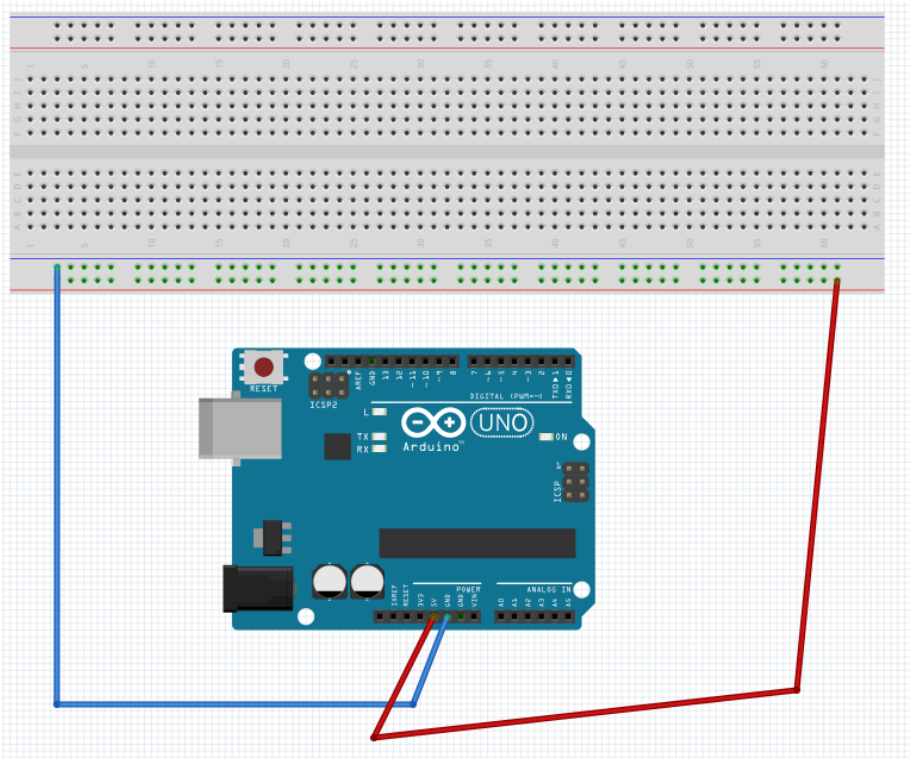


7. Turn on the ultrasonic sensor to turn on a light when approaching an obstacle.

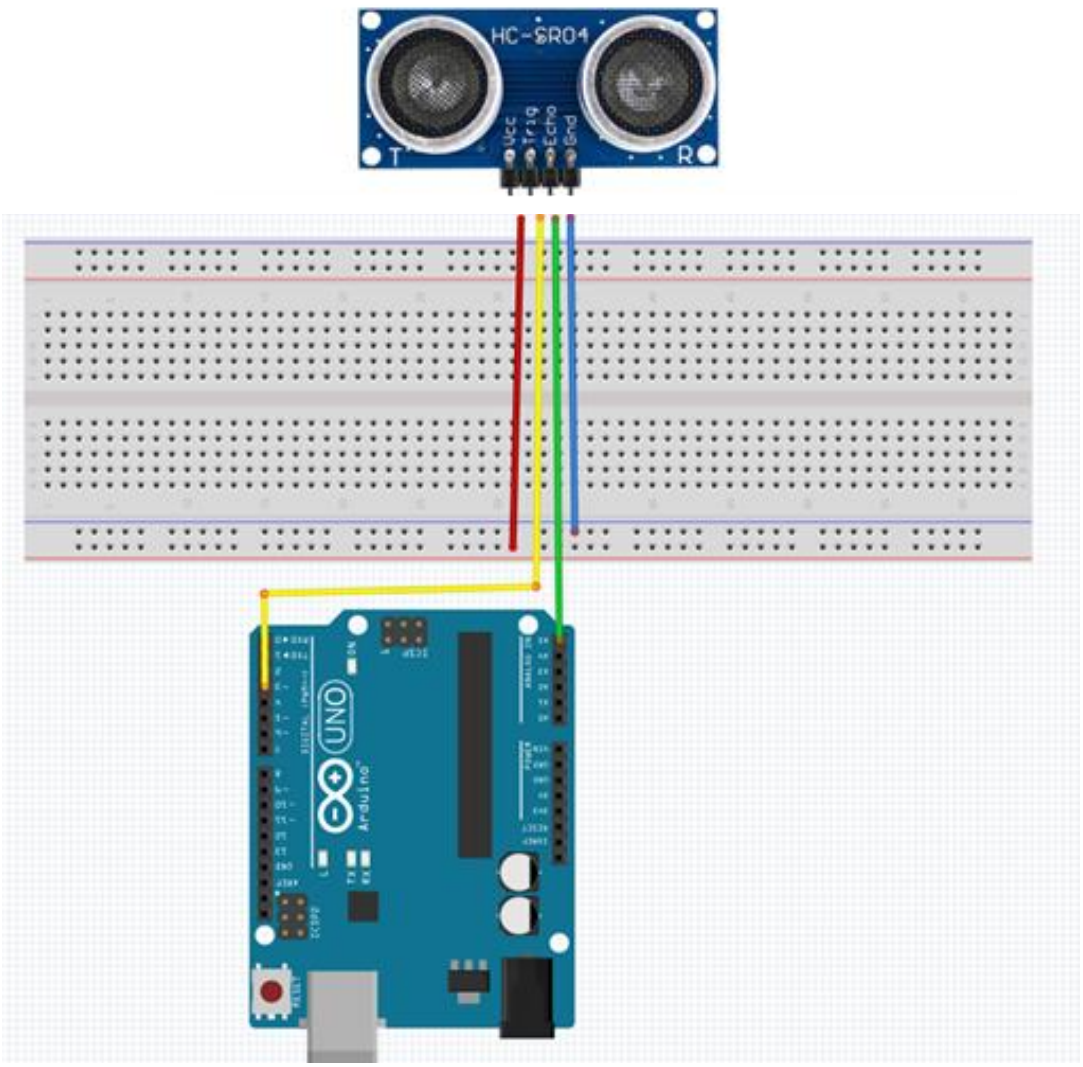
7.1. Connecting the wires to Pin 5V

Problem: We have a problem because we only find 2 pins 5V on the arduino board and if we put several components we need several pins 5V.

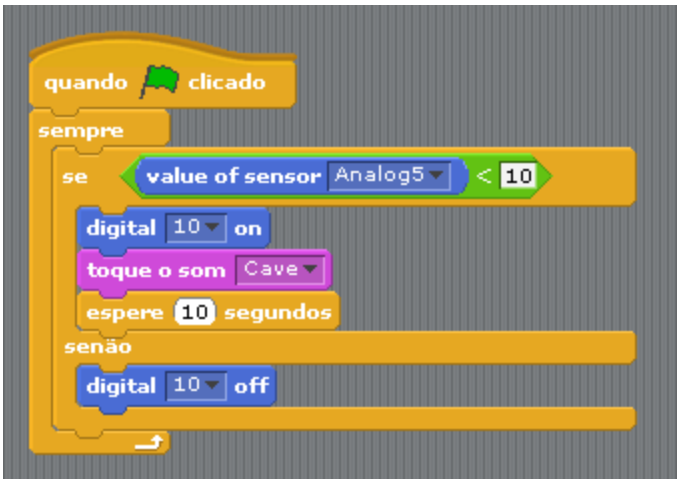
Resolution: We make a connection between the 5V pin and the breadboard on the red horizontal line. Thus, all pins of the horizontal red line are supplied with 5V.


RESET
ICSP2
UNO
Arduino
ON
TX
RX
DIGITAL (PWM~)
POWER
ANALOG IN

7.2. Turn on the ultrasonic sensor



7.3. Programming



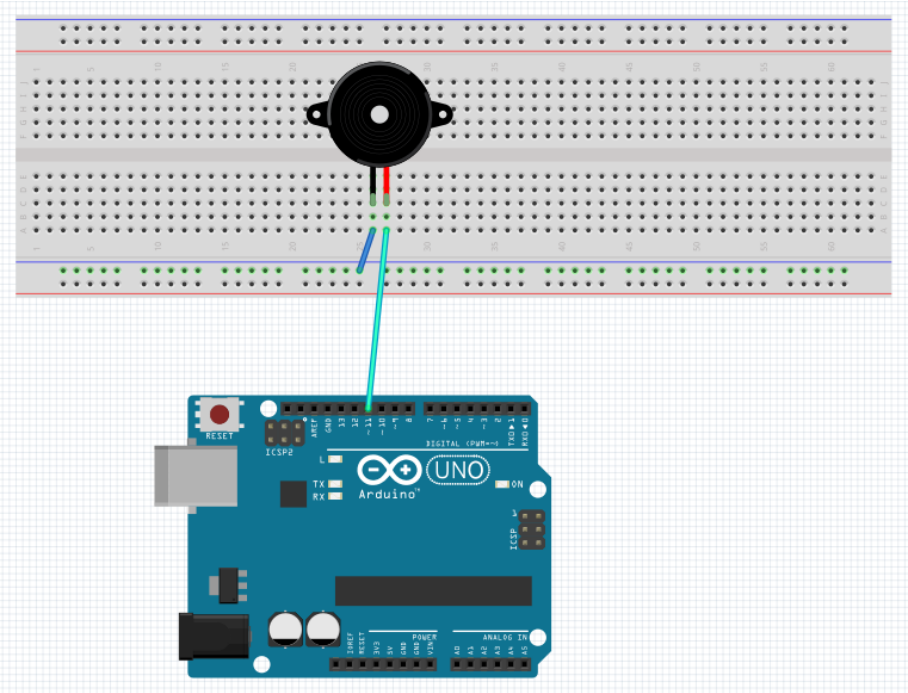
8. Ring the bell when clicking the button

8.1. Assembly of the structure (put the photos in the presentation as evidence of the next steps)

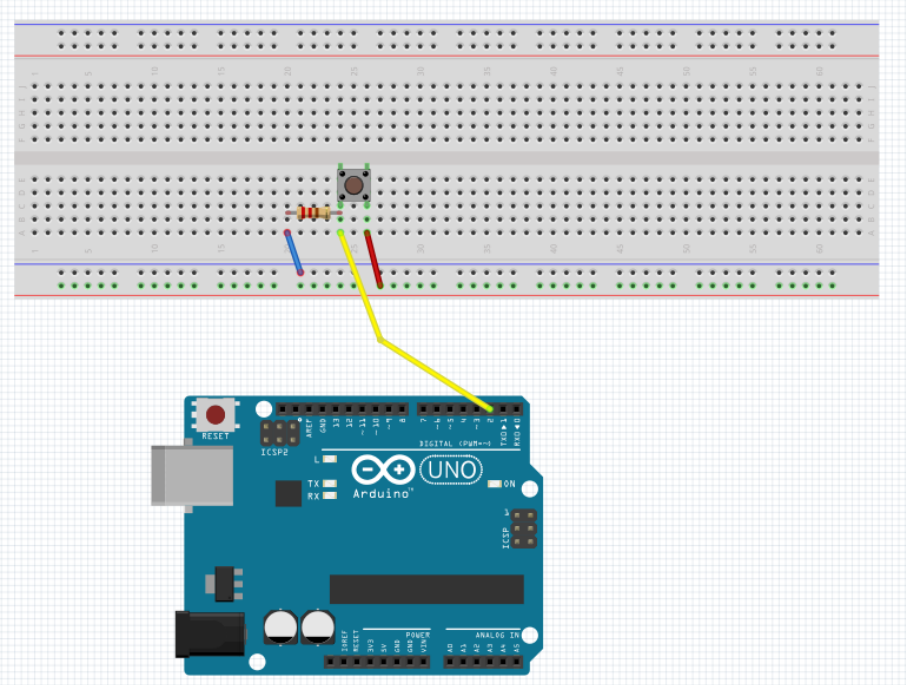
8.2. BreadBoard connection to the GND pin

8.3. BreadBoard connection to pin 5V

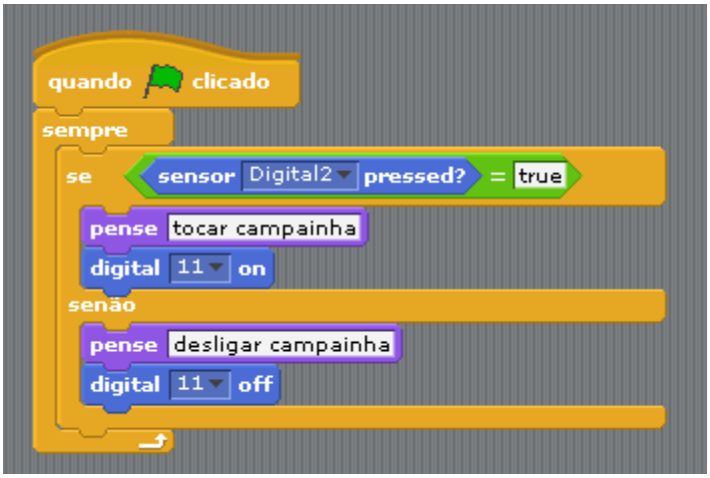
8.4. Buzzer Link



8.5. Button Connection



8.6. Programming



9. Turn on two lights for 5 seconds - when clicking the button, in addition to ringing the bell. The lights turn off when you press the space bar

9.1. Make the connections

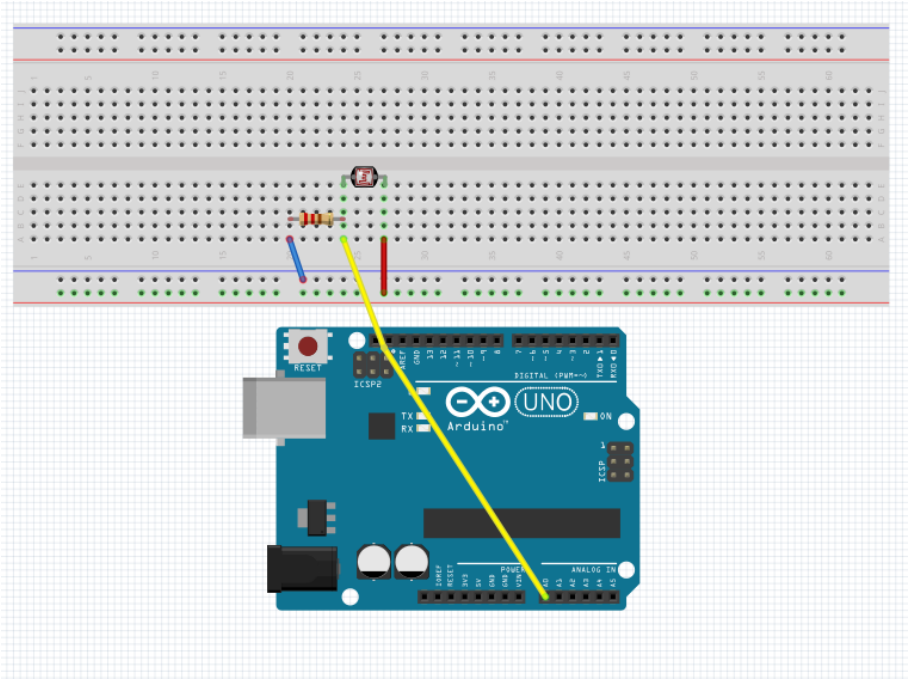
9.2. Program

10. Control home light using light sensor - When it is daytime (there is light the light turns off). When night comes, the light turns on

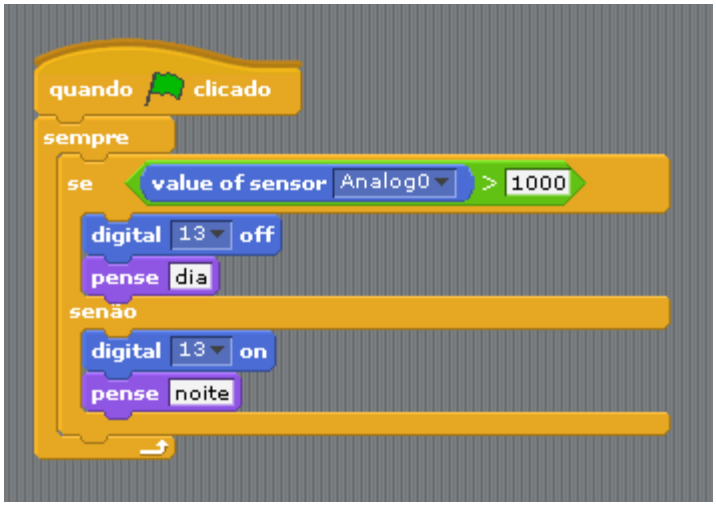
10.1. Assembly of the structure (put the photo in the presentation as evidence of the next assembly).

10.2. LED connection.

10.3. Brightness sensor connection



10.4. Programming



INKSCAPE

Inkscape is a Free and open source vector graphics editor for GNU/Linux, Windows and macOS.

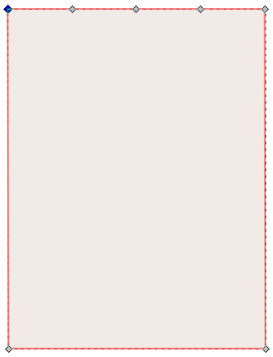
Objective: Use various Inkscape tools to create an ice cream.

1. First, let's start by drawing a rectangle, for that click on the Rectangle Tool icon  and draw a rectangle on the page.

2. Select the rectangle and access the menu Path – Object to path.

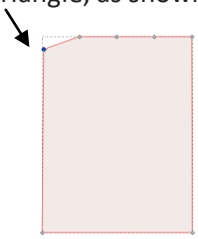
3. Click on the icon – Edit paths by nodes. 

4. Insert new nodes through the icon  so that it looks like the image:

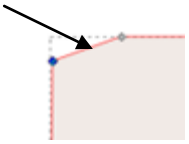


5.Round the upper corners with the help of the icon – 

First pull the node slightly downwards so that it looks like a triangle, as shown in the picture

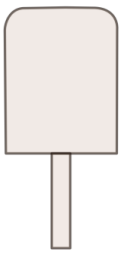


Then in the middle of the line, pull up to round



Do the same for the same for the right side.

6. Draw another rectangle to make the ice cream stick.

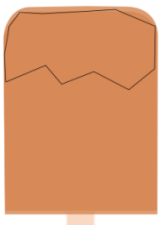


Proceed with the same steps as above to round the stick at the bottom.

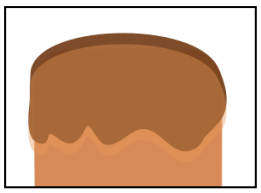
7. Proceed to painting the ice cream and stick at your discretion.

8. Press CTRL+D to duplicate the ice cream to create a 3D effect.

9. Create an overlay with the Bézier icon.



10. Round and straighten the nodes to look like the picture. You can also double the coverage.

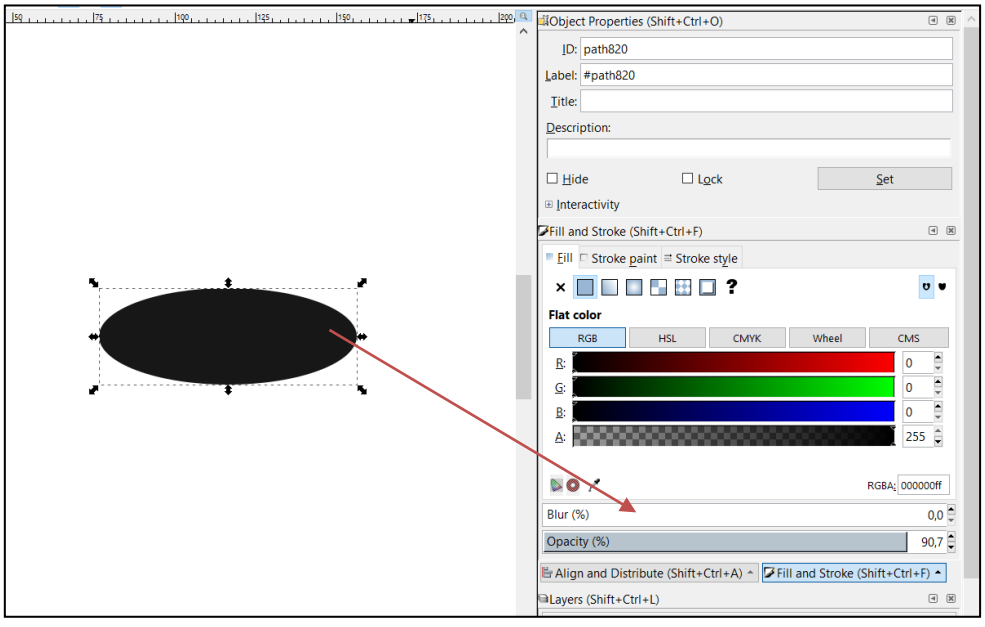


11. Duplicate the stick to give it a 3D effect.

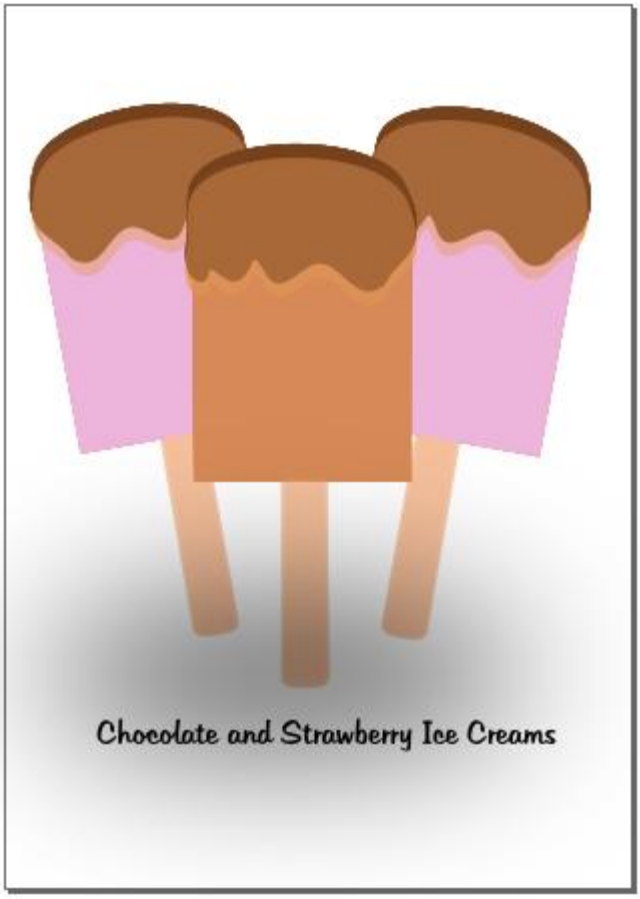
12. Select all and group the object. (Object – Group)

13. Duplicate the ice cream and change color. You should have 3 ice creams. (as shown in the image below)

14. Make a black circle and apply the blur.

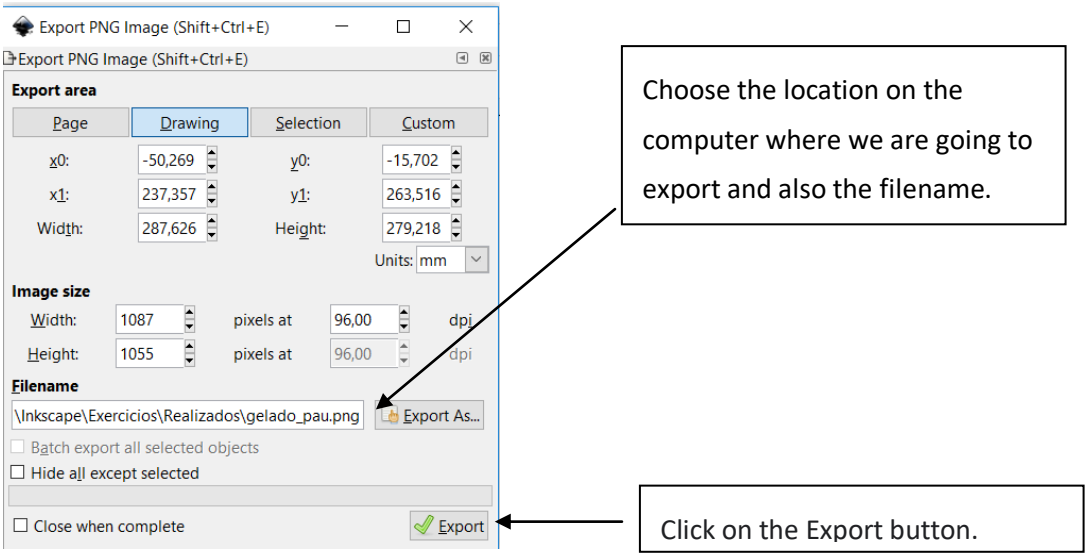


15. Write something at your discretion, according to the image.



17. Save your work, with the name of ice cream (File –Save).

18.Export your file to PNG format (FILE- Export to PNG Image).



STEAM Education Develops in 21st Century Schools

STEAM LESSON PLAN

Title: English Lesson about Space Exploration

Author: Susana Matos

Abstract

English lesson about space exploration, topic included in the module about technology. The skills that are developed in this lesson are the following: speaking, use of English (vocabulary), listening comprehension and writing.

Keywords

English, ESL, Technology, Space exploration

Licenses

The work presented in this document has received funding from the European Union's ERASMUS + KA229 numbered 2020-1-BE02-KA229-074698 'STEAM education develops in 21st Century Schools' School Strategic Partnership project and neither the EC or EUN are responsible for any use that might be made of information contained.

Summary table

Subject	*English*
Topic(s) within the subject	*Technology, Space Exploration*
Key real-life topic	*Technology*
Age of students	*15-18*
Preparation time	*1 hour*
Teaching time	*90 minutes*
Online teaching material	*Padlet, Thinglink, WordWall, YouTube*
Offline teaching material	*Worksheet*

Integration into the curriculum

English subject – 10th grade (professional courses)

Module 3 – "The Technologic World". Subtopic "Future living: space exploration"

Aim of the lesson

Speaking;

Learning new vocabulary about space exploration/solar system;

Listening comprehension of a song;

For fast learners, practice vocabulary.

Outcome of the lesson

- Worksheet – results after correction.

21st century skills

Learning and innovation skills: critical thinking and problem solving, communications and collaboration, creativity and innovation

Activities

Describe here in detail all the activities during the lesson and the time they require. Remember, that your lesson plan needs to correspond to real-world problems in STEAM education.

Name of activity	Procedure	Time
Introduction - Speaking	Explore the definition of space exploration (Padlet) from the *Encyclopædia Britannica*. Speaking activity giving opinion about the importance of space exploration. Space Exploration (padlet.com)	5 minutes
Milestones of Space Exploration	Understand the rivalry between the USA and the USSR – explore a bit of the history of space exploration: the first man to travel into space (Yuri Gagarin) and the first man to set foot on the Moon (Neil Armstrong). Watching the video of the Apollo 11 mission: Neil Armstrong - First Moon Landing 1969 - YouTube	10 minutes
Vocabulary revision: solar system	Revision of the vocabulary related to the solar system. SolarSystem (thinglink.com)	5 minutes
Speaking activity	Look at the photograph of an astronaut in outer space. Speaking activity- Answer a few questions, such as: - How would you feel in outer space? - Would you like to be an astronaut? - What kind of tasks is an astronaut supposed to do? - What could go wrong?	15 minutes
Listening	Listen to the song "Space Oddity" by David Bowie and answer the questions on the worksheet. David Bowie – Space Oddity (Official Video) - YouTube	40 minutes
Vocabulary (for fast learners)	If there is some time left, have fun completing the following activities: https://wordwall.net/resource/57145389 https://wordwall.net/resource/57144769 https://wordwall.net/resource/57145872	5 minutes

Assessment

Speaking – register gride

Listening – results of the worksheet

Student feedback

The students enjoyed this class very much.

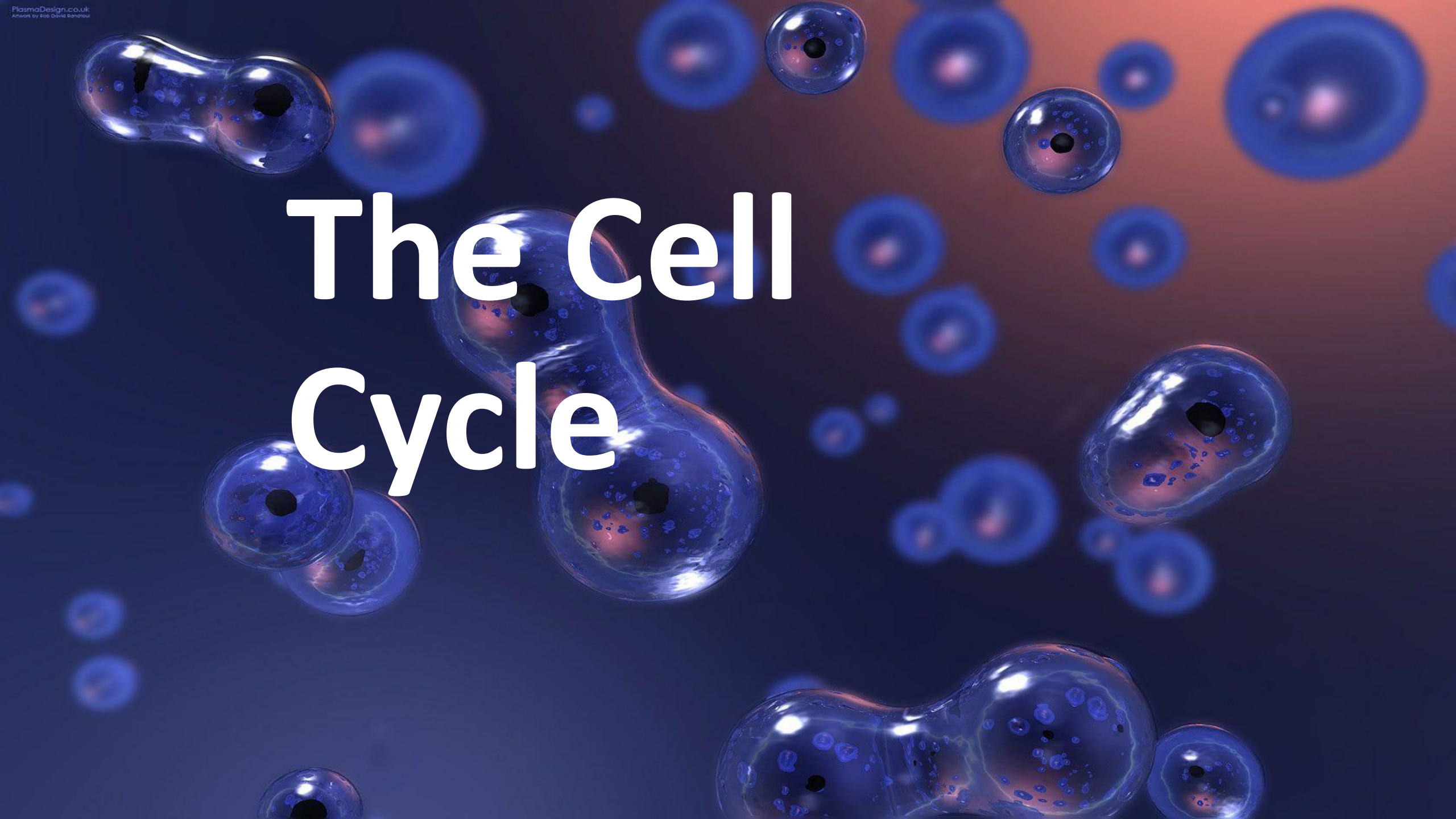
Cell Growth & Reproduction

On a sheet of paper:

1. **Write** what you think meiosis and mitosis means.
2. **Describe** how they are related.
3. **Explain** why they are important.

Sit quietly and prepared until further instruction.

~ Thank you!



The Cell Cycle

What Is It?

- Can be thought as the **life cycle** of the **cell**.
- It is an ordered series of events involving cell growth and development steps a cell undergoes to make new daughter cells.
- It is a cycle rather than a linear pathway.

Cell Cycle

Also known as: **Cell Division**

The process in which a parent cell divides into **two or more** daughter cells.

Eukaryotes have two major types of cell division: **mitosis** and **meiosis**.

- **Meiosis** is used to produce **gametes** (sex cells – eggs and sperm).
- **Mitosis** is used to produce **somatic** (non-sex) cells for growth and healing throughout the body.

Prokaryotes (bacteria) undergo a type of cell division known as **binary fission**, where their genetic material is separated **equally** into **two** identical daughter cells.

All cell divisions, regardless of organism, are preceded by a **single** round of **DNA replication**.

Mitotic cell division enables sexually reproducing organisms to develop from the one-celled **zygote** (a fertilized ovum).

After growth, cell division by mitosis allows for continual construction and repair of the organism.

The human body experiences about
10 quadrillion cell divisions in a lifetime.

MEIOSIS

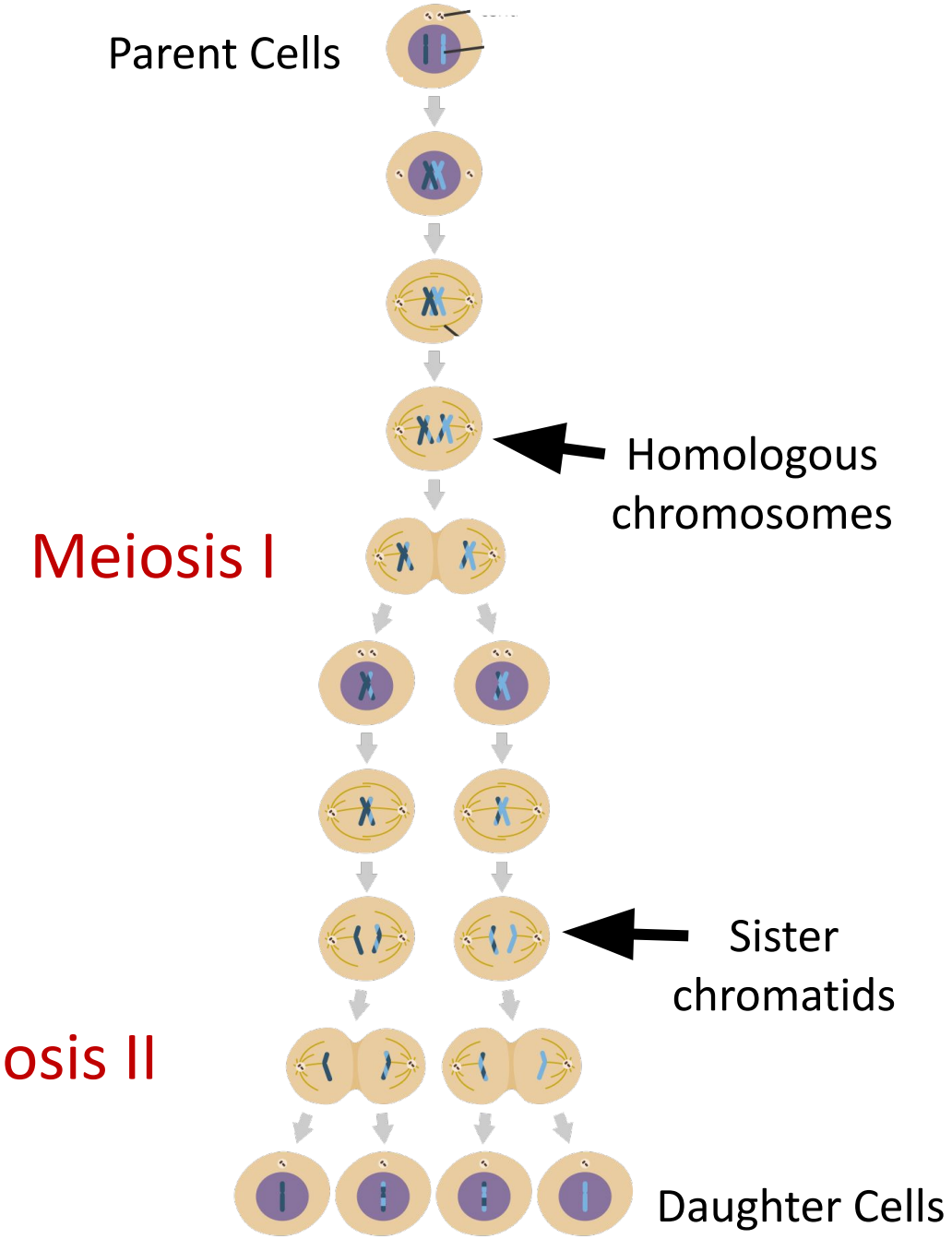
Mei = Sex

- Meiosis makes _gametes_ or **germ cells** (sex cells).
- Occurs in the testes and ovaries.
- Results in **haploid** (4) non-identical daughter cells.
- Daughter cells contain **half** the number of chromosomes as the original cell.

Meiosis results in **four** haploid daughter cells by undergoing one round of DNA replication followed by the two divisions.

Homologous chromosomes are separated in the first division, and **sister chromatids** are separated in the second division.

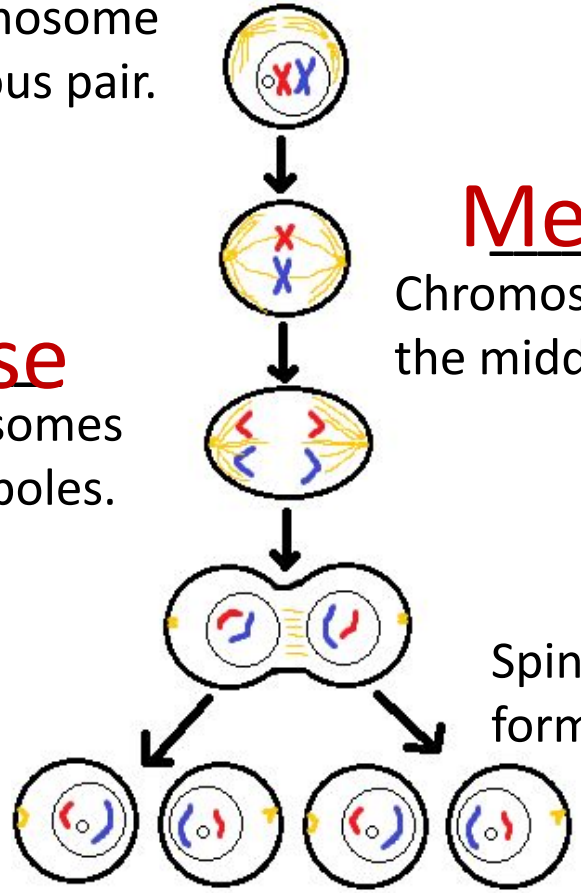
- **Parent** cells (4n) have **92** chromosomes after duplication.
- **Daughter** cells (2n) have **46** chromosomes.



Stages of Meiosis

Prophase

Cells have one chromosome from each homologous pair.



Metaphase

Chromosomes align at the middle plate.

Anaphase

Daughter chromosomes move toward the poles.

Telophase

Spindle disappears, nuclei form, and cytokinesis begins.

Cytokinesis

Meiosis results in haploid (4) daughter cells.

Crossing Over

Crossing over occurs only during **prophase** of meiosis.

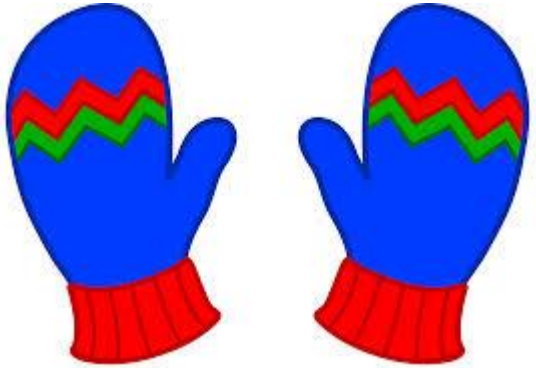
Crossing over is the **swapping** of **genetic material** that occurs in the **germ line**. During the formation of egg and sperm cells, also known as meiosis, paired chromosomes from each parent align so that similar DNA sequences from the paired chromosomes cross over one another.

- A **germ line** is the **sex cells** (eggs and sperm) that are produced to differentiate male and female gametes.

MITOSIS

Mit = Mittens

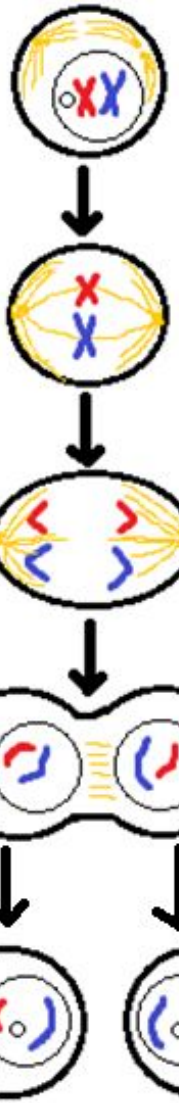
- Mitosis produces identical **somatic** (non-sex) cells.
- Results in **diploid** (2) daughter cells.



Stages of Mitosis

Prophase

Cells have one chromosome from each homologous pair.



Metaphase

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Cytokinesis

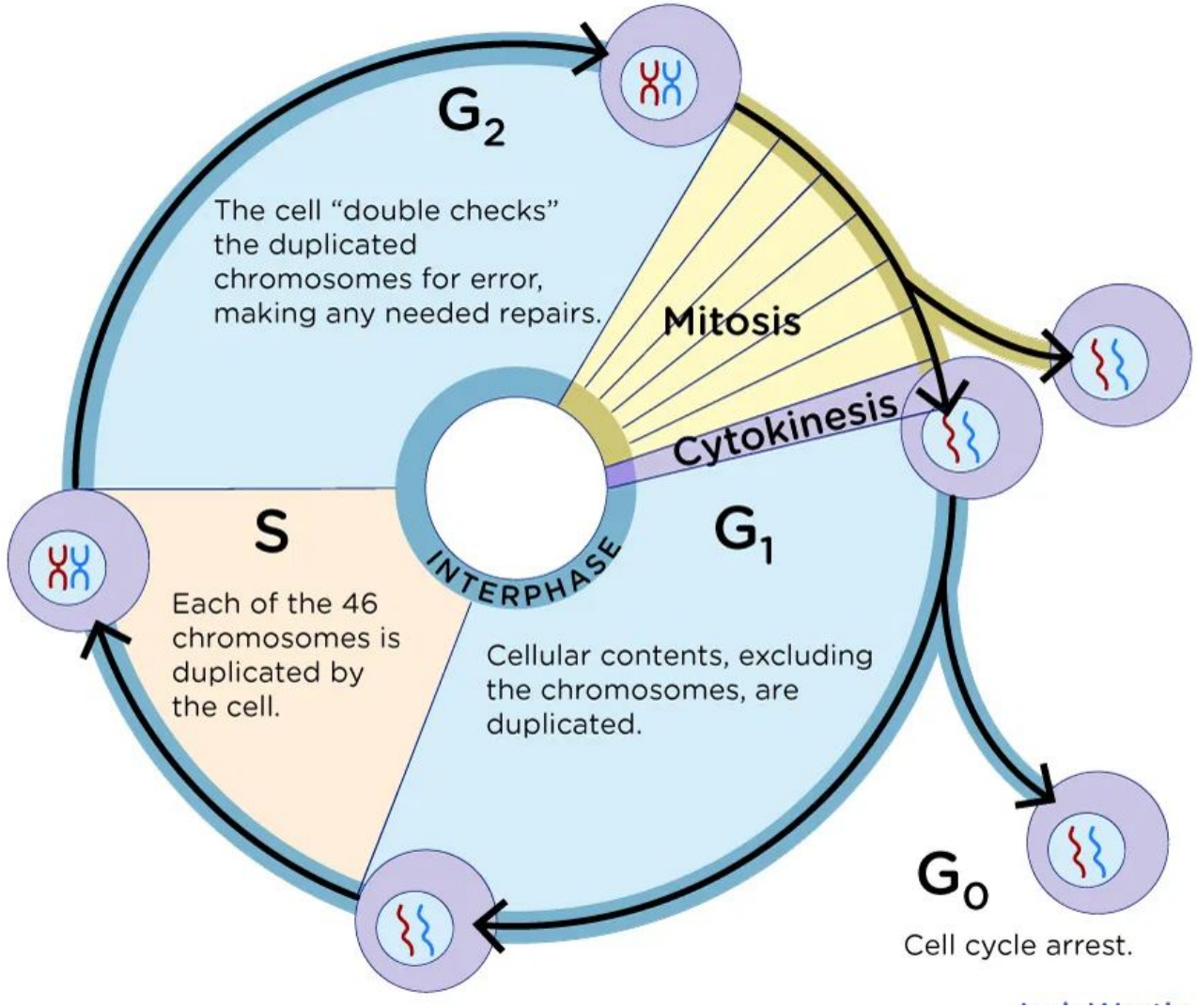
Meiosis results in diploid (2) daughter cells.

Interphase (pre-mitosis)

- The **chromosomes** are _duplicated_ just before mitosis, so there are **two** identical ('sister') copies of each one.
- This gives a total of 92 chromosomes (2 x 46).
- The **chromosomes** are invisible because they remain in their '_unwound_' state.
- The **centrioles**, a pair of cylindrical structures, are also **duplicated**.
- Each set of centrioles is surrounded by a tubule-making zone; these together make up a **centrosome**.

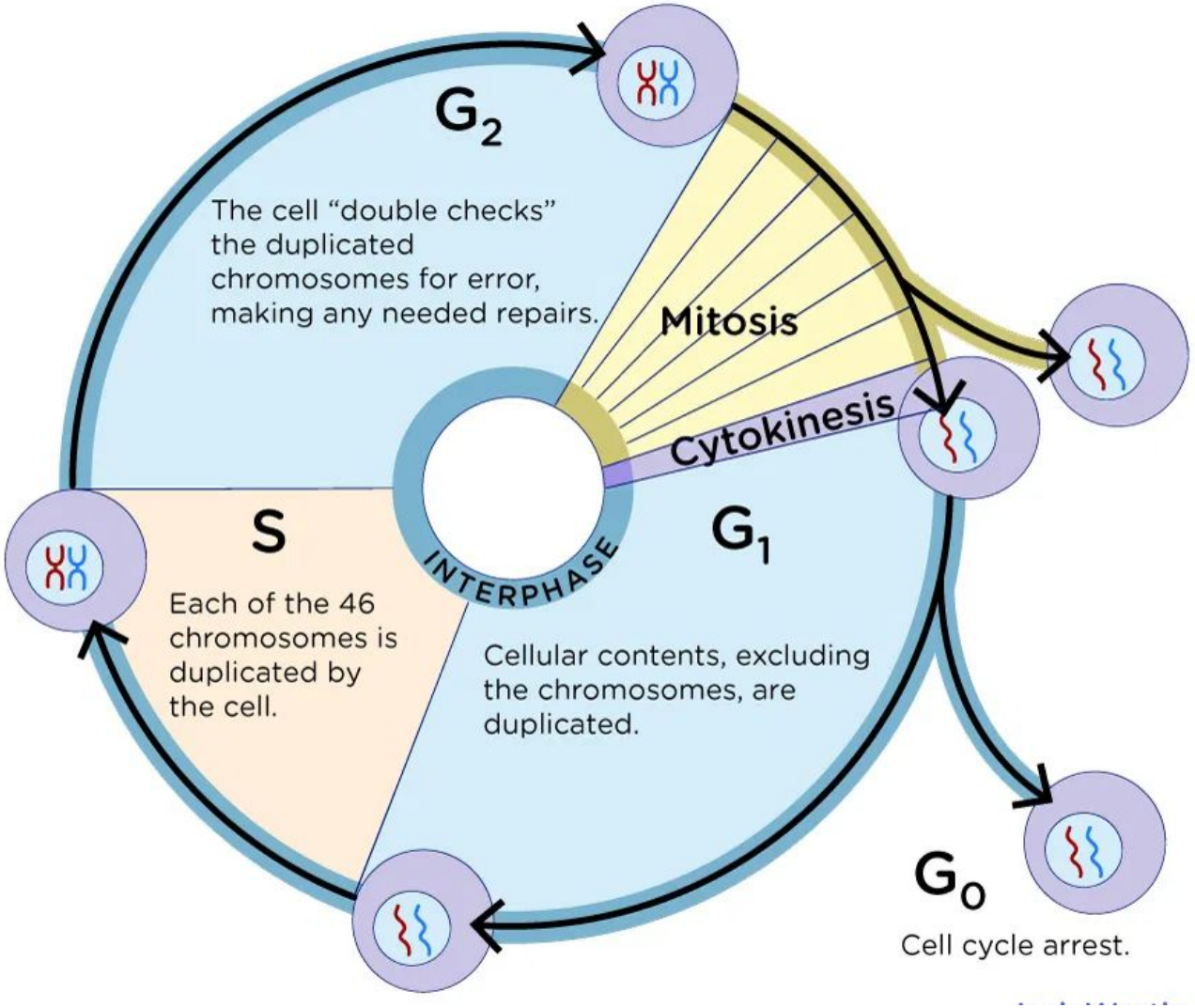
Interphase (G1)

- The **first gap** stage (G1) is the first step in interphase, hence the number 1 in the name.
- This phase is all about growing bigger.
- Cellular contents are duplicated.



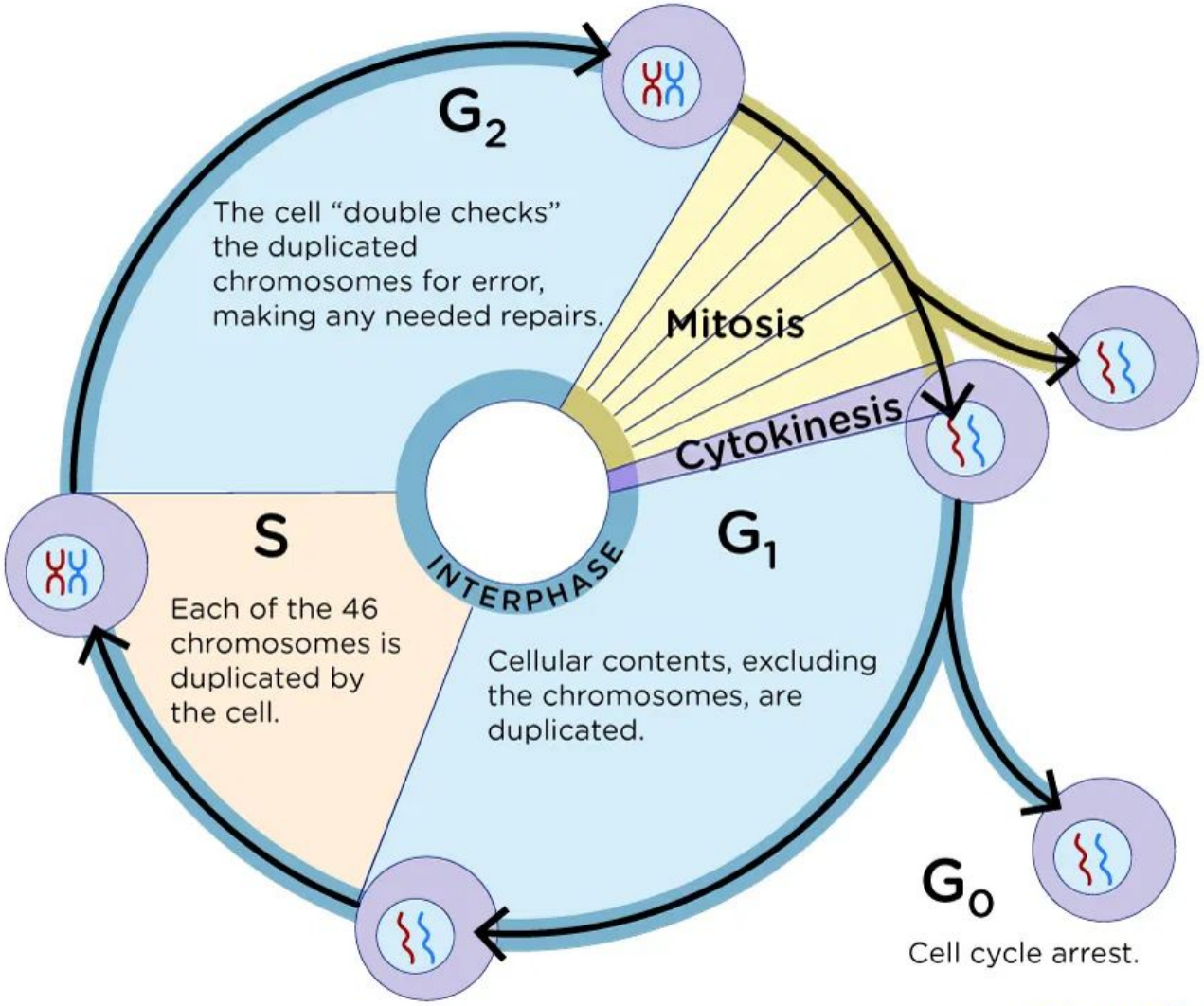
Interphase (S)

- Is responsible for the synthesis or _replication_ of **DNA**.
- In this way, the **genetic material** of a cell is **doubled** before it enters mitosis or meiosis, allowing there to be enough DNA to be split into daughter cells.
- Each of the 46 chromosomes is duplicated by the cell, resulting in a total of 92 chromosomes at this point of cell division.



Interphase (G2)

- Is the **shortest** phase of interphase. It is when organelles and proteins necessary for cell division are produced.
- The cell **requires** a bunch of **proteins** and other stuff to separate the chromosomes and divide the cell in half. All of these materials are **produced** during G2.
- The cell "**double checks**" the duplicated chromosomes for error, allowing for any needed repairs.



Nuclear Division

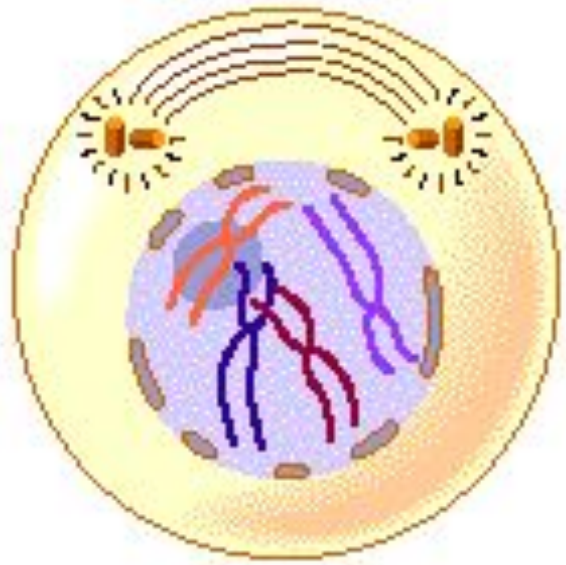
The process by which a **nucleus** __divides__, resulting in the **segregation** of the __genome__ to **opposite** poles of a dividing cell.

Nuclear divisions occur in both mitosis and meiosis.

- Prophase
- Metaphase
- Anaphase
- Telophase

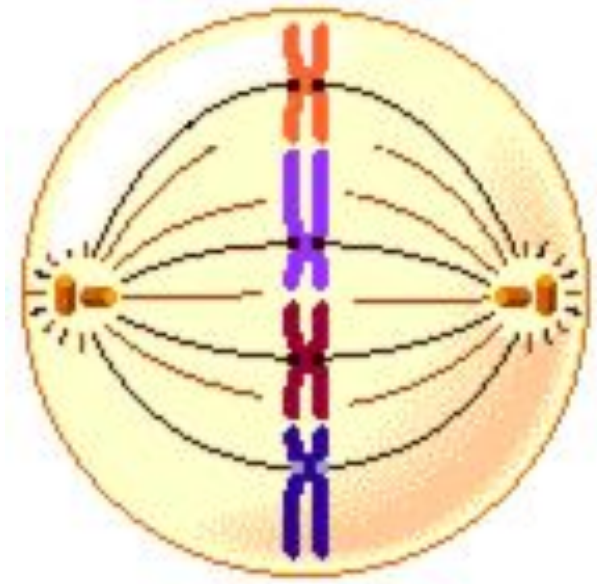
Prophase

- The chromosomes become visible.
- The two **identical** copies of each **chromosome** are called chromatids
- Each chromatid pair is joined together, forming an 'x-shaped' structure called a **metaphase** chromosome.
- The nuclear membrane, nucleolus, endoplasmic reticulum and Golgi complex break up.
- The **centrioles** move to **opposite** ends of the cell, and spindle fibers begin to grow out from them.



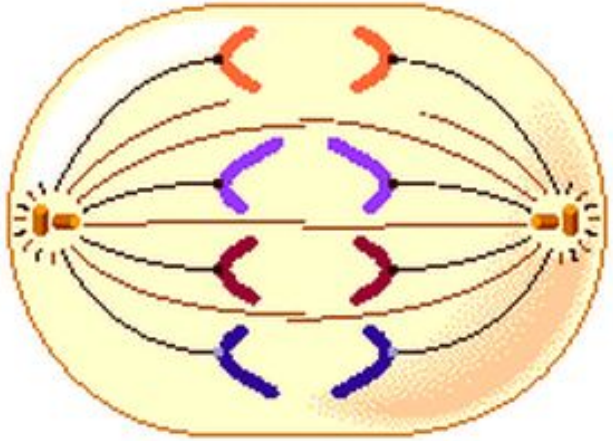
Metaphase

- The **chromosomes** are located at the ___middle___ of the cell.
- Spindle fibers **attached** to chromatids.



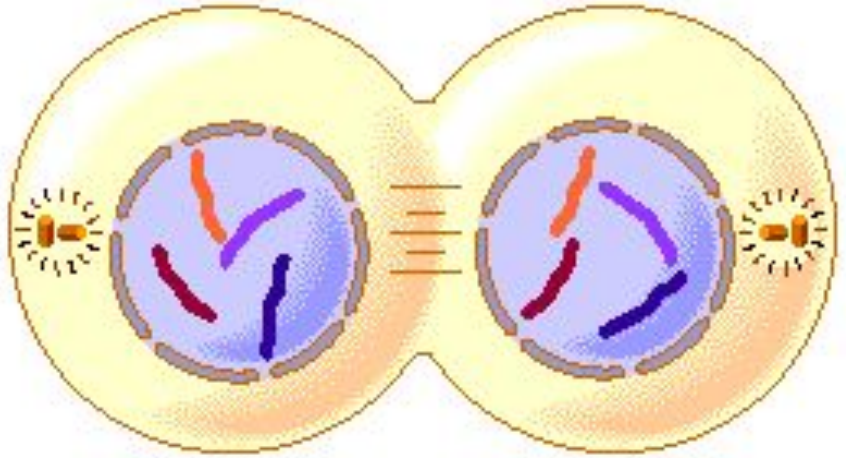
Anaphase

- The two **sister chromatids** are _____ and pulled to _____ ends of the cell.
- As a result, each of the daughter cells end up with **one** copy of every chromosome that was in the original cell.
- The cell begins to pinch inwards in the middle.



Telophase

- The two **sister chromatids** are now at **opposite** ends of the cell.
- At the site of the metaphase plate, the cytoplasm pinches inward.

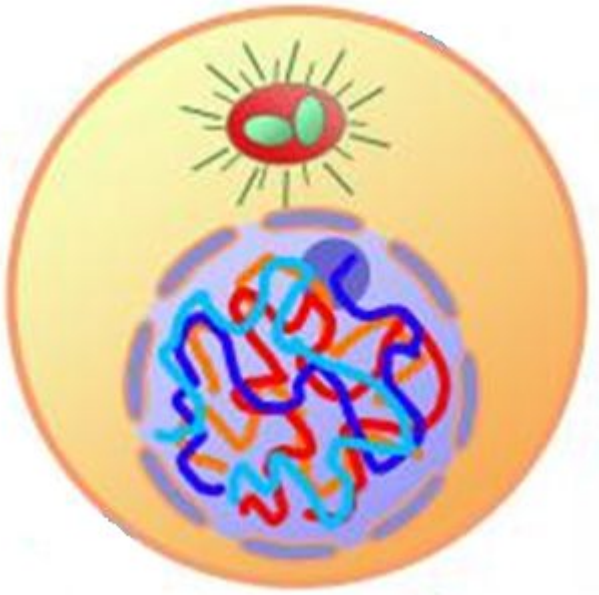


Cytokinesis

The **final stage** of cell division.

The result is two cells that are identical to each other and the original cell (mitosis), or four cells that are non-identical (meiosis).

In each new cell, the nuclear membrane and other organelles begin to re-assemble and the chromosomes are 'unwound’.



Steps of Cell Cycle

Interphase = I

Prophase = Prefer

Metaphase = Milk

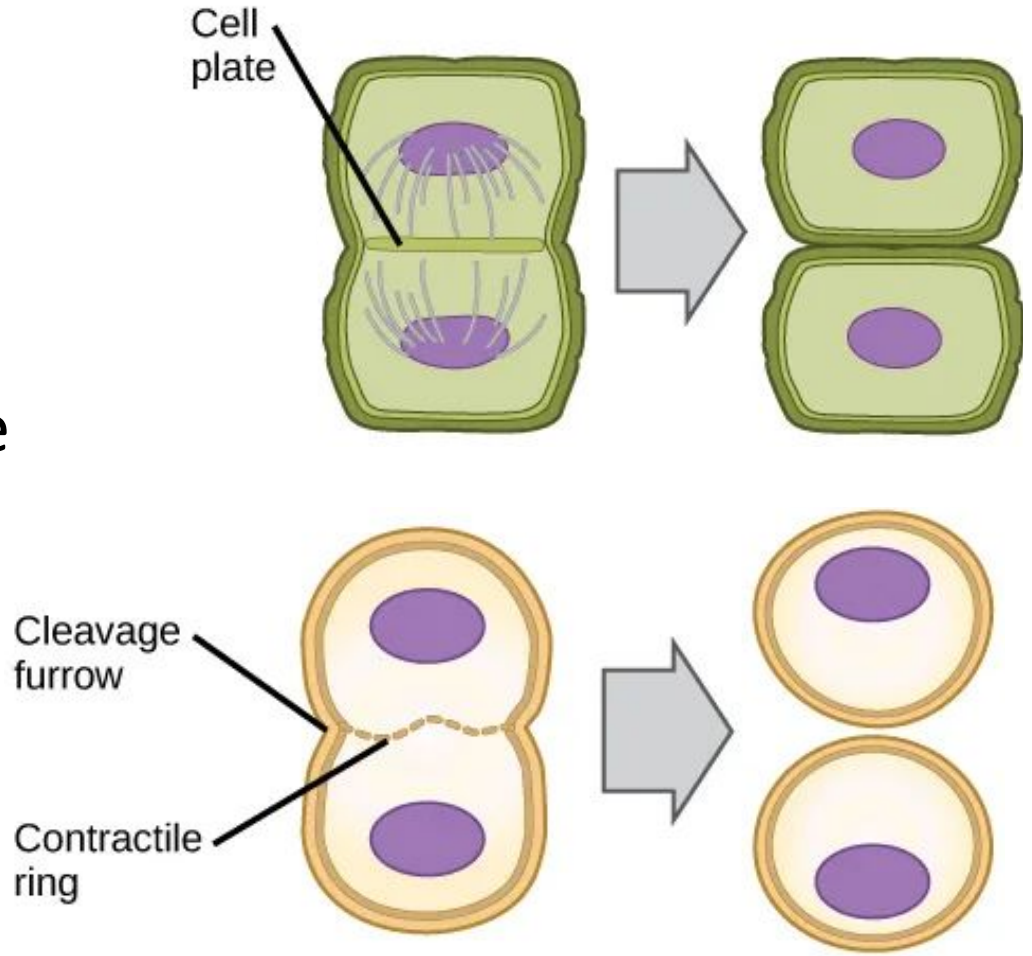
Anaphase = And

Telophase = Tea

Cytokinesis = Cookies

Cytokinesis (Plant vs Animal)

- **Plant** cells form a cell **plate** between the two daughter cells.
- **Animal** cells, a **cleavage furrow** and a **contractile ring** is formed between the two daughter cells.



3:01 https://www.youtube.com/watch?v=g7iAVCLZWuM

Importance of Cell Division

Mitosis and **meiosis** both involve cells **dividing** to make new cells. This makes them both vital processes for the existence of **living things** that reproduce sexually.

Meiosis _makes_ the cells **needed** for sexual _reproduction_ to occur, and **mitosis** _replicates_ **non-sex** cells needed for _growth_ and _development_.

Importance of Mitosis

Mitosis is important to **multicellular** organisms because it provides new cells for growth and for replacement of worn-out cells, such as skin cells.

Many **single-celled** organisms rely on mitosis as their primary means of **asexual** reproduction.

Importance of Meiosis

Meiosis is important because it ensures that all organisms produced via sexual reproduction contain the correct number of chromosomes.

Meiosis also produces genetic variation by way of the process of recombination.

DNA Replication

DNA replication is the process by which a **double-stranded DNA** molecule is **copied** to produce __two__ identical DNA molecules.

Replication is an essential process because, whenever a cell divides, the two **new daughter cells** must contain the __same__ **genetic information** (or DNA) as the parent cell.

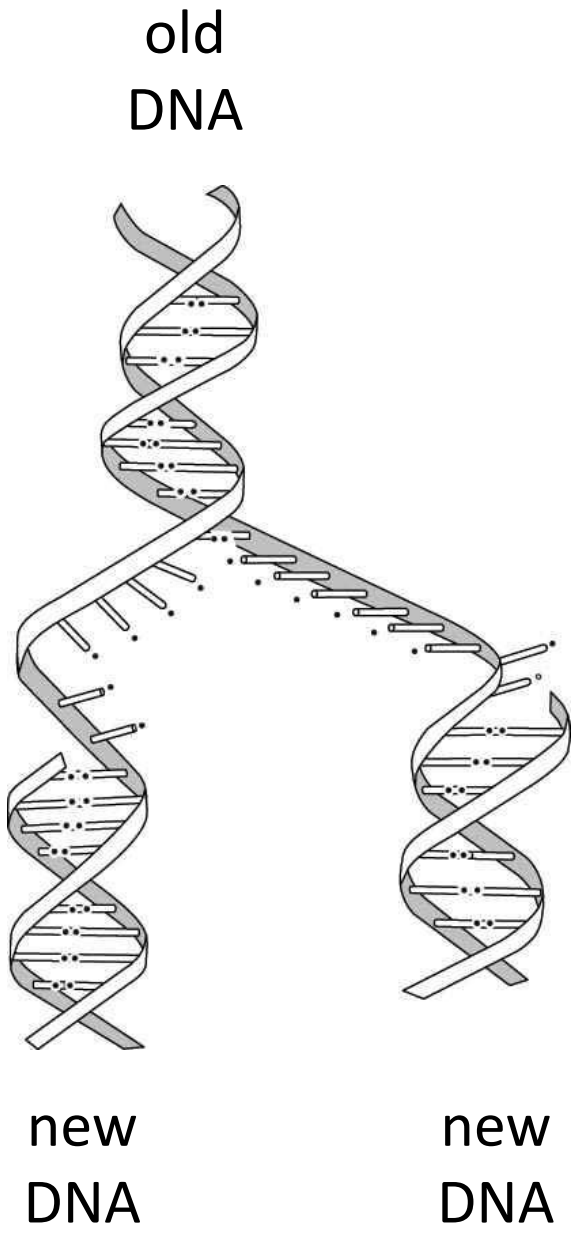
Replication occurs in three major steps: **the opening of the double helix and separation of the DNA strands, the priming of the template strand, and the assembly of the new DNA segment**. During separation, the two strands of the DNA double helix uncoil at a specific location called the origin.

Replication occurs in three major steps:

1. The opening of the **double helix** and separation of the **DNA strands**.
2. The priming of the **template strand**.
3. The assembly of the new **DNA segment**.

During **separation**, the two strands of the DNA double helix uncoil at a **specific location** called the origin.

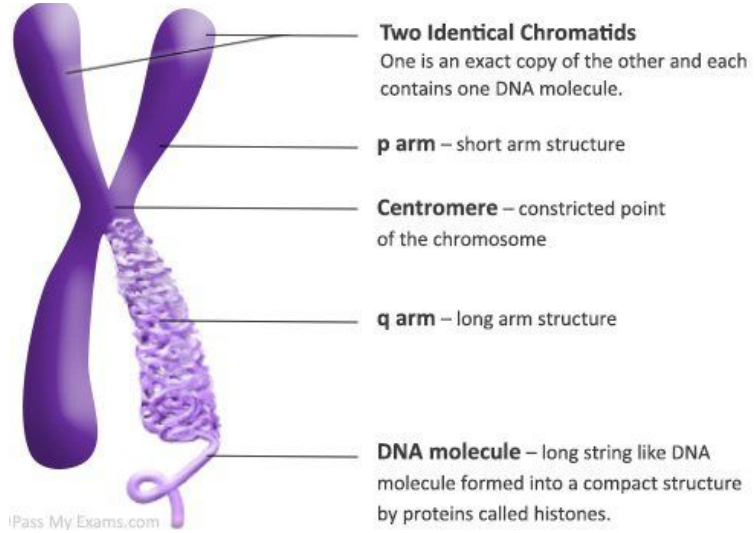
Copying a DNA segment into RNA is a process called transcription, and it is the **first step** in **protein synthesis**.

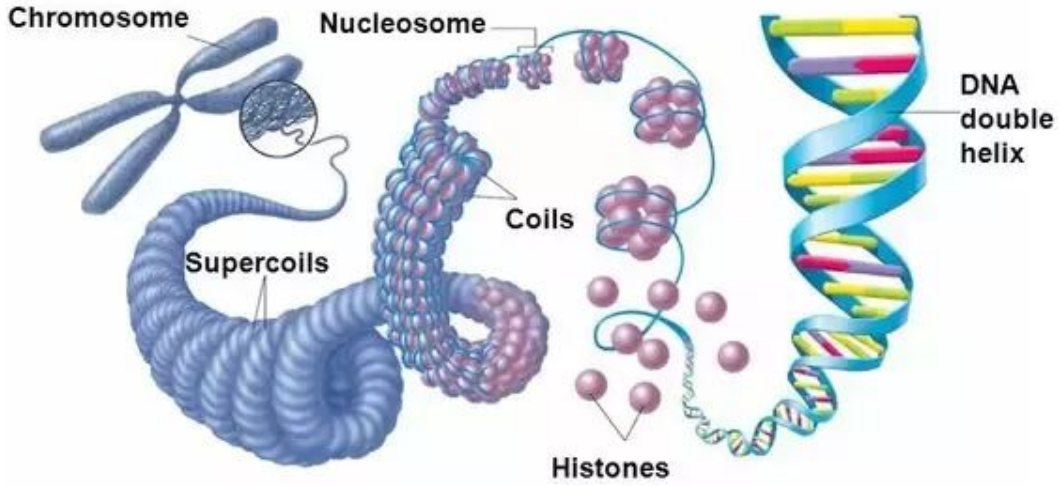


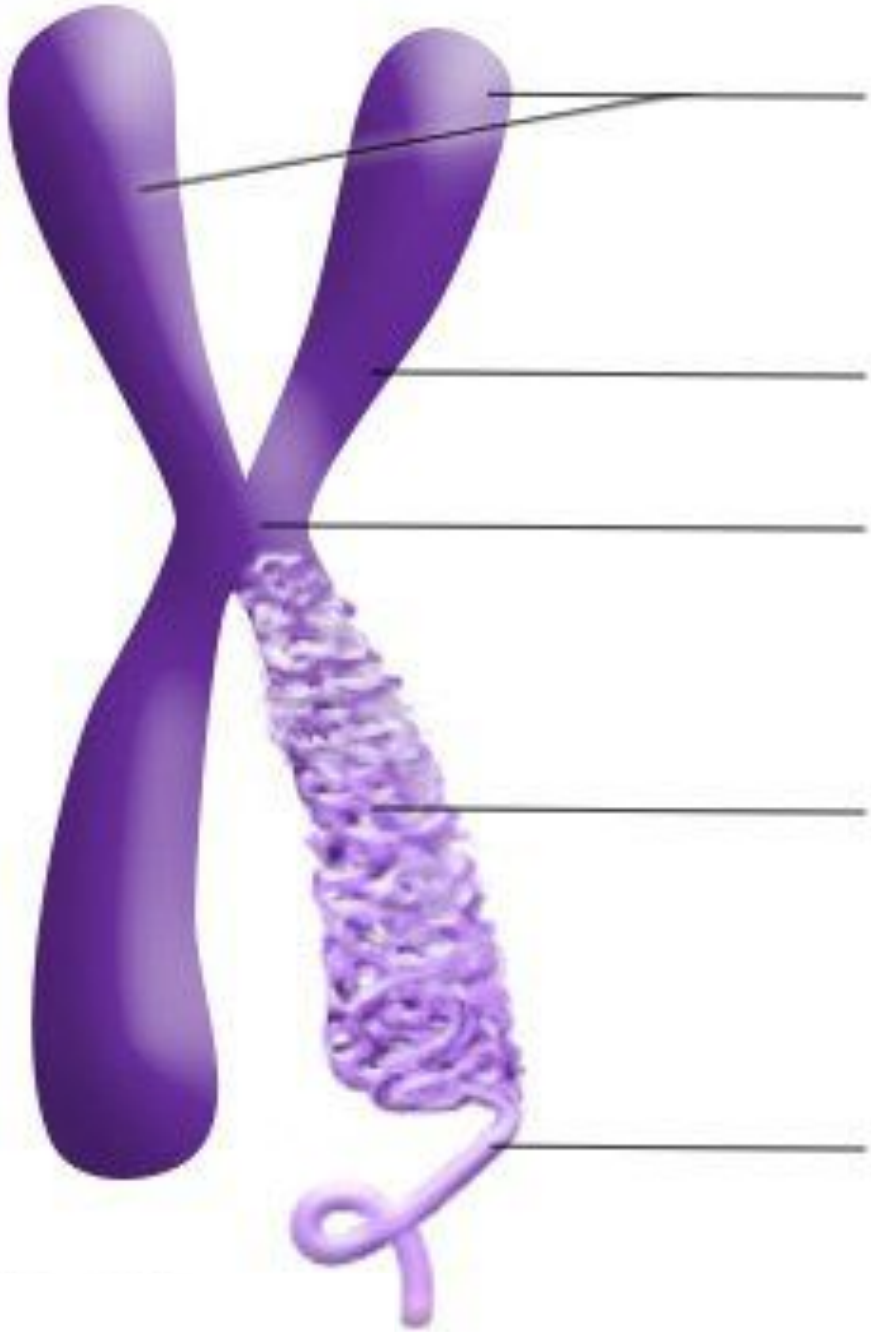
Chromosome Composition

The unique structure of chromosomes keeps DNA **tightly wrapped** around spool-like **proteins**, called __histones__.

Without such packaging, DNA molecules would be too long to fit inside cells.







Two Identical Chromatids
One is an exact copy of the other and each contains one DNA molecule.

p arm – short arm structure

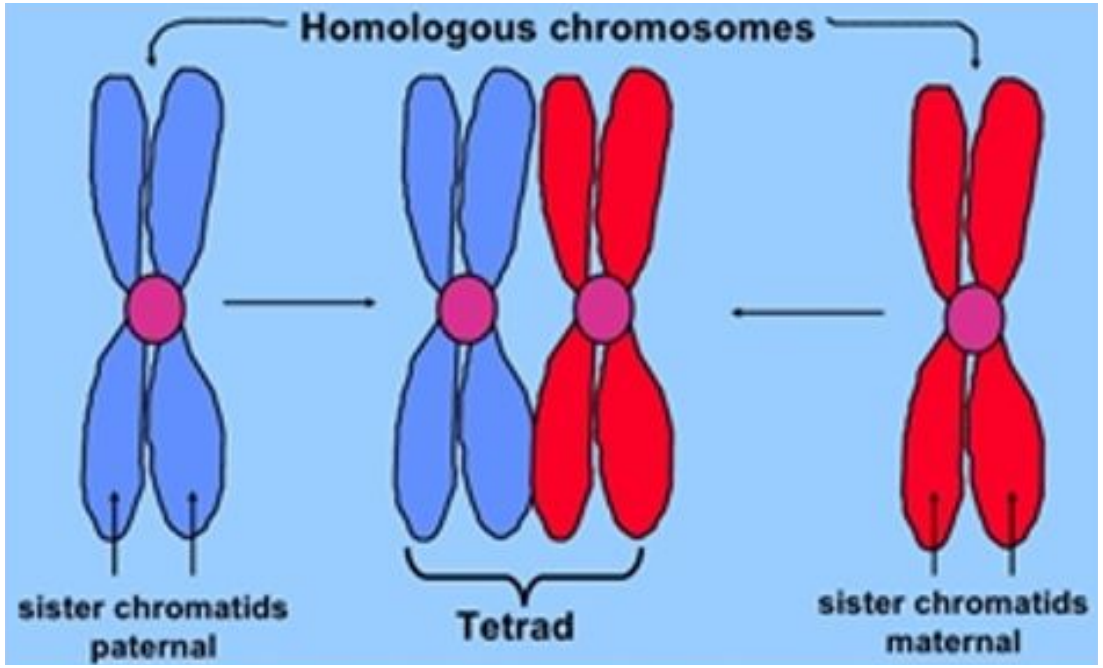
Centromere – constricted point of the chromosome

q arm – long arm structure

DNA molecule – long string like DNA molecule formed into a compact structure by proteins called histones.

Tetrad

Tetrad is a **group** of _four_ chromatids that make up two chromosomes.

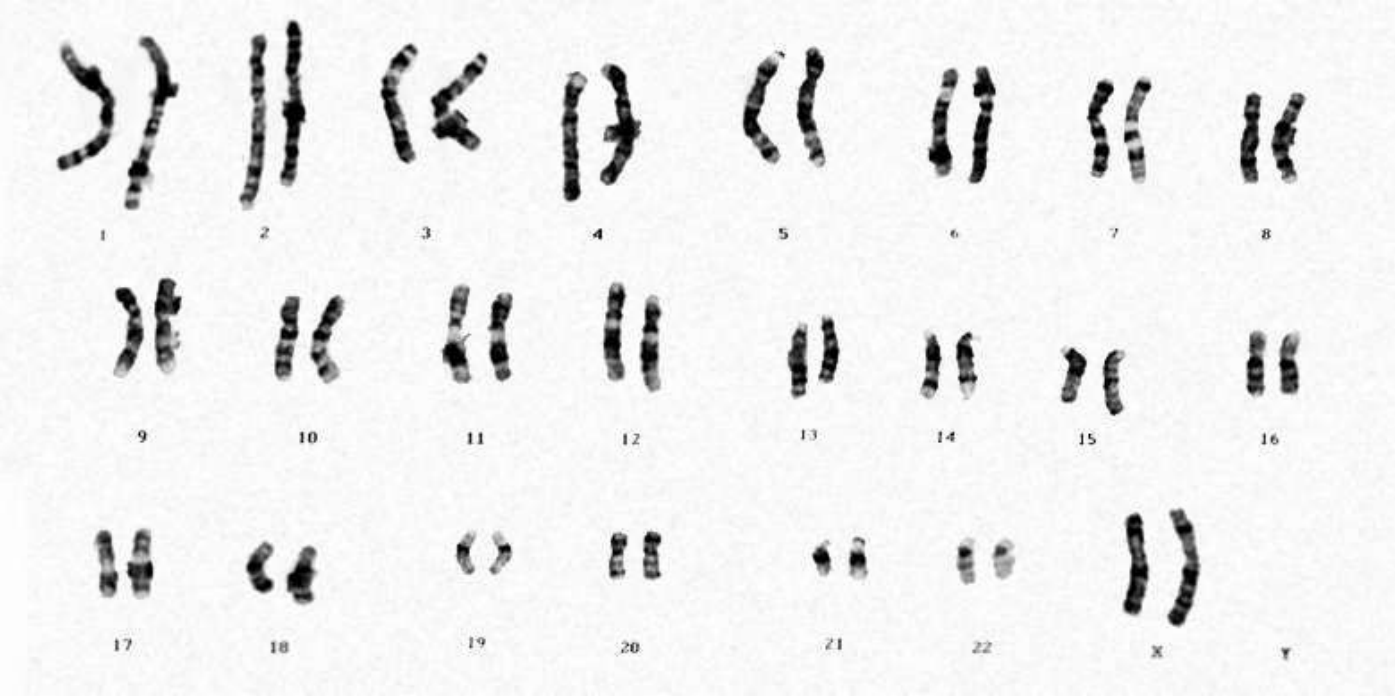


Chromosomal Mutations

- **Structural Abnormalities**: a chromosome's structure can be altered in several ways.
  - **Deletions**: a portion of the chromosome is missing or deleted.
  - **Duplications**: a portion of the chromosome is duplicated, resulting in extra genetic material.
  - **Translocations**: a portion of one chromosome is transferred to another chromosome.

Types of Chromosomal Mutations

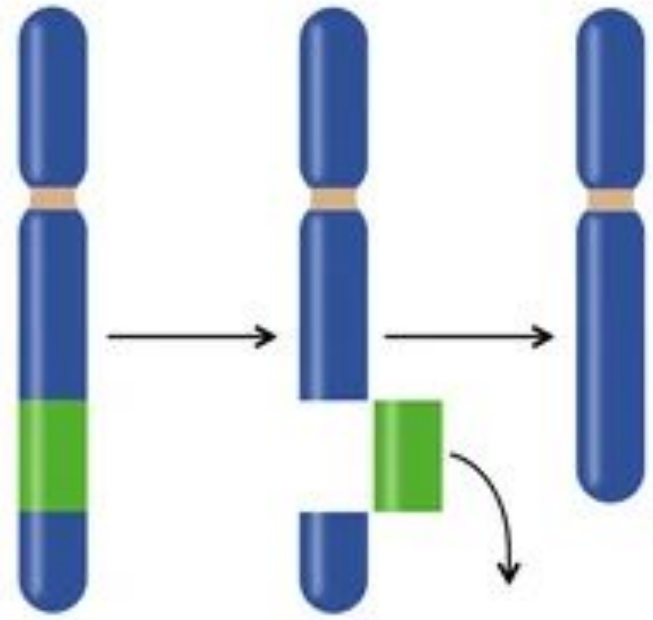
- Deletion
- Duplication
- Inversion
- Translocation
- Nondisjunction



Deletion

Part of a chromosome is missing.

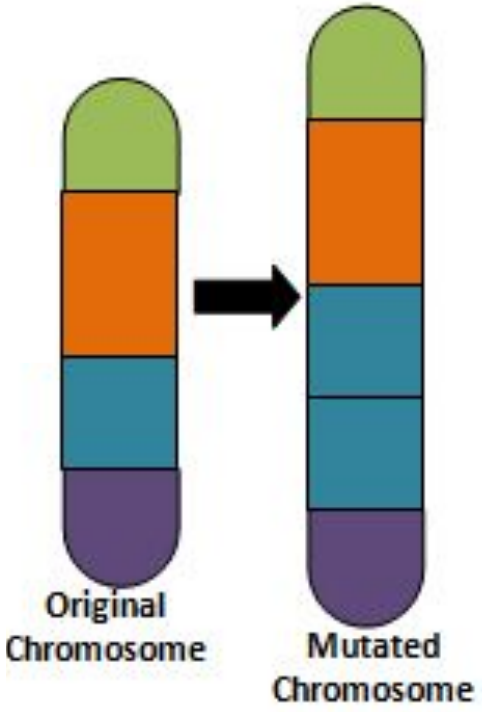
- Examples: Duchenne Muscular Dystrophy, Cystic Fibrosis

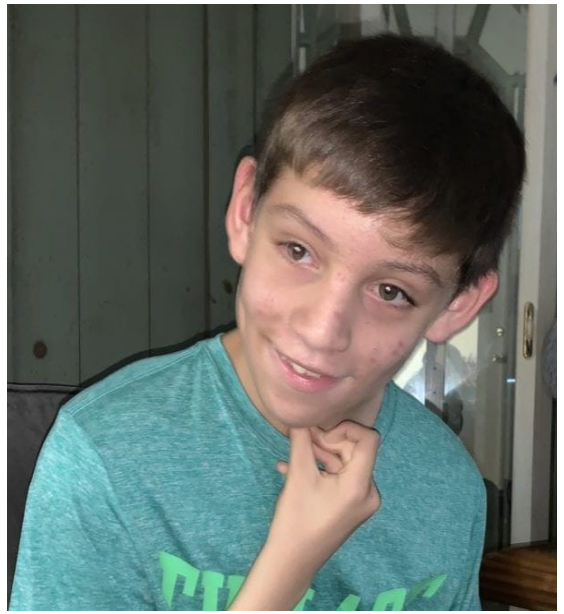


Duplication

Part of a chromosome is copied.

- Examples: William-Beuren Syndrome, MECP2

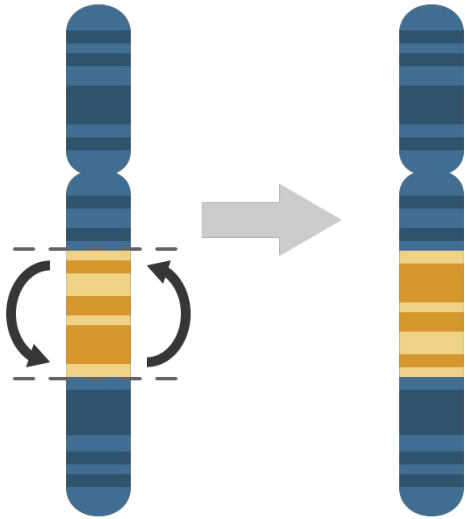




Inversion

Part of a chromosome reverses direction.

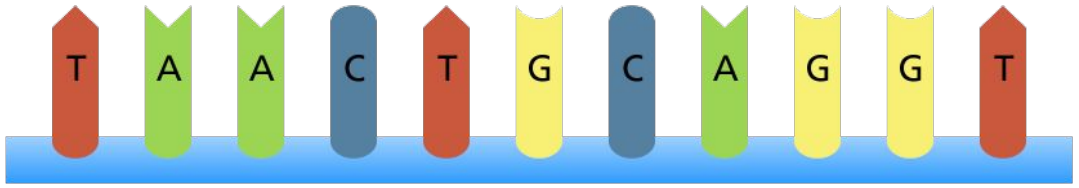
- Examples: Walker-Warburg Syndrome, Hemophilia A



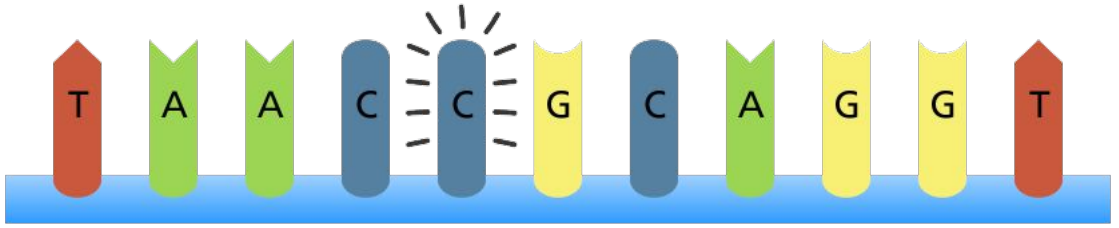
Insertion

A small mutation where the DNA receives an extra base pair.

Original Sequence
11 base pairs



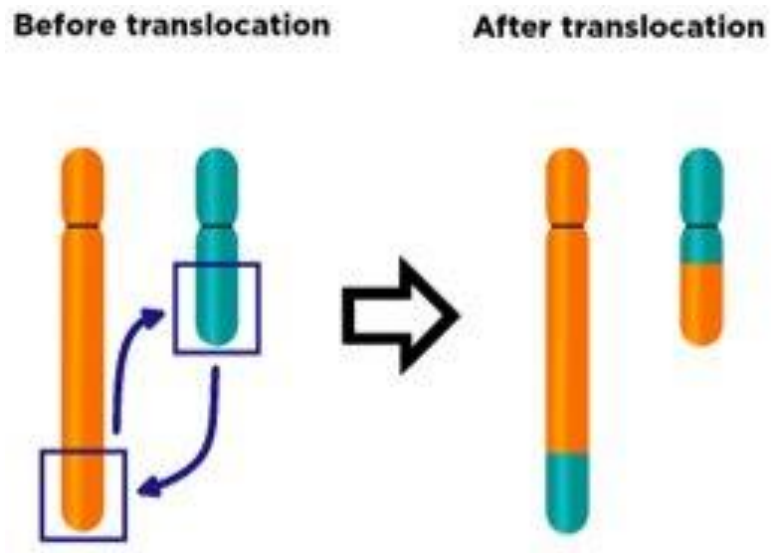
New Sequence
12 base pairs

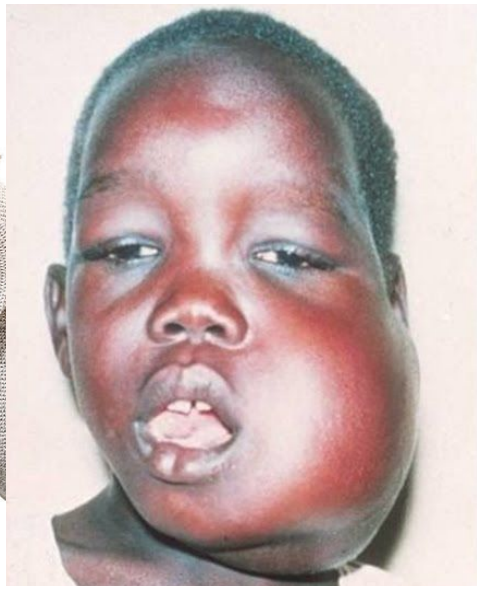


Translocation

Part of a chromosome attaches to another chromosome.

- Example: Mental Handicap, Cancer (Burkitt's Lymphoma)

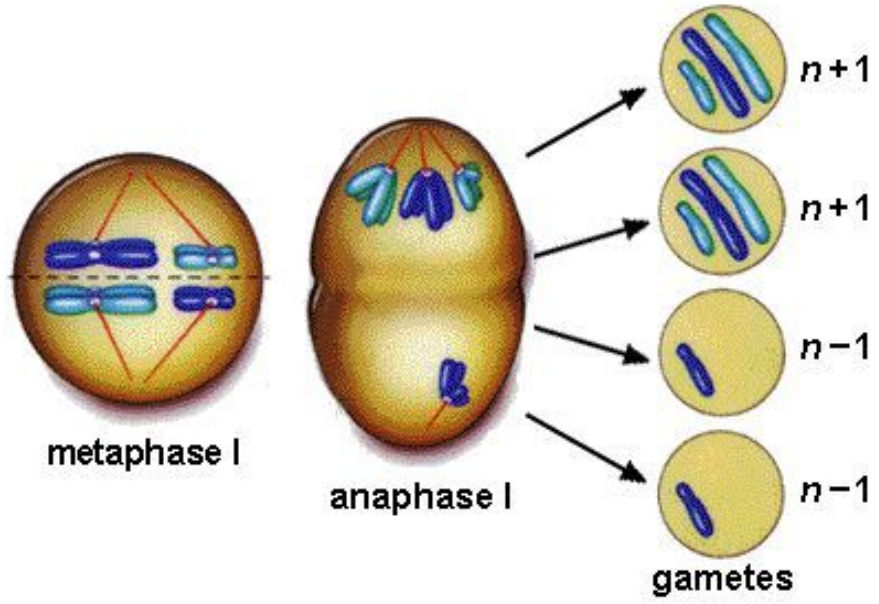




Nondisjunction

Nondisjunction is the **failure** of the chromosomes to **separate**, which produces daughter cells with extra (trisomy) or missing (monosomy) chromosomes.

- Examples: Down Syndrome, Turner's Syndrome



Changes in Chromosome Number

Changes in chromosome number can occur by:

- **Aneuploidy** – the addition of all or part of a chromosome.
- **Monoploidy** – the "missing" or loss of an entire set of chromosomes.
- **Euploidy** – the **gain** of one or more complete sets of chromosomes.

Each of these conditions is a variation on the normal diploid number of chromosomes.

7:13 https://www.youtube.com/watch?v=vl6Vlf2thvI

Vocabulary

Cell Cycle – a series of events that takes place in a cell as it grows and divides.

Interphase – the stage in which the cell grows, replicates its DNA and prepares for mitosis.

Mitosis – a type of cell division that results in two identical daughter cells each having the same number of chromosomes as the parent cell; makes somatic cells.

Meiosis – a type of cell division that results in four non-identical daughter cells each having half the number of chromosomes as the parent cell; makes gamete cells.

Cytokinesis – the process by which one (or two) cells divide into two (or four) cells; the final stage of mitosis and meiosis.

Vocabulary

Cell Plate – a plate that develops in the middle of a plant cell during the separation of two daughter cells.

Cleavage Furrow – an indentation that appears in an animal cell's surface when the cell is preparing to divide.

Prophase – the first stage of cell division; the chromosomes become visible as paired chromatids and the nuclear envelope disappears.

Metaphase – the second stage; the chromosomes line up in the middle of the cell and attach to spindle fibers.

Anaphase – the third stage; the chromosomes move away from one another to opposite poles of the spindle.

Telophase – the final phase; the chromatids or chromosomes move to opposite ends of the cell and two nuclei are formed.

Vocabulary

Haploid – having a single set of unpaired chromosomes.

Diploid – having two complete sets of chromosomes, one from each parent.

Chromosome – a threadlike structure of nucleic acids and protein found in the nucleus of most living cells, carrying genetic information in the form of genes.

Chromatid – each of the two threadlike strands which a chromosome divides longitudinally during cell division, each contains a double helix of DNA.

Homologous Chromosomes – chromosome pairs that are similar in length, gene position and centromere location.

Tetrad – a group of four chromatids.

Crossing Over – the swapping of genetic material that occurs in the germ line.

Vocabulary

Spindle Fiber – form a protein structure that equally divides the chromosomes in a parent cell to daughter cells.

Somatic Cells – any cell that is not a sex cell.

Gametes – sex cells (egg and sperm).

Germ Cells – a specific sex cell that differentiates males and females (eggs in female, sperm in male).

Chromosomal Mutation – an unpredictable change that occurs in a chromosome.

Deletion – part of a chromosome is missing.

Duplication – part of a chromosome gets an extra copy.

Translocation – part of a chromosome switches with the part of another chromosome.

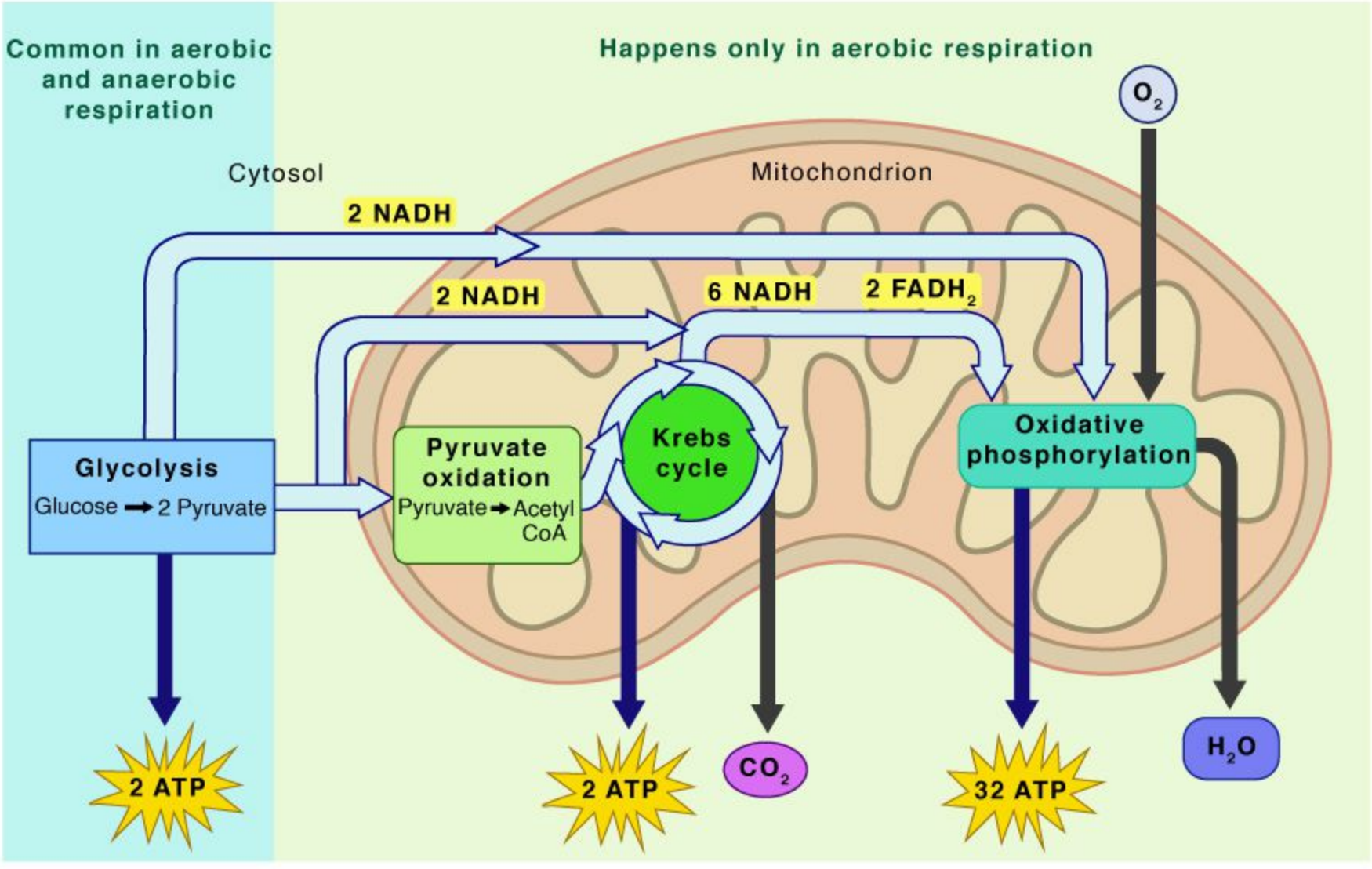
Vocabulary

Nondisjunction – chromosomes fail to separate during cell division.

Insertion – DNA receives an extra base pair.

Inversion – part of a chromosome gets flipped around.

Cellular Respiration



Activity description "Chemistry and environment: natural cosmetics. Product branding"

Grade	10 th class
Naming of activity	Project "Chemistry and environment: natural cosmetics. Product branding"
Duration	1 lesson (45 min.)
Learning tasks	Create the brand of the selected product in the graphics processing program
Hardware and software	Computer, internet connection, internet browser, image manipulation program, text editor, drawing tablet, document scanning mobile app
Interdisciplinary (Cross disciplinary) connections	Chemistry, IT, art, economics
Interdisciplinary topics	Chemical phenomena in the biosphere (for example, photochemical smog, eutrophication, drifting waste islands, etc.) are examined in connection with anthropogenic activities, pollutants, and their properties. The influence of pollutants on nature is discussed
Hybrid training scenario	The lesson topic and tools are suitable for both face-to-face and hybrid learning. Tools during contact and hybrid learning: • Virtual environment (intended to present the textual task of the lesson and to trigger the completed work. For example, Moodle) • Virtual communication environment (to communicate with students at a distance. For example, MS TEAMS or GOOGLE CLASSROOM) • Graphics processing program (eg GIMP) • Online graphics processing programs (eg https://pixlr.com/x/) • Mobile phones (used for scanning drawings) • ADOBE SCAN or similar mobile app for document scanning • Allow more time for remote students to complete class work

Flow of lesson

Requirements for the organization of the lesson:

• The components of the product chosen in the previous chemistry lessons are reviewed.

• Key recipe products are highlighted.

• Presents what the brand should look like.

• Explains how to create it in a graphics application.

• Students draw a sketch on paper and/or in a graphics processing program with graphics tablets.

• The paper version is scanned with ADOBE SCAN or a similar program and uploaded to the computer.

• The project is colored and processed according to the requirements given in the lesson.

• Students upload their creative works to the virtual environment.

Further development

**Students with visual impairments can enlarge the task, the image can also be enlarged in graphics programs.*

**Students with hearing impairments sit closer to the teacher. The teacher approaches such a student from time to time and calls his attention by asking, how he manages to keep the student from disconnecting from the general work of the class. Lesson assignments are also provided in text format so that children can read them.*

The created brand is hosted as a website favicon and used on an online page - the website.

All the collected material is presented on the websites on the project settlement day in chemistry, informatics, and English classes.

Activity reflection

At the end of the lesson, we discuss how you managed to complete the task of creating a brand, what problems you encountered, how you solved the difficulties that arose.

Notes

Before starting this project, you should:

• Coordinate with the chemistry teacher the topics that can be used to create the desired product. Possible examples: cosmetics, household chemicals, etc.

• Plan the arrangement of time during the academic year, combining chemistry and IT lessons. To determine the time and form of delivery of the work result. The chemistry teacher must provide activities for students to test the product development process. In the IT lessons, only the preparation and finishing of the product presentation is done.

Example of product branding created by students

Evaluation of the brand created by the "Chemistry and environment - natural cosmetics" project:

1. A sketch of the brand is drawn on paper. 1 point

2. The sketch is uploaded to the virtual learning environment. 1 point

3. The brand project is redrawn or outlined in a graphics program. 1 point

4. The drawn contours are not visible. 1 point

5. The product mark has a transparent background. 1 point

6. The product mark is colored in no more than 4 colors. 2 points (more colors - 1 point, no color - 0 points)

7. A name is invented and written for the product. 1 point

8. The name is matched to the mark. 1 point

9. Save and load work in three formats *.xcf, *.png and *.jpg. 3 points (one point for each format)

A total of 12 points.

Title: Exploring Stellar Evolution through Spectral Analysis

Subject: Physics and Astronomy (12th grade) Duration: 45 minutes

Objective:

- Understand the concept of stellar evolution and its relation to the electromagnetic spectrum.
- Explore the process of spectral analysis and its role in determining the properties of stars.
- Apply knowledge of physics and astronomy to interpret stellar spectra.

Materials:

- Laptop or computer with internet access
- Projector or smartboard
- Stellar spectrum simulation software (e.g., Stellarium, SpectraSnapp)
- Handouts with blank spectral graphs and analysis questions

Procedure:

1. Introduction (5 minutes):
    - Begin the lesson by introducing the topic of stellar evolution and its significance in understanding the life cycles of stars.
    - Explain that we can study stars using the electromagnetic spectrum and that spectral analysis is a powerful tool in this regard.
    - Emphasize the importance of spectroscopy in revealing information about a star's composition, temperature, and motion.
2. Spectral Analysis Demonstration (10 minutes):
    - Conduct a live demonstration of spectral analysis using the simulation software and a projector.
    - Choose a specific star and display its spectrum on the screen.
    - Explain the key features of a stellar spectrum, such as absorption and emission lines, and their implications.
    - Point out how the spectrum can provide clues about the star's temperature, composition, and motion.
3. Guided Activity: Analyzing Stellar Spectra (20 minutes):
    - Distribute handouts with blank spectral graphs and analysis questions to each student.
    - Instruct students to use the provided software to simulate and analyze the spectra of different stars.
    - Ask students to record their observations and interpretations on the handout.

- Encourage students to identify absorption and emission lines, determine the spectral type, and make inferences about the star's properties based on their analysis.

4. Group Discussion and Analysis (10 minutes):
    - Facilitate a class discussion to share the findings from the guided activity.
    - Encourage students to present their spectral graphs, interpretations, and any conclusions they have drawn.
    - Discuss the commonalities and differences between the analyzed spectra and the implications for stellar evolution.
    - Address any questions or misconceptions that arise during the discussion.
5. Conclusion (5 minutes):
    - Summarize the main points discussed during the lesson, emphasizing the importance of spectral analysis in understanding stellar evolution.
    - Highlight the connection between the electromagnetic spectrum and the properties of stars.
    - Encourage students to further explore the topic independently and engage in related research or reading.

Note: This lesson plan can be modified based on the availability of resources and the specific needs and interests of the students.

**Suggested analysis questions:*

1. What is a spectral graph in the context of astronomy and physics, and what information can be extracted from it?
2. How is wavelength related to the spectral graph? Explain the significance of different regions of the electromagnetic spectrum.
3. What are some common types of spectral lines observed in astronomy? How are these lines produced and what can they tell us about celestial objects?
4. Describe the process of spectroscopy and how it is used in astronomy to study the composition and properties of distant objects.
5. In a given spectral graph, how can you determine the temperature of a star or an astronomical object? What characteristics of the graph would you analyze?
6. What is the difference between an absorption spectrum and an emission spectrum? How do they provide information about the composition and conditions of astronomical objects?
7. Explain the concept of redshift and blueshift as observed in spectral graphs. How does the Doppler effect play a role in determining the motion of celestial objects?
8. How can the presence of specific elements be identified in a spectral graph? What are the key features that indicate the presence of a particular element?
9. Discuss the concept of stellar classification based on spectral types. What criteria are used to categorize stars into different spectral classes?

10. How can astronomers use spectral graphs to study the properties of galaxies and determine their distances from Earth?
11. What is the main purpose of a spectral graph in astronomy and physics?
12. How is the wavelength of light related to the colors we see in a spectral graph?
13. What information can we gather from the shape or pattern of a spectral graph?
14. How do astronomers use spectral graphs to determine the composition of stars and other celestial objects?
15. What is the significance of absorption lines in a spectral graph, and how do they help us understand the properties of astronomical objects?
16. Can you explain the concept of redshift and how it is observed in spectral graphs? How does it provide evidence for the expanding universe?
17. Describe the difference between emission and absorption spectra. How do they differ in terms of their appearance on a spectral graph?
18. What are some common techniques used to analyze and interpret spectral graphs in astronomy and physics research?
19. How can the Doppler effect be observed and measured using spectral graphs? What does it tell us about the motion of celestial objects?
20. Give an example of how astronomers have used spectral graphs to make significant discoveries or advancements in our understanding of the universe.

Title: Gender Equity in STEM Education

Setting the Stage

We will be researching different groups that support women in STEM and compare this to an increase of human rights and a decrease of Climate Change throughout the globe. Students will discover that there is a correlation between: an increase in women in STEM fields, a decrease in climate change, and an increase in human rights globally and locally.

Lesson Overview

In this lesson, students will discuss and learn about two phenomena: First, students will learn about programs and people that have dedicated their time to making the STEM field a more equitable place for all genders. Second, students will discuss how this idea of gender equity in STEM education will stabilize/decrease climate change, and increase human rights globally.

Instructional Overview	
Grade Level	9 - 12
Instructional Time	50 minutes
Driving Question	What might happen to climate change if more genders were represented in STEM?
Concepts	An increase of women in STEM will increase women's empowerment globally while also having a positive impact on climate change.
Outcomes	Students will be able to identify and explain the relationship between an increase in women in STEM and the decrease in climate change.
Materials	❏ PPT Slides ❏ Worksheet ❏ Presentation Sheet
Material Preparation	*Print worksheet and presentation sheet, one per student *Give students access to google slides
Human rights connections	This lesson will provide an understanding of how empowering women in the STEM fields will lead to a decrease in Climate Change.

Lesson Flow

Activity 1: Introduction to the lesson.

● (5 minutes) Focus question: What might happen to climate change if more genders were represented in STEM?

○ Have students hypothesize the answer and talk to students around them

● (5 minutes) Background information

○ Teacher will run through the first 3 slides of the presentation while students think about questions and work in groups to propose some ideas.

○ In the google slide notes (located just below the slides) are possible answers to each question which can be used to introduce new ideas/concepts. If the teacher has time, discuss each question.

Activity 2: Small group work

● (10 minutes) Form small groups and research different organizations

○ Students will form groups of 4-5 and will be assigned one of the 9 programs/inspirational people to present on (see slides).

○ Students then fill out the worksheet with background information they have found based off of the recommended sites embedded in the slides.

○ Students will then add this information onto their designated slide (sides 6-14 on the presentation).

Engage:

Students google and learn about groups and organizations that encourage women to go into STEM and the effects on the environment and community around them. While they are learning about the group/organization, the students fill out the Gender Equity in STEM Worksheet (see link in Materials).

Explore:

Students will spend time working on obtaining knowledge from internet research and the suggested websites (linked on the google slides) to prepare to share this knowledge with the rest of the class.

Activity 3: Class presentations

● (20 minutes) Students form new groups and present to one another their findings

○ Students will split up into new groups, one person from each group in the new group (i.e. 9 students per new group).

○ Students spend 30 seconds to 1 minute presenting their information in the new group. Next, they will spend 30 seconds to 1-minute answering questions from their peers.

○ Students listening to the presentations will fill out the presentation note sheet and write down questions to ask.

Explain:

Students will make a presentation discussing an organization that supports women in STEM and how this has affected the community around the women. They will present this to their peers in small groups.

Concluding discussion

● (10 minutes) Class discussion

○ Talk about the common findings within each organization about how more women in STEM can help decrease Climate Change.

○ Provide room for students to ask or write down questions that can be later discussed or answered. Not all questions they ask need to be answerable, it is best if they are asking questions that lead to more discussions and do not have a concrete answer. This is excellent practice at phenomenon based knowledge.

Evaluate:

Informal assessments include participation in the presentation, effort on the worksheet, and effort on the presentation note sheet.

Useful resources:

UNESCO International Symposium and policy forum. cracking the code: Girls' education in STEM. UNESCO. (2018, January 30). from https://en.unesco.org/unesco-international-symposium-and-policy-forum-cracking-code-girls-education-stem

UNICEF. (2020, October). Reimagining girls education through science 2020 - UNICEF. Reimagining Girls' Education Through STEM. from https://www.unicef.org/media/84046/file/Reimagining-girls-education-through-stem-2020.pdf

Imafidon, A.-M. (2022, February 15). Girls do science too... Stemettes ®. Retrieved April 10, 2022, from https://stemettes.org/

Akhtar, S., Chen, Y., Imran, M., & Ahmad, S. (2021, April 17). Environmental education and women ... - journals.sagepub.com. SAGE Open. from https://journals.sagepub.com/doi/abs/10.1177/21582440211009469

Hughes, C. (2017, September 13). How women's Rights Drive Economic Development. The Borgen Project. from https://borgenproject.org/womens-rights-drives-economic-development/

Armstrong, L., & Adamson, G. (2021, July 2). The role of gender in peer-group perceptions of climate scientists' media statements. Public understanding of science (Bristol, England). from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8488648/

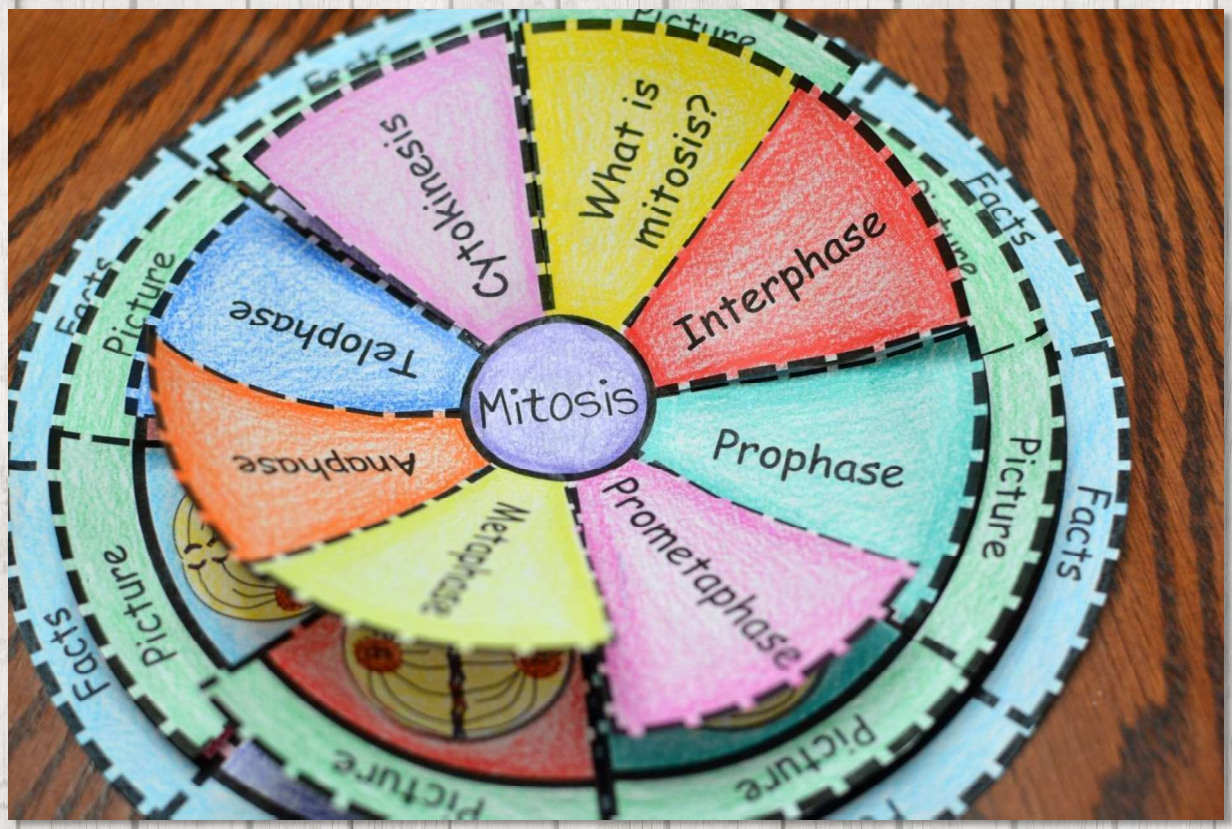
Hill, C., Corbett, C., & St. Rose, A. (2010). Why so few? women in science, technology, engineering, and mathematics.American Association of University Women. from https://eric.ed.gov/?id=ED509653

Young, C. (2021, February 11). Calling all girl scientists: Climate change needs you.

OECD Education and Skills Today. from https://oecdedutoday.com/girl-women-scientists-climate-change-green-jobs/

Trumper, R. (2010, December). How do learners in developed and developing countries relate to environmental issues?Science Education International. from https://files.eric.ed.gov/fulltext/EJ907042.pdf

Mitosis Foldable without Prometaphase



Students can use this foldable as a study tool! Foldable can be used in interactive notebooks!

Option 1

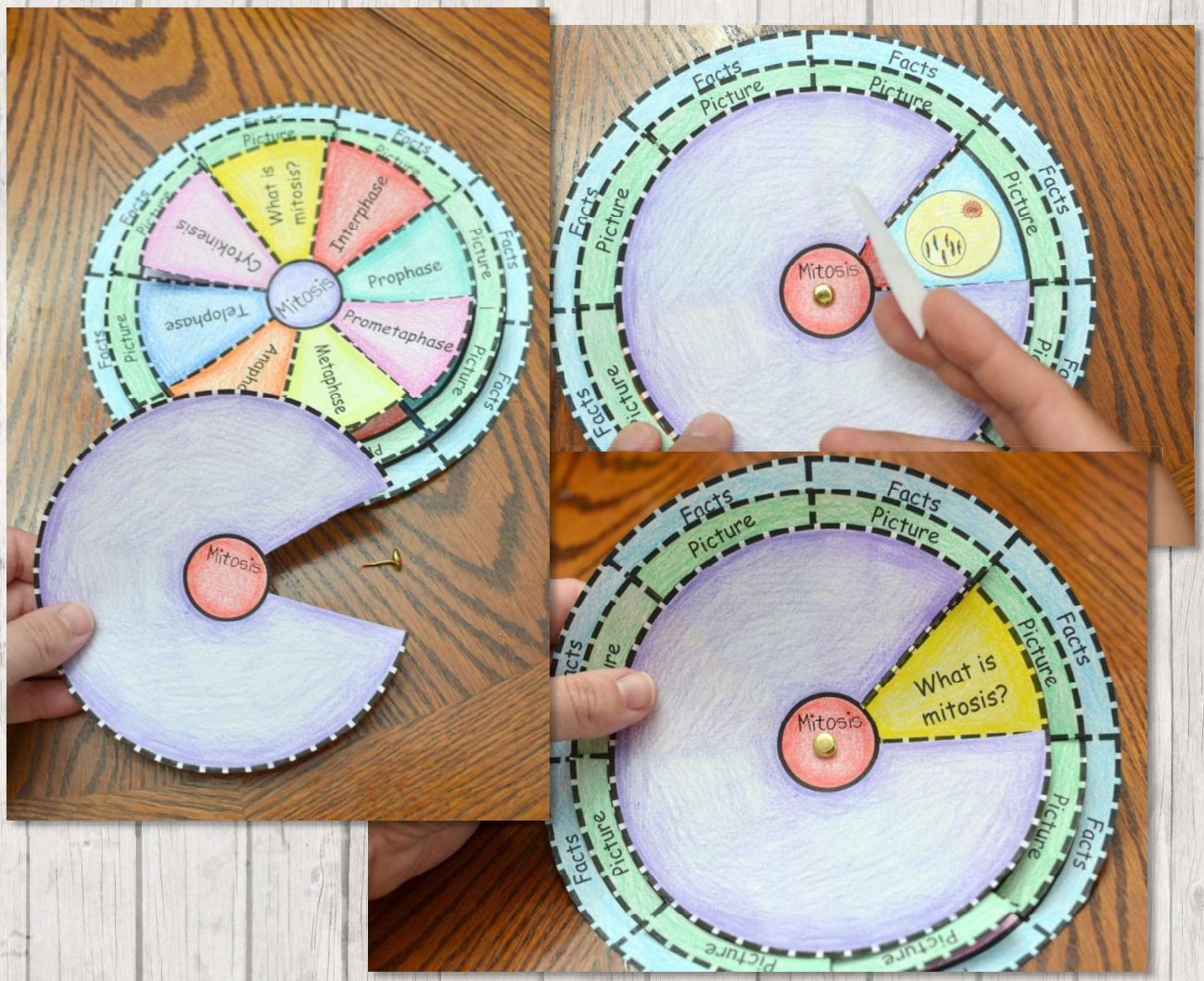
The first option is to have students construct the foldable and use as a handheld study tool.

Option 2

The second option is to have students glue the foldable into their interactive notebook.

Note – If your students have a really small composition notebook, print the foldable at 90% or you can students fold the side of the foldable.

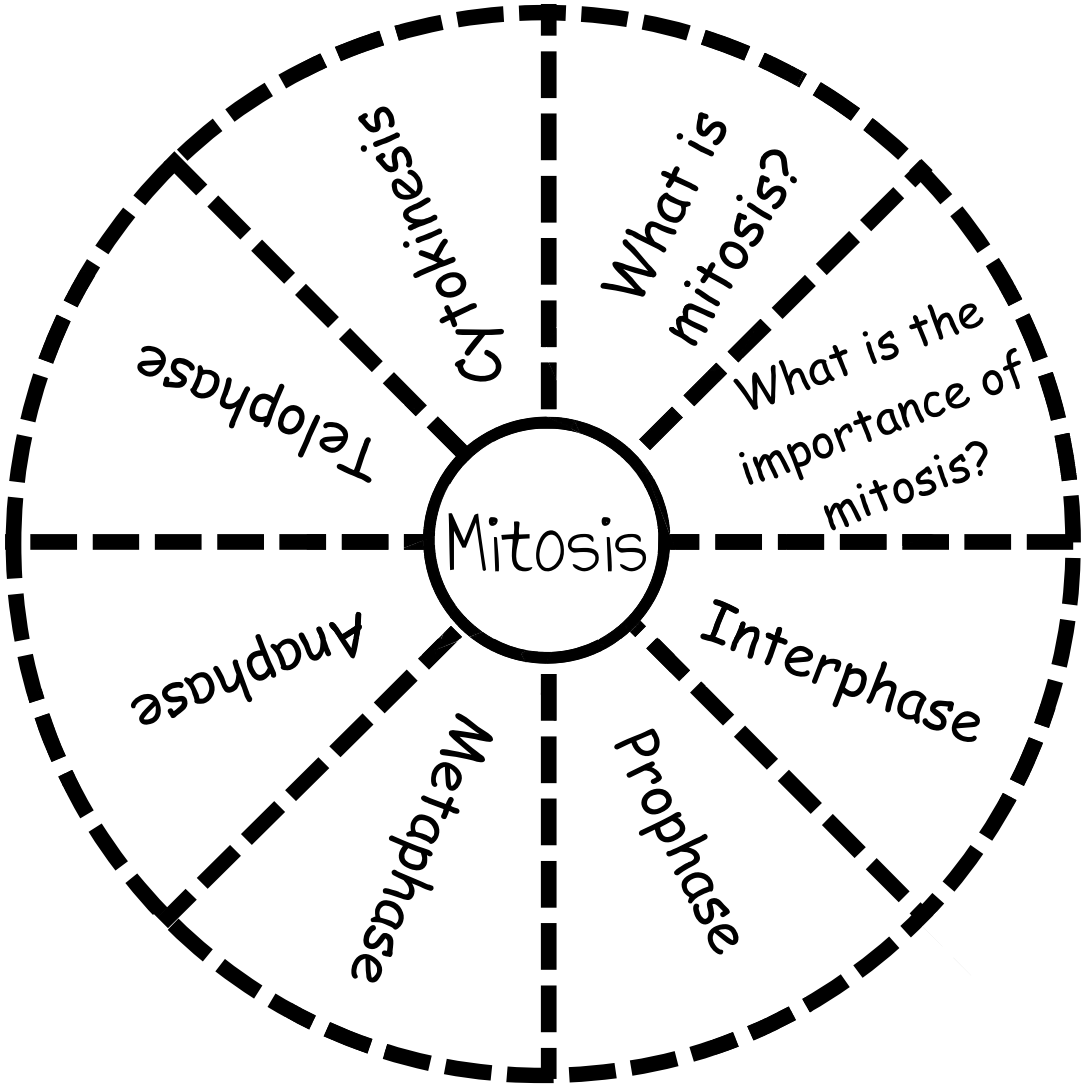
Option 3

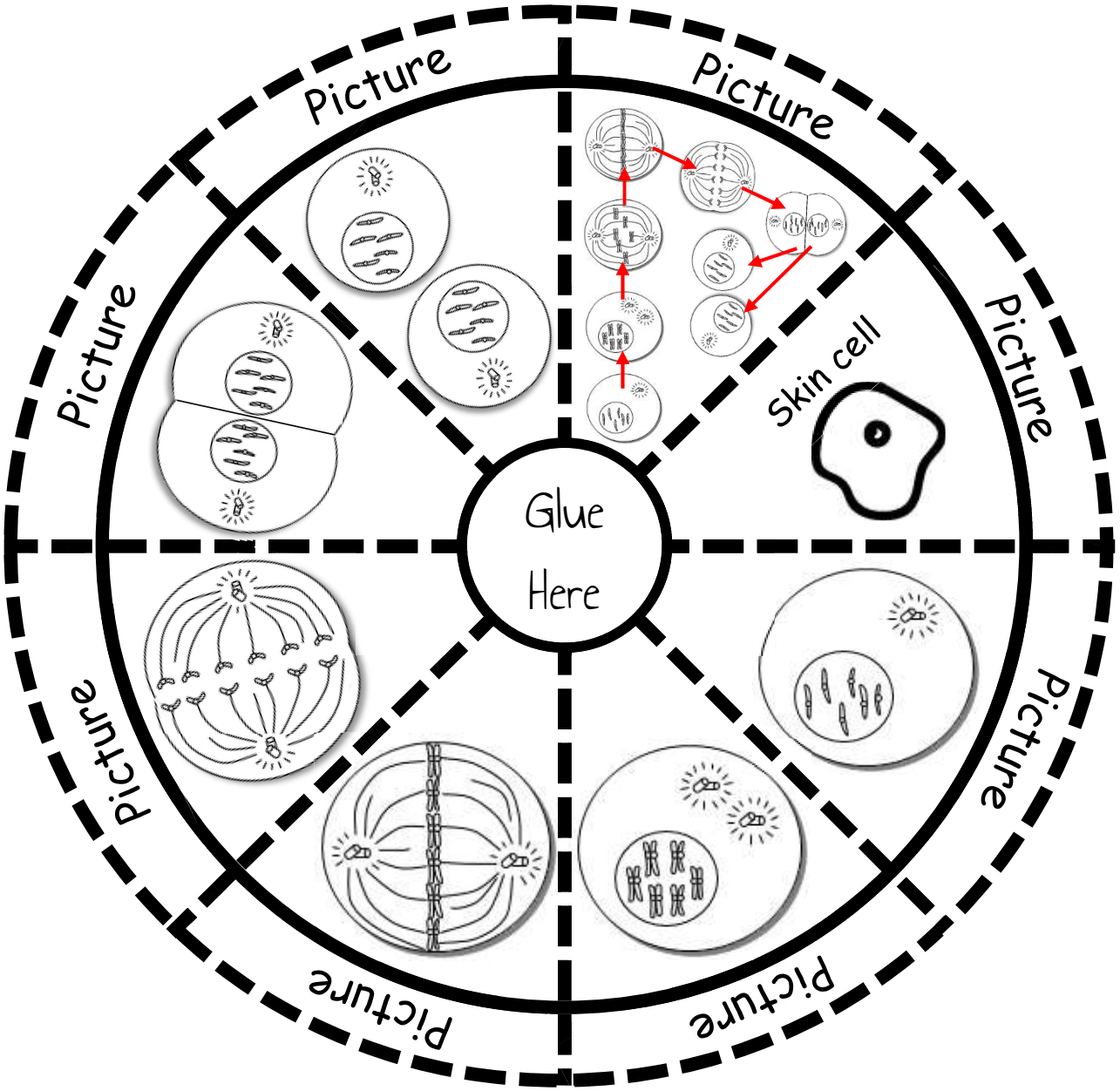


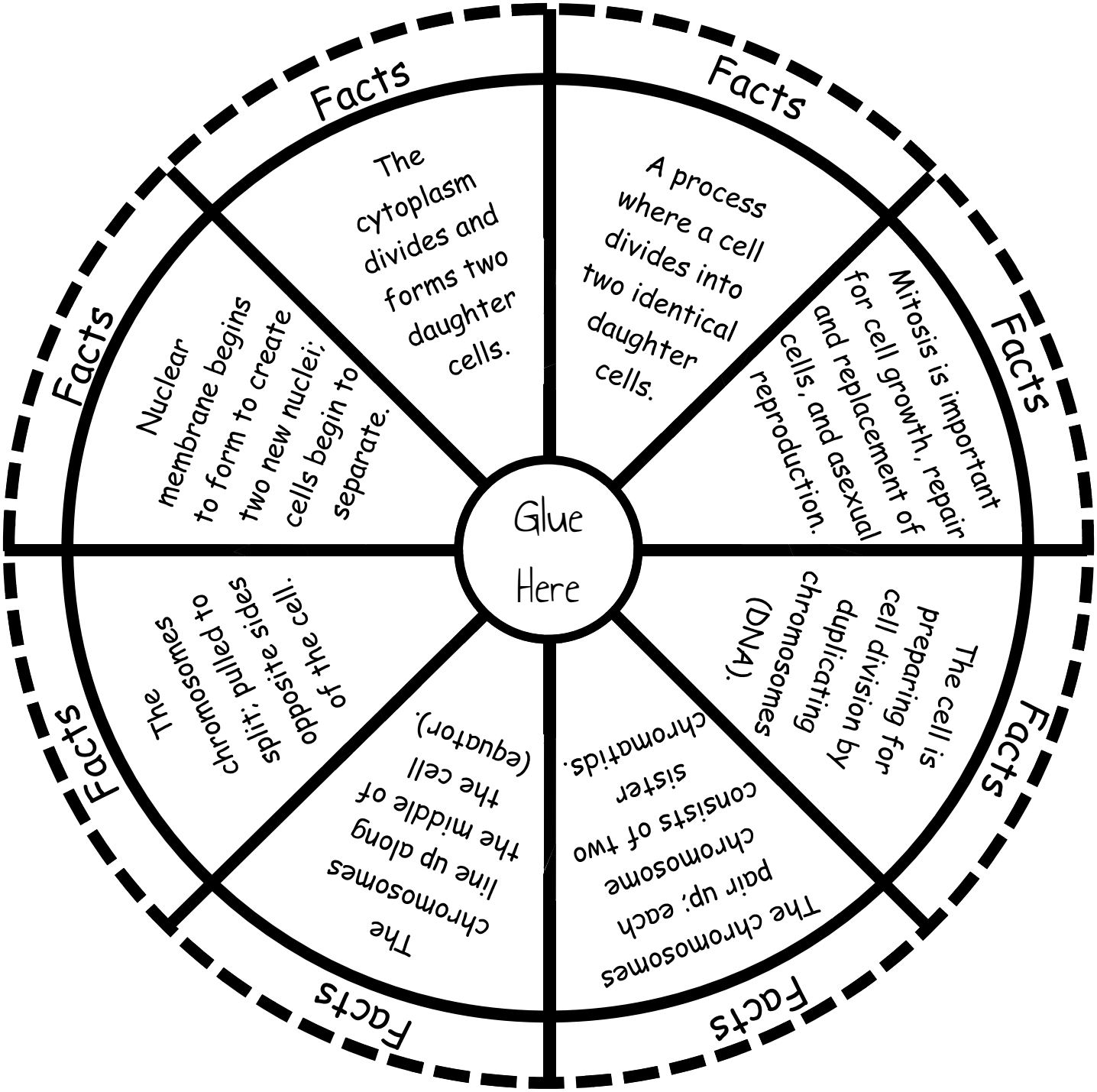
The third option is to have students construct the foldable with a cover. The cover allows them to study the phases in order.

Directions: Color and cut out the circles on page 1 through page 3. Cut the dotted lines between the sections. You will need to glue the wheels together by placing glue on the small circles that say "Glue Here". The biggest circle will be glued on the bottom and the smallest circle will be glued on the top.

Important Note – Make sure to line up your circles before gluing! For example, you will want "Interphase" to be glued on top of its picture and facts.





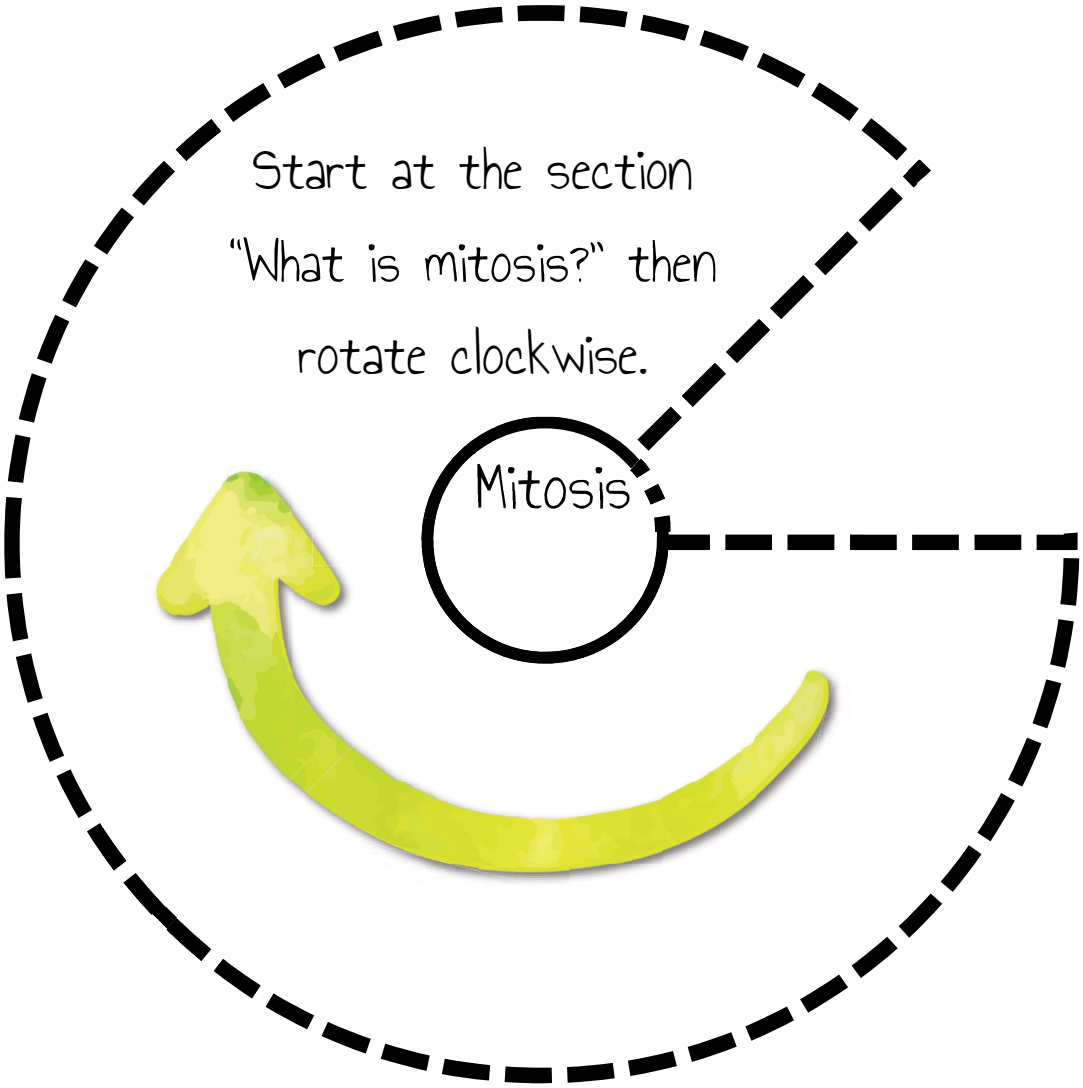


Cover

The cover given below is optional to use. The cover is a nice way for students to study the order of the phases. In order to use the cover, students will need paper fasteners.

Students will need paper fasteners.

Directions: Cut out on the dotted lines. Place the circle on top of your foldable. Place a paper fastener in the very center of your foldable.



MITOSIS – CELL DIVISION LAB

MATERIALS NEEDED

- **2 Sets of Different Colored Pop-It Beads (32 of each color)**
- **(8) 5-Holed Pop-It Beads (used as centromeres)**
- **(1) Dry-Erase Board**
- **(1) Dry-Erase Marker**

In this experiment, students will follow the movement of the chromosomes through mitosis to create somatic daughter cells.

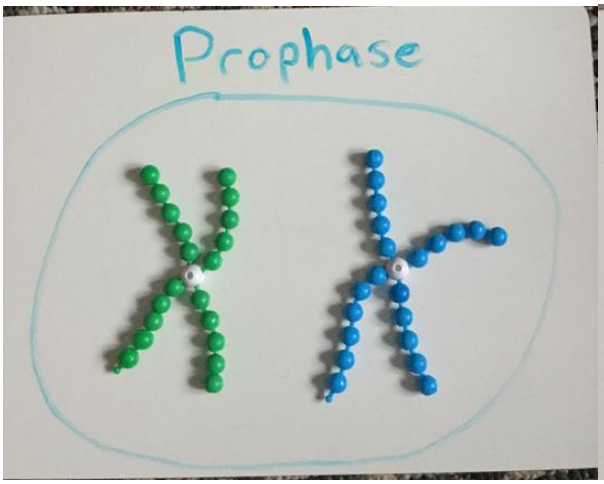
PROCEDURE

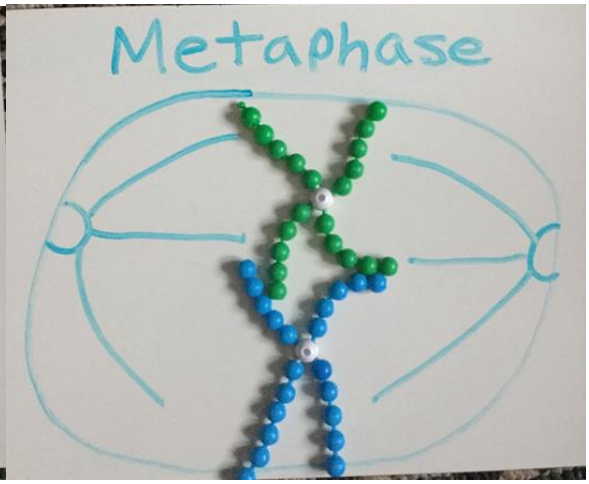
Genetic content is replicated during interphase. DNA exists as loose molecular strands called chromatin, it has not condensed to form chromosomes yet.

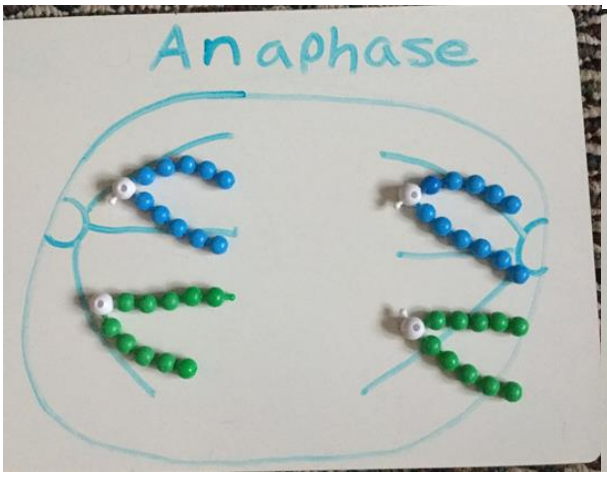
Sister chromatids begin coiling into chromosomes during prophase. Begin the experiment here:

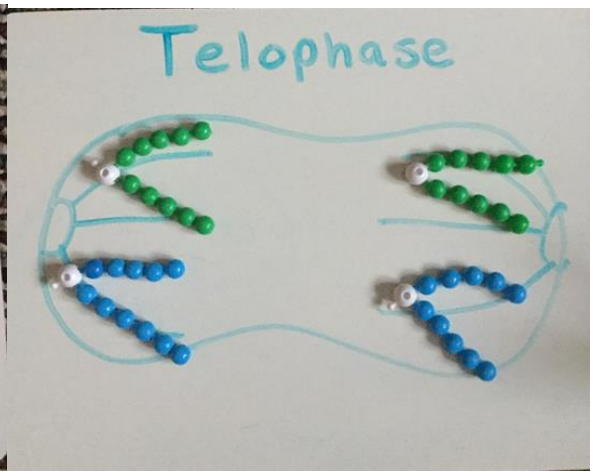
1. Build a pair of replicated, homologous chromosomes. 10 beads should be used to create each individual sister chromatid (20 beads per chromosome pair). The 5-holed beads represent each centromere.
    a. Start with 20 beads of the same color to create your first sister chromatid pair. 10 beads must be snapped together with a 5-holed bead in the center for each chromatid. This represents an "I" shape.
    b. Repeat Step 1a to create a second chromatid.
    c. Connect the "I" shaped sister chromatids by the 5-holed beads to create an "X" shape.
    d. Repeat the above steps using 20 new beads (of a different color) to create the second sister chromatid pair.
2. Assemble a second pair of replicated sister chromatids. Use 12 beads, instead of 20, per pair (six beads per each complete sister chromatid strand).
3. Repeat this process using 12 new beads (of a different color) to create the second set of replicated sister chromatids.
4. Use your dry-erase board and marker to draw a large circle (to represent the cell), and draw spindle fibers as they appear in each phase of the cell cycle.
5. Configure the chromosomes onto the dry-erase board as they would appear in each of the stages of the cell cycle (prophase, metaphase, anaphase, telophase, and cytokinesis).

See the following examples of this activity:









Cellular Respiration Worksheet

1. What are the 3 phases of the cellular respiration process?

   Glycolysis, Krebs Cycle, Electron Transport

2. Where in the cell does the glycolysis part of cellular respiration occur?
   in the cytoplasm

3. Where in the cell does the Krebs (Citric Acid) cycle part of cellular respiration occur?
   in the mitochondria

4. Where in the cell does the electron transport part of cellular respiration occur?
   in the mitochondria

5. How many ATP (net)are made in the glycolysis part of cellular respiration?
   2 (net)

6. How many ATP are made in the Kreb's cycle part of cellular respiration?
   2

7. How many ATP are made in the electron transport part of cellular respiration?
   32 – 34

8. In which phase of cellular respiration is carbon dioxide made?
   Krebs Cycle

9. In which phase of cellular respiration is water made?
   Electron Transport

10. In which phase of cellular respiration is oxygen a substrate?
    Electron Transport

11. In which phase of cellular respiration is glucose a substrate?
    Glycolysis

12. On average, how many ATP can be made from each NADH during the electron transport process?
    3

13. On average, how many ATP can be made from each $FADH_2$ during the electron transport process?
    2

14. What would happen to the cellular respiration process if the enzyme for one step of the process were missing or defective?
    The entire process beyond that point could not happen.

15. What happens to the high-energy electrons (and hydrogen) held by NADH if there is no O_2 present? If no oxygen is present, the pyruvic acid must take the electrons (and their hydrogens) back.

16. Explain why this happens.
    This happens because there are only a small number of NAD^+ molecules in the cell. They must be reused to keep glycolysis going with additional glucose molecules. This means they need to "unload" the electrons from NADH by giving them to some other molecule. Since the pyruvic acid cannot continue on to the Krebs cycle when there is no oxygen present, it receives the electrons. This allows the glycolysis portion of cellular respiration to continue even when O_2 is not present. This process of making ATP in the absence of O_2 is called fermentation

17. What is the overall reaction for fermentation in yeast?
    Glucose → 2 Ethyl alcohol + 2 CO2 + 2 ATP + Heat

18. What is the overall reaction for lactic acid fermentation?
    Glucose → 2 Lactic Acid + 2 ATP + Heat

19. Only a small part of the energy released from the glucose molecule during glycolysis is stored in ATP. How is the rest of the energy released? (HINT: It is a product in the overall reaction for cellular respiration.)
    It is released as heat.

ANSWERS FOR THE BONUS WILL BE POSTED AFTER THE TEST.

BONUS – Answer the questions below on a separate sheet of paper and **turn them in before the test**. They are worth a possible of 5 bonus points on the test.

20. When your cells use fat for energy, the fatty acids are broken up into molecules of acetyl CoA. Predict how many ATP can be made from **one molecule** of acetyl CoA if oxygen **is** present. Show your work.

21. Suppose that each fatty acid in a certain fat can make 9 molecules of acetyl CoA. Predict how many ATP can be made from the fatty acids in this fat. (Remember there are 3 fatty acids in the fat molecule.)

Lesson Plan
Cell Cycle

SUBJECT: Biology

GRADE LEVEL: 9 **TOPIC:** The Cell Cycle

DURATION: 135 Minutes (approximately 1-3 class periods)

OBJECTIVES:

- Students will understand cell division.
- Explain the difference between meiosis and mitosis.
- Identify the phases of cellular division.

DURATION	ACTIVITY	DIRECTIONS FOR ACTIVITY
5-10 mins.	Warm-Up	Allow students to look at samples of the mitosis cell division cycle under a microscope and have them describe what the cells look like. Have students describe what they see in each phase.
30 mins.	PowerPoint Lecture	Go through this *PowerPoint Lecture together as a whole class. PowerPoint includes fill-in-the-blanks to make the lecture more interactive, as well as vocabulary words from the lecture at the end for them to define and study.
16 mins.	The Cell Cycle Videos	Play this *Mitosis Cell Process video (8:26) and the *Meiosis Cell Process video (7:44) to help your students get a better understanding for the processes of cell division.
30 mins.	Meiosis and Mitosis Interactive Notebook	Give each student a copy of these *Meiosis and Mitosis Foldable wheel activity sheets and have them cut out and glue it into their notebook.
30 mins.	Mitosis Cell Division Activity	Allow students to work with a partner or alone for this *Mitosis Cell Division activity. Each group gets a dry-erase board, a marker, and some pop-it beads. On the dry-erase board, students draw a large circle to represent the cell and draw spindle fibers. Students use the pop-it beads to construct and demonstrate the phases of cell division.
15 mins.	Mitosis Mover! Interactive	Students use a laptop, tablet, or other device to access this *Mitosis Mover! Interactive activity on biomanbio.com The game has a scorable questions quiz included along with click-and-drag interaction. Use this game as a quiz to test

	Game and Quiz	students' knowledge on mitosis, or have them play it as a reteach activity and/or deepen comprehension.
5-10 mins.	Whole Class Close-Out Discussion	End the class period by having a whole-class discussion to share what they learned, what they thought was interesting, and give them a chance to share what they are still confused about from this lesson.

MATERIALS NEEDED:

1. SmartBoard
2. PowerPoint
3. YouTube
4. Pop-It Beads
5. Meiosis and Mitosis Foldable Wheel Activity (printables)

Links to materials:

https://www.youtube.com/watch?app=desktop&v=f-ldPgEfAHI (Mitosis Cell Process)

https://www.youtube.com/watch?app=desktop&v=VzDMG7ke69g (Meiosis Cell Process)

https://biomanbio.com/HTML5GamesandLabs/Genegames/mitosismoverpage.html (Mitosis Mover! Interactive activity on biomanbio.com)

Title: Understanding Cellular Respiration

Grade Level: 9th - 10th grade

Subject: Biology

Time: 45 minutes

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

1. Define cellular respiration and explain its importance in living organisms.
2. Understand the chemical reactions involved in cellular respiration.
3. Identify the different stages of cellular respiration.
4. Apply STEAM (Science, Technology, Engineering, Art, and Math) concepts to explore and understand cellular respiration.

Materials:

- Projector or whiteboard
- Computer or tablet with internet access
- Diagrams or visual aids of cellular respiration
- Sticky notes
- Colored pencils or markers
- Scratch paper
- Stopwatch or timer

Procedure:

1. Introduction (5 minutes):
    - Begin the lesson by asking students if they have ever wondered how living organisms obtain energy from food.
    - Discuss the importance of cellular respiration in providing energy for cells.
    - Introduce the concept of STEAM and explain how we will be incorporating various STEAM elements into our lesson on cellular respiration.
2. Explanation of Cellular Respiration (10 minutes):
    - Use the projector or whiteboard to display diagrams or visual aids of cellular respiration.
    - Explain the process of cellular respiration, highlighting its three main stages: glycolysis, the Krebs cycle (citric acid cycle), and the electron transport chain.
    - Discuss the overall equation for cellular respiration: glucose + oxygen -> carbon dioxide + water + energy (ATP).
3. STEAM Activity: Model Building (15 minutes):
    - Divide the students into groups of 3-4.
    - Provide each group with sticky notes, colored pencils or markers, and scratch paper.

- Instruct the groups to create a 3D model or diagram that represents the stages of cellular respiration using the given materials.
- Encourage students to think creatively and use their artistic skills to visually represent the key concepts of cellular respiration.
- Set a time limit of 10 minutes for the model building activity.

4. Group Presentations and Discussion (10 minutes):
    - Have each group present their models or diagrams to the class.
    - As each group presents, ask them to explain the different stages of cellular respiration depicted in their models and how the process works.
    - Encourage other students to ask questions and engage in a discussion about the presented models.
5. Wrap-up and Assessment (5 minutes):
    - Summarize the key points of cellular respiration and its importance in living organisms.
    - Ask students to reflect on the STEAM activity and discuss how incorporating art and creativity helped them understand the topic better.
    - Assess students' understanding through a brief quiz or a class discussion.

Extensions/Modifications:

- For advanced students, provide additional information on anaerobic respiration and its differences from aerobic respiration.
- Incorporate technology by assigning students to research and create digital presentations on specific stages or aspects of cellular respiration.
- Assign a written reflection where students explain how cellular respiration relates to real-world applications, such as energy production or sports performance.

Note: Adjust the timing and complexity of the activities according to the needs and abilities of your students.

Belgian Steam Lesson Plan 1

Date:	18-04-2023
Subject:	English
Target group:	5th year (16-17 y-o)
Lesson title:	Time for a sustainable pitch!
Skills:	reading - listening - speaking/oral interaction
Lesson duration:	100 minutes + finish at home
Teacher:	Joke Reubens
Didactic Tools:	handouts + Chromebooks + Google Classroom (slides)

Lesson objectives:

- students are able to define 'sustainability' and 'pollution'' in their own words
- students can read articles about climate issues.
- students can find the main idea in articles they've read and are able to explain them.
- students can use the context of the article to understand words that are new to them.
- students can show the necessary effort to read-hear-express what they need in terms of the assignment.
- students can express their personal opinion on what they have read/heard.
- students show respect to their classmates during pair work and class discussions.
- students can watch a video and derive the main ideas of the message that is given.
- students focus on language correctness and make use of digital dictionaries if they need them.
- students can pitch a personal idea to the class, using the correct pitch structure and elements.
- students can respect deadlines and finish assignments at home.

Lesson progress:

Introduction	- Students are welcomed and asked to sit with a partner of their choice. → they are given the handouts necessary for this lesson. - The words 'sustainability' and 'pollution' are written on the blackboard and students add words they believe are linked to create a wordweb about these words. (5') - students are asked to write down a personal definition on both words based on what they've learnt from the wordweb. (2') → Now students are given a definition by the teacher which they compare with their own definition. (2') → students add elements from the teacher's definition which they find important if it's lacking in theirs.

Step 1	- Student A reads article 1 'Why won't we stop drinking bottled water'? - Student B reads article 2 'What happens if the water runs out'? (15') → Student A summarizes the article for student B, focusing on the main ideas. → Student B summarizes the article for student A, focusing on the main ideas. ('5)
Step 2	Teachers explains the purpose of the articles. Students will prepare a 'pitch' in which they will present a new app/gadget/product/service/ … as an entrepreneur to a board of investors (like in Shark Tank or Dragon's Den) - Teachers checks if students know what a pitch is. ('5) - Students watch this video and complete the questions about it in their handouts. (see attachment). They work together to do so. ('10) - The questions are corrected together with the whole class (= pitch analysis/ deciding whether this was a good pitch or not (and why / defining the different elements present in a good pitch)
Step 3 (= lesson 2)	Using the information given in the articles and the problems described, the students get to work in their team to come up with a new product/service/gadget/ … that would be a sustainable solution to the problem. - they write down the idea, draw an image of the product if possible. They start preparing the pitch, respecting the different elements (as seen in the video) they need to present a complete and credible pitch. - students are allowed to use their chromebooks to do so. - students create a Google Slide show to support their presentation. - students divide the information among them so they both have an equal amount of text. - students create a logo + company name for their product/gadget/service

Article 1: **Why won't we stop drinking bottled water?**

We have all seen the damage plastic waste is doing around the world – but sales of bottled water have continued to grow

For all the innovation and choice that define the food and drink industries, if you want to make money, you could do a lot worse than bung some water in a bottle and flog it. A litre of tap water, the stuff we have ingeniously piped into our homes, costs less than half a penny. A litre of bottled water can cost well over a pound, especially for something fancy that has been sucked through a mountain.

Yet the bottled water market is more buoyant than ever, defying the plastics backlash inspired by stricken albatrosses on the BBC's Blue Planet, and a broader, growing sense that something has to change.

Sales in the UK were worth a record £558.4m in the year to last November, an increase of 7%, according to the latest figures from the market analyst Kantar. Separate data from the analysts Nielsen show that last year we guzzled more than 2.2bn litres of bottled water, including "take-home" and "on-the-go" products. That's an annual rise in volume of 8.5%.

Imagine laying out half-litre bottles on the pitch at Wembley Stadium. You could fit 1.7m bottles on the grass, packed into a tight grid. Now imagine building up layers of bottles, covering the same area, to build a tower. To contain all the bottled water we buy each year, you would end up with a 514-metre skyscraper – 200 metres taller than the Shard.

Environmental campaigners are struggling to fathom why nations blessed with clean tap water grow only fonder of the bottle. "It's very surprising to me," says Sam Chetan-Walsh, a political adviser at Greenpeace and campaigner against ocean plastic. "Public awareness has never been higher, but the message is not quite reaching all the people it needs to."

Where it is heard, the message is stark. As well as requiring oceans of fossil fuels to make and ship, single-use plastics of all types are polluting our cities and seas. Blue Planet II, broadcast in 2017, showed how albatrosses unwittingly feed

plastic fragments to their chicks, ultimately killing them, and how even dolphin milk can become contaminated.

Campaigners cite the show as a watershed moment, and moves against various plastics have gathered pace, from shopping bags to straws and plastic-lined coffee cups. Chetan-Walsh argues that bottled water is different because the alternatives are so obvious. “If a product that is so nakedly unnecessary can exist, then the whole system is failing,” he says.

Hope is not entirely out of reach. That plastic skyscraper conceals attempts in the bottled water industry to change. If nothing else, the rate of growth has begun to ease (sales were up 7% in the year to November 2018, compared with 8% the previous year).

But even if large numbers of us are quitting bottled water because of care for the environment, others are taking it up. The introduction of the “sugar tax” on juices and fizzy drinks has pushed more people to bottled water, while health awareness has boosted its desirability. Kantar says tap water consumption is growing at roughly the same pace (we still drink almost three times as much tap water as bottled water).
So the plastic tide only creeps higher. The industry is quick to point out that all its bottles are recyclable. “But collection rates are, at the most generous estimates, 56%, so the actual recycling rate will be lower than that,” Chetan-Walsh says. And while bottles may be recyclable, very few are made of recycled plastic. Highland Spring launched recycled half-litre “eco” bottles alongside its standard bottles in January; Evian has vowed to use only recycled plastic across its range by 2025.

Chetan-Walsh believes in a ban on single-use bottles. Bans exist in some places. Glastonbury festival organisers announced that water bottles will not be sold this summer. San Francisco has banned them from city property and events. Last year, the UK parliament set out plans to ban single-use plastic from its estate.

Water bottlers, unsurprisingly, don’t support bans. But they raise concerns about health rather than bottom lines. Last month, the chief executive of Harrogate Water, James Cain, said that bans would “result in greater consumption of sugary drinks, adding to all the health dangers of obesity, diabetes and tooth decay”.

Kinvara Carey, general manager of the Natural Hydration Council, an association of the biggest bottled water manufacturers, cites a survey in which people were asked what they would do if bottled water were not available. “Forty-four per cent would buy another drink, which is not great, 14% would go without and 4.5% said they would find a fountain,” she says. “The choice is important.”

What if fountains were more numerous, and tap water more clearly available in cafes, restaurants and elsewhere? The London mayor, Sadiq Khan, is installing dozens of fountains in partnership with Thames Water. There are similar initiatives elsewhere. Before plastic and the marketing that made us think we needed bottled water in the first place, fountains were an urban fixture.

Greenpeace, among others, is also pushing for a “deposit return” scheme in

which a levy on bottled water would be refunded to customers who returned the plastic for recycling.

Even if bottled water sales are growing slightly more slowly, the industry is racing to adapt to changing concerns and tastes. Flavoured water is booming: sales of the sparkling variety shot up by 20%, according to the latest Kantar data. Meanwhile, brands including Evian, as well as a range of startups, are selling high-end reusable bottles. And if you must fill them with tap water, why not add flavouring?
As the owner of multiple sugary drink brands – and Aquafina bottled water – PepsiCo is facing challenges on health and environmental fronts. Last year, the company bought SodaStream for $3.2bn (the drinks machines make tap water fizzy; you add flavours). It also launched Drinkfinity, a range of fancy bottles that work with tap water and flavour pods (think more lemongrass and spirulina than 7 Up). The bottle is reusable. The pods? Not so much, and, yes, they are made of plastic, although Pepsi invites users to post them back for recycling.

As is so often the case, ingenious marketing can trump reason; awareness is rarely enough. "There is always this kind of slip between concern, intent and changed behaviour," says Giles Quick, an analyst at Kantar. "The best example is five a day. Almost everyone is aware of it, but something like 15% of us achieve it." Unless a far-reaching bottle ban does come into force, it will be up to consumers to not only demand change – but to act themselves.

https://www.theguardian.com/environment/2019/apr/28/if-we-care-about-plastic-waste-why-wont-we-stop-drinking-bottled-water

Article 2 -

BEFORE YOU READ:
Have you ever had a drought• where you live? What happened?

What happens when the water runs

CURRENT CULTURE: CAPE TOWN

Nickname: Mother City
Residents: Capetonians
Languages: Afrikaans, English, Xhosa
Population: 3.78 million
Currency: Rand
Highlights: Victoria & Albert Harbour, Table Mountain, Robben Island – the prison where future president Nelson Mandela spent 27 years.
Climate: South Africa can be hot and dry much of the year, but Cape Town's Table Mountain traps ocean winds and helps create rains.

Residents of Cape Town, South Africa save up for a 90-second shower and one toilet flush a day. How come? This major metropolis• could run out of water. Even worse: it can happen anywhere!

"I knew we were in trouble when I found myself Googling dry composting toilets," says Aryn Baker. What's a dry composting toilet, you ask? It's a water-saving toilet to recycle human waste. So why would Baker need one? As the young *Time* magazine reporter who lives in Cape Town explains, "This coastal paradise on the southern tip of South Africa is to become the first modern major city in the world to completely run dry." In other words – no clean water!

Over three years ago Cape Town officials announced that the city was heading towards 'Day Zero' – the moment when dam• levels would run so low that the city's taps• would be turned off. Residents would be sent to water collection points – protected by armed guards! Day Zero was predicted to occur in spring 2018, but so far it has been avoided. How come?

"We've cut down on water usage – dramatically," says Aryn Baker. Like all Cape Town residents, she's allowed only around 13 gallons• of water per day. Households that go over the limit must pay hefty• fines, or have a meter installed to shut off water. But if you think 13 gallons sounds like a lot, it's not. That daily amount, says Baker, is just enough for:

- a half-gallon of drinking water
- enough water to cook one meal
- one full sink to hand-wash dishes or laundry
- two hand washes
- two lots of tooth brushings
- one 90-second shower
- one toilet flush.

"I figured I could save an extra couple of gallons with a dry composting toilet," she says. "There's no way I'm going to flush more than a third of my precious daily water supply down a regular toilet."

And Baker is not alone in finding ways to reduce water use. "I wear the same clothes for days and fill the toilet with water from our washing machine," says Georgia, a Cape Town student.

Meanwhile, the cuts are

WATER STAT
Nearly half the global population live in areas that suffer water shortages for at least one month a year.

out?

PICTURESQUE PENNINSULA: Cape Town is one of the most beautiful cities in the world - but will the water crisis ruin it?

working: consumption has dropped from 1.2 billion litres a day in 2015 to 519 million litres this year. Still, the city aims to slash• usage to only 450 million litres a day.

YOU: You have to give up one activity above for a day – like a shower, brushing your teeth or a toilet flush – to save even more water. What would it be and why?

How did the crisis happen?

Nearly 800 million people worldwide live with no access• to safe clean water. The majority of them live in dry, desert regions, like sub-Saharan Africa. But Cape Town is a major metropolis, a tourist hotspot full of splashy• beachfront hotels and five-star restaurants. So how did such a massive crisis occur?

- Three years of severe drought – the worst in a century – have left dam and reservoir water levels dangerously low.
- Poor city planning has resulted in an outdated water system unable to cope with a soaring• population.
- Inaction by authorities has made the crisis even worse. For years, Cape Town officials merely publicised a 'Water Aware' campaign. "The rest of us prayed for rain," Aryn Baker says. Only when the city faced the shock of dry taps did lawmakers take action with tough cuts.

YOU: Your local officials ask you to conserve water voluntarily. Will you honestly do it? Why / Why not?

What's life like in Cape Town now?

"Once lush• city parks and golf courses have withered•," says *Time* magazine. Using taps to wash cars or fill swimming pools is now illegal.

In fact, water restrictions impact every aspect of Capetonian life. Says Georgia, "We don't play water polo, which is one of our school's main sports. We can't use the pool." Fellow student Claudia adds, "Field sports are out. So instead of soccer we play futsal – and we can't shower after sport. I carry hand sanitiser everywhere."

Trendy cafés use paper cups and plates to cut down on dishwashing. And anyone looking to stock up on bottled water has to queue – bottles fly off the shelves as soon as they arrive in stores.

Says resources analyst David Olivier, "The fundamental problem is our lifestyle. There's a sense of entitlement that we have a right to consume as much as we want."

YOU: If there was a water shortage where you live, how would it affect your city? And your school?

How widespread is the world's water shortage?

"What's happening in Cape Town can happen anywhere," says Aryn Baker. Until recently such a water shutdown would have been inconceivable•. But, says *National Geographic*, "as overdevelopment, population growth, and climate change upset the balance between water use and supply, major

cities around the world face threats of severe drinking-water shortages."

Many of Mexico City's 21 million residents, for example, only have running water part of the day. Officials in Melbourne, Australia – also affected by drought – warn the city is just a decade away from dry taps.

In fact, up to 3.5 billion people could live with water scarcity* by 2025 if steps aren't taken to conserve now. Yet the bigger problem is that the planet faces a warmer, drier future with more unpredictable rainfall, say climatologists at the University of Cape Town.

YOU: What do you think are the main reasons behind water shortages?

How is Cape Town trying to solve the crisis?

The city and region are racing to create new water supplies. Four new desalination* plants are under construction. New water wells are being drilled, and a plant to reuse effluent* is being built. "All but one project, however, is behind schedule," says *National Geographic*.

One expert has come up with a radical idea: lasso* an iceberg*! Engineer Nick Sloane wants to tow* an iceberg from Antarctica to Cape Town to feed the city's pumps. Needless to say, city officials have nixed* the plan. But solving the crisis will be anything but easy. As Cape Town student Claudia puts it, "Be grateful for the water you have. Be careful how you use water so that you don't end up like us."

YOU: Can you think of any ideas to bring water to Cape Town?

LISTEN
Track 2: Interview with a Cape Town student
www.mg-plus.net/audio

Now go to Language Checkpoint Page 22

WORDWISE

drought (n): a long period of little rainfall, causing a water shortage
metropolis (n): a very large and busy city
dam (n): a manmade lake that provides a water supply
tap (n): a device that allows water to flow, usually in a sink
gallon (n): a unit of volume equal to 4.55 litres
hefty (adj): a large amount
to slash (v): to cut by a lot
access (v/n): the ability to use something
splashy (adj): very fancy and impressive
soaring (adj): growing very fast
lush (adj): an area full of healthy grass, plants and trees
to wither (v): to dry out, to turn brown
inconceivable (adj): impossible to imagine
scarcity (n): a state of short supply; shortage
desalination (adj/n): turning ocean water into drinking water, mainly by removing salt
effluent (n): liquid waste, sewage
to lasso (v): to cover with a rope
iceberg (n): a large floating mass of ice
to tow (v): to move with a ship
to nix (v): to reject something

PRACTISE LANGUAGE LAB
Online activities on this article
www.mg-plus.net/languagelab

Belgian Steam Lesson Plan 2

GO! Atheneum Geraardsbergen
Papiermolenstraat 103
9500 Geraardsbergen
054/41 21 88

E-mail: secretariaat@ka-geraardsbergen.be
Website: www.ka-geraardsbergen.be

LESSON PLAN

TEACHER		STUDENTS	
surname	Borreman	subject	Applied informatics
name	Nicky	year	5 BI
subject	Applied informatics	date and period	9 March 2023 – 10 March 2023 (10:15 – 11:05pm) 14 March 2023 (11:05 – 11:55pm)

Lesson subject: Webdesign – My restaurant

Objective	Web design - Creating websites using HTML and CSS (integrated exercise)
Starting point	Part II of lesson dating March 7 In the previous lesson the students learnt how to add images to a website and they have practised this.
Sources used	• www.handleidinghtml.nl • https://www.w3schools.com/html/
Tools	worksheets Internet Evaluation rubric (Classroom)

Objectives	Lesson steps - Methods - Evaluation	MEDIA	Time

Part 2 - Websites 1. Website structure 1.1 Recognizing and naming the different parts and characteristics of a good web page. 1.2 Writing and using a hyperlink 1.3 Organising a complete website and dividing the information on different pages. 2. Implementation 2.1 Draft pages using the suitable fonds, colours, texts and links. 2.2 Integrating tables 2.3 Integrating images, audio, and video.	1. Motivational Fase Introduction • Handing out the assignment • Discussing the goal of the assignment: an integrated exercises which contains all the previously practiced web page elements: hyperlinks, tables, lay-out and images. : ◦ You have just opened your own restaurant and you wish to create a website to promote your business. ◦ You are free to design the website anyway you want but be creative! ◦ Your website has to meet the following standards: ▪ It has to contain at least 2 pages. ▪ The homepages (save as index.html) needs to have an opening word for your website's visitors and needs to invite them to explore the rest of your website. ▪ Through a link on your homepage you offer your visitor the option to go to the next page where they will find your menu (save as weekmenu.html). This page will open in the same browser window. ▪ You are free to choose the week menu yourself. ▪ For your week menu you need to use an non-ordened list which mentions the days of the week. ▪ When a visitor clicks a certain day the menu will immediately pop up. All menus are found on the same page so you will have to provide ankers. ▪ Each menu is accompanied by a suitable image (use the steps we discussed in class). ▪ Each menu needs to have a 'back' button so the visitor can click and go back to the list of menus per day. ▪ On each weekday menu you provide a link to a google page that allows the visitor to look up information on the dish you serve. This link opens in a new browser window. ▪ This assignment is made individually	Class assignment hand-out	15 min

	but of course you can help each other if necessary. You are allowed to use the Internet as well but keep the tips to make efficient searches in mind. ■ March 14 '23 is your final deadline so don't forget to hand in the link to your website on Classroom by then. Some tips: ○ Provide a creative but clear lay-out. ○ Check your text for spelling and/or grammar mistakes. ○ Divide the files in folders and sub folders in a logical and correct way. ○ Should you have finished before the deadline you can always add extras (audio, video). I'm convinced you will manage. 2. Learning fase · The students make this assignment individually. They are required to use the actions, steps and terms we have studied correctly (hyperlinks, tables, images, lay-out). The teacher is present in class to offer help if needed or when there are questions. 3. Lesson closure The students complete the self evaluation honestly: what went well/what was difficult; did they like the assignment yes/no. **Evaluation:** · Subject attitudes (work independently, work efficiently, respect the materials) → Evaluation class assignment	Formulier klastaak Notepad ++ Google Chrome Internet (o.a. https://www.w3schools.com/html/) Cursus	130 min 5 min

weekmenu.html

```
<html>
    <head>
        <title> Weekmenu </title>
        <link href="styles.css" rel="stylesheet" type="text/css" />
    </head>
    <body>
        <h1> <b> <a id="weekmenu">Weekmenu </b> </h1>
        <ul>
            <li><a href="#maandag"> maandag</a> </li>
            <li><a href="#dinsdag"> dinsdag </a> </li>
            <li><a href="#woensdag"> woensdag </li>
            <li><a href="#donderdag"> donderdag </a> </li>
            <li><a href="#vrijdag"> vrijdag </a> </li>
            <li><a href="#zaterdag"> zaterdag </a> </li>
            <li><a href="#zondag"> zondag </a> </li>
        </ul>
        <h1> <p> weekmenu: </p> </h1>

        <h2> <p> <a id="maandag"> maandag </p> </h2>
        <p> voorgerecht: </p>
        <ul>
            <li> <p> Kaaskroket </p> </li>
        </ul>
            <img src="images/kaaskroket.jpg" alt="Hier komt normaal een foto van een kaaskroket" title="kaaskroket" width="
        <p><a target="_blank" href="https://dagelijksekost.een.be/gerechten/kaaskroketten"> recept </a></p>
        <p> hoofdgerecht: </p>
        <ul>
            <li> <p> spaghetti bolognaise </p> </li>
        </ul>
        <p> dessert </p>
        <ul>
            <li> chocomouse </li>
```

Weekmenu

- maandag
- dinsdag
- woensdag
- donderdag
- vrijdag
- zaterdag
- zondag

weekmenu:

maandag

voorgerecht:

- Kaaskroket

recept

Belgian Steam Lesson Plan 3

Date:	4 February 2023
Subject:	Biology - Dutch - Art
Target group:	5th year (16-17 y-o)
Lesson title:	Study of populations - Bee populations + Class presentation + Creating our very own insect hotel
Skills:	theory + practice
Lesson duration:	100 minutes + finish at home
Teacher:	K. De Quick + M. Vanderroost + field study visit to a beekeeper
Didactic Tools:	handouts + Chromebooks + Google Classroom (slides) + insect hotel materials

Lesson objectives:

- Cooperation between Biology - Dutch and Arts
- Biology: students are taught about bee populations, how they work, the types of bees that form a population, how they create honey and what the job of a beekeeper consists of.
  → The lessons are closed with a visit to a beekeeper so they can see it for real.
- Dutch: students put the studied theory into practise and create a group presentation in which they present bees with general facts and necessary information to convince people not to hate them + they focus on why bees aren't to be hated.
  => they do this in a video or audio format so it can be used to inform people and the works can be spread on the school website in preparation for Spring and the arrival of the bees.

→ The students show the necessary interest in the subject to look up the information they need.
→ The students work together, respecting each other.
→ The students aren't afraid to ask questions if anything's unclear
→ The students know what a bee population is, what it's made up of, how honey is made, what they need to survive.
→ The students can name the different types of bees and know what their function in the population is.
→ The students know the correct words for different animal populations.
→ The students focus on language correctness, both in their written preparation as in their spoken outcome.
→ The students can use the correct tools while preparing their assignment (Google, Classroom, ...)
→ The students use relatable sources and save the URLs as proof.

Lesson progress:

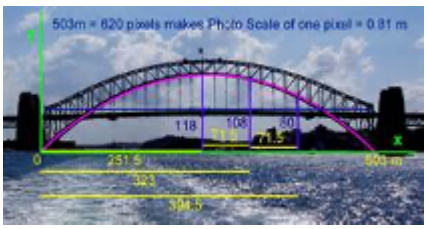
Biology (+ Dutch)	Step 1: Class quiz about names of animal populations. (played in teams of 2) → checking the students' knowledge. (

	Step 2: Theory - bee populations → how is a population formed? → how does a bee population form? → what types of bees form a population? → how can you recognize a queen + how does a beekeeper mark them? → what are possible threats to a bee population? → What diseases can they catch + what does a healthy bee look like? → What do beehives look like here and abroad? → Why is beekeeping hard in Vietnam? → What are the advantages of bees for humans. Step 3: Theory - the Asian hornet → discussing what the impact is of the Asian hornet in our country and how it affects the native bee populations. Step 4: Visit to colleague beekeeper P. Vanderhaegen to see for ourselves what a colony looks like, what honey combs are en learn from him how the process works / what the risks are / how long it takes / how difficult it is / ...
Dutch	What is expected? Many people consider wasps to be a great nuisance + they are scared of getting stung. The problem is that most people know hardly anything about them and are just out to get them killed. It's up to you to make a documentary / vlog / podcast / ... providing accessible information and answers to make people aware of the importance of these little buzzers. Information that should be provided: - Why are wasps useful? - Are all wasps the same? - Do all types of wasps bother us? - How does the climate affect the number of wasps that buzz around? - Why do wasps start bothering us around mid summer? - How to avoid getting stung? - What do you do when you are stung? - Explain the term 'addicted wasps' and what consequences this has. Create groups of three and divide the work among you. Create a shared Google doc. to work in. When done, hand in your final creation on Google Classroom. Focus on language correctness (both written and spoken), look up the correct terminology and speak at a comprehensible pace for the spoken parts. Useful websites:

	- www. tuindingen.nl/blog/insecten/hallo-ik-ben-een-wesp - www.natuurpunt.be/nieuws/dit-zijn-de-5-grootste-misverstanden-over-wespen-20190605 - www.wespennest.vlaanderen/alles-over-wespen - www.vrt.be/vrtnws/nl/2022/08/22/opinie-wespen - www.naturetoday.com/intl/nl/nature-reports/message/?msg=23496

Belgian Steam Lesson Plan 4

Date:	22 November 2022
Subject:	Mathematics and English
Target group:	6th year (17-18 y-o)
Lesson title:	What role do mathematics play in real life?
Lesson duration:	100 minutes + finish at home
Teacher:	P. Van Mello & C. Coudron
Didactic Tools:	handout + Chromebook
Lesson objectives:	
Students will examine two examples of how the Pythagorean Theorem is used in real life situations. They will work in teams to determine other examples of math in the real world and create a commercial to convince people that learning math is important.	
Lesson progress:	
Step 1	a class discussion in which students give examples of when they have used math within the last month – OUTSIDE the classroom. Ask them to explain what a pipefitter and a baseball player have in common and how they think each would use math.
Step 2	View with students The Pipefitter and the Pythagorean Theorem and discuss the importance of math in that career. Engage students in the Baseball interactive and again discuss the Pythagorean Theorem and math in the real world. ⇒ Video 1: The Pipefitter and the Pythagorean Theorem ⇒ Video 2: The Baseball interactive and the Pythagorean Theorem
Step 3	Students take a closer look at the images below and discuss the link with

	mathematics among them.      
Step 4 (English)	Design Challenge: Advertising a commercial → Discuss advertising with students: what are their favorite/least favorite commercials, what makes a commercial good or bad? → Divide students in teams of advertising professionals → Each team will create a 2-minute commercial illustrating why the world needs mathematics and how mathematics can be found all around us. → The commercial will include a slogan and an informational segment (props and visuals need to be included) on how mathematics are used in our everyday lives. → Finished commercials will be uploaded on Classroom and later watched by the whole class.

Belgian Steam Lesson Plan 5

Date:	4 March 2023
Subject:	Engineering, Mathematics and Arts
Target group:	6th year (17-18 y-o)
Lesson title:	How to build a better birdhouse?
Lesson duration:	4 class periods (theory and creating combined)
Teacher:	B. Niemegeers & F. Van Neyghem

Didactic Tools:	Chromebook + construction materials for bird house
Lesson objectives:	
Students will design and build a structure for a specific purpose. Emphasis is placed on the process. Students will analyze the problems and needs in construction Students will diagram a solution using materials at hand Students will construct a feeder/bird house	
Lesson progress:	
Step 1	In preparation for this lesson, students had to watch this video: 'John Ochsendorf; structural engineer' (9:51) as homework. Students watch the following video: 'Engineering Design Process'. (4:50) This video gives a good description of how engineers work, tackle problems and create solutions. After watching, students' opinions are asked and the video is discussed to see what they think about the way the engineers handled all of it.
Step 2	Focus on bird feeders/birdhouses. Students watch the following video: 'Backyard Birdfeeders'. (2:50) This video examines different bird feeders and bird food. Engage the students in a discussion of the most important considerations to keep in mind when designing a bird feeder.
Step 3	Explaining the activity: 1. Before design and construction students should consider the following: · What construction materials are available? · How will materials be connected? · How will the feeder be hung? · How will the feeder be cleaned? · What type of bird seed will be used and how will the feeder be filled? 2. Design Process: · Create a materials list for the feeder. · Use a ruler or a measuring tape to measure all the construction items. · Use graph paper to design your bird feeder. · Submit the design plan to the teacher for approval. 3. Construction Process:

	· After design approval students will construct their feeders. Remind them that part of the design process is to clean up after themselves.

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LESSON PLAN

LESSON: Maths

DURATION: 90'

Students' class: 11th – 12th grade

Number of students: 20 – 30

Teachers: Stefano Calvano – Marilena Sarchione

DESCRIPTION

To encourage students to think about their own creativity and how they could develop it further. Methodology: project-based learning working online.

PROCEDURE

The lesson took place online on the Microsoft Teams platform; the teacher uploaded the teaching material to a folder accessible to all pupils and conducted the lesson by sharing his screen.

At the beginning of the lesson the pupils were introduced to the project-based learning methodology used.

In the first part of the lesson the teacher showed the pupils a video about the measurement of the Earth's radius made by Eratosthenes in ancient times; the high accuracy of the measurement was achieved by using simple knowledge of goniometry and observation of natural phenomena.

https://www.nagwa.com/en/videos/287108723870/

On the basis of the project method introduced, the pupils were divided into random groups, through the creation of different virtual rooms, and were asked to solve some reality tasks, the solution of which required the same knowledge of trigonometry as that shown in the video. To support the pupils, the teacher provided a summary of the main theorems of trigonometry.

In the final part of the lesson all pupils returned to the main virtual room for a discussion on the solution methods used for the reality problems. The teacher corrected any errors that had arisen and provided an explanation of the solution path to follow in each exercise.

ASSESSMENT

Some difficulties were encountered due to the division of the pupils into random groups. Some of the groups were made up of pupils who had already dealt with those topics in class and were able to solve the problems more easily. Other groups were made up of pupils who were dealing with trigonometry for the first time, but with the help of the teacher they were able to apply their knowledge correctly and achieved their goal.

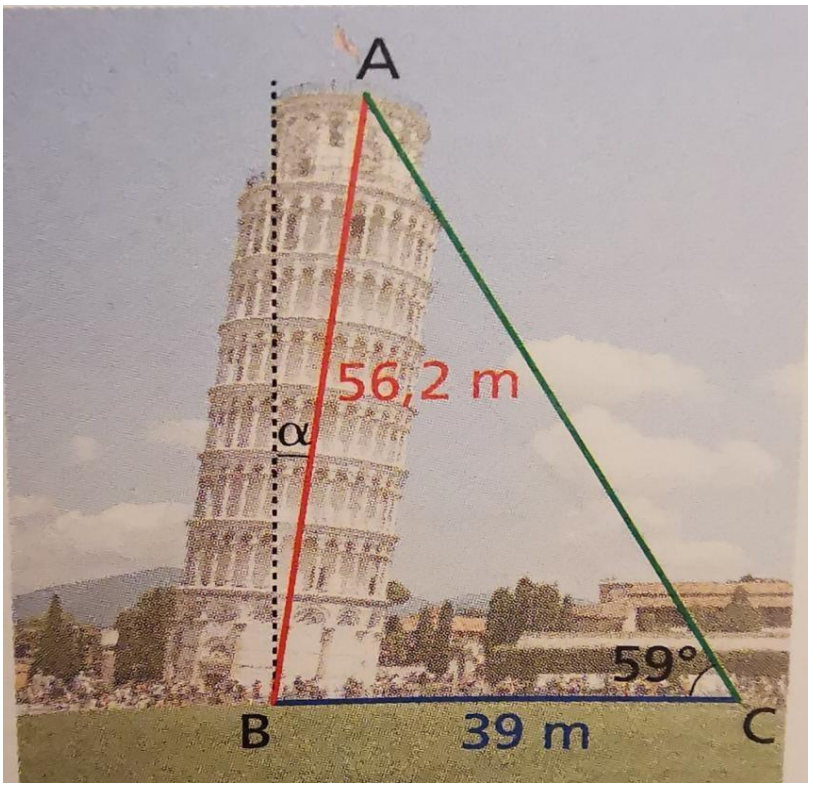
Reality Tasks Maths Workshop

Exercise No. 1

Leaning Tower

The Leaning Tower of Pisa is a bell tower, famous for its steepness. The top A of the tower is 56.2 m from the center B of the base of the tower. From a point C on the ground, 39 m away from center B, summit A can be seen at an elevation angle of 59°.

How much is the tower inclined with respect to the vertical axis?



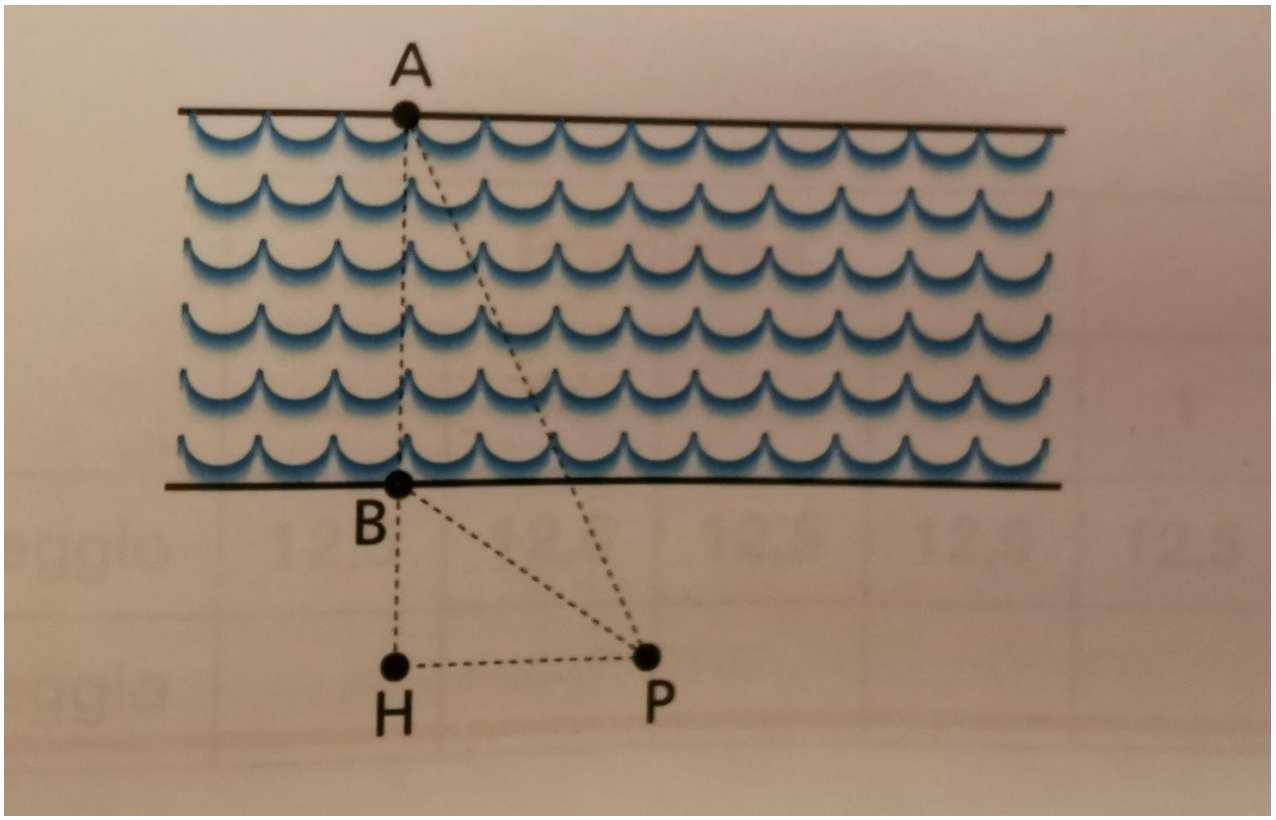
From shore to shore

A surveyor has to measure the width of a canal. After identifying the reference point A on the opposite bank, he pitches two poles: one on the embankment in position B and the other in position H, so that the line ABH is perpendicular to the banks.

From position P, such that $\widehat{PHA}$=90°, he measures the angles $\widehat{HPB}$, $\widehat{HPA}$ and the distance PH:

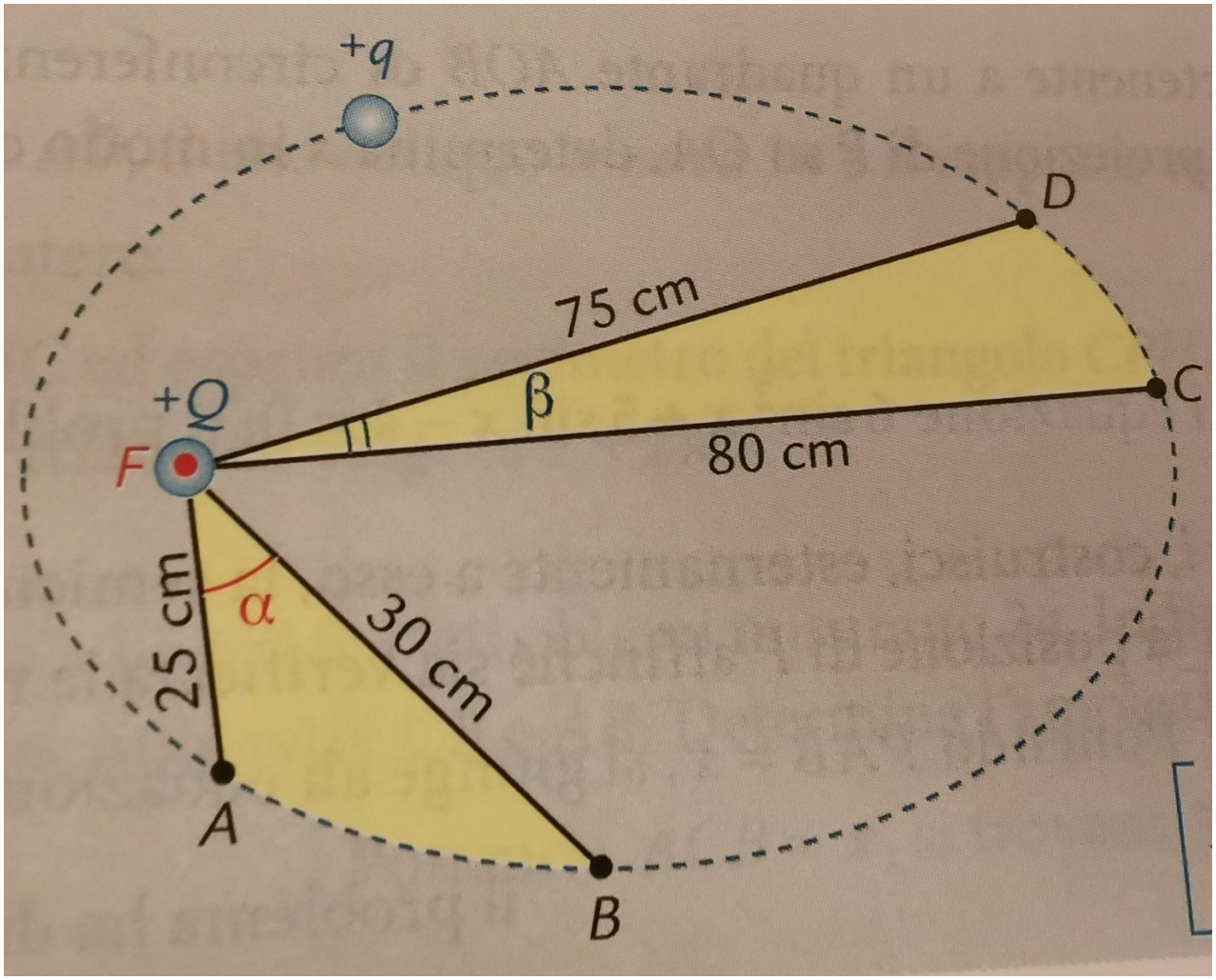
$\widehat{HPB}$=35°; $\widehat{HPA}$=65°; PH=20 m.

What is the AB width of the canal?



An electric charge +q orbits around another charge +Q and, according to the electric analougue of Kepler's laws, it travels through an ellipse of which +Q occupies one of the foci and its position vector with respect to this point describes equal areas in equal times. The figure shows the situation, assuming that the two colored areas correspond to equal time intervals. Assuming we approximate these areas with those of the corresponding triangles, what is the ratio between sin α and sin β?

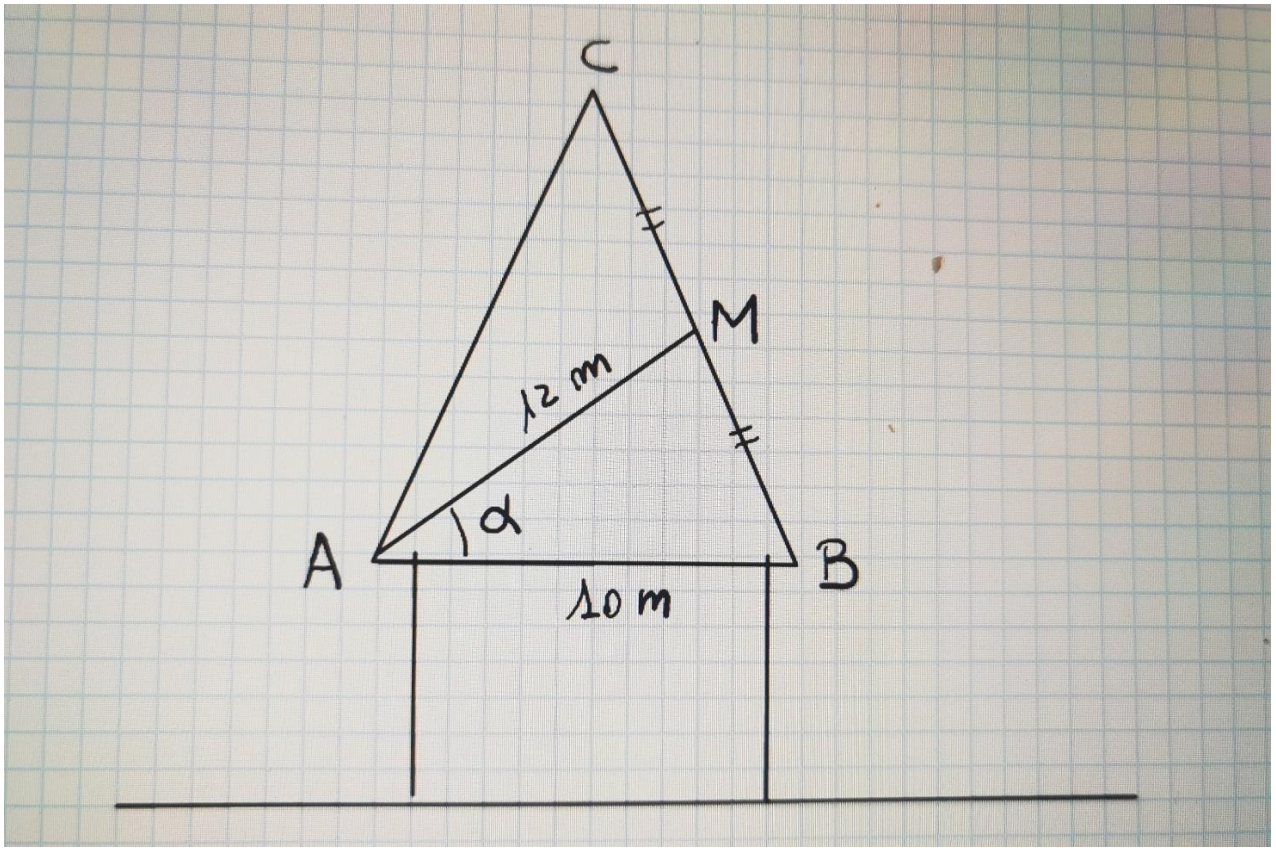
Assuming α=45°, how long are the segments AB and CD?



Exercise No.
PAGE 2

A builder has designed the roof structure illustrated, with $\cos \alpha = \frac{5}{16}$.

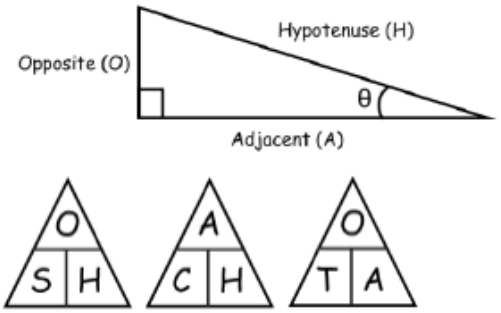
Explain why it's impossible to construct a roof that satisfies the described properties.



Exercise No.

Trigonometry and Sine & Cosine Rules Formulae Sheet

Trigonometry

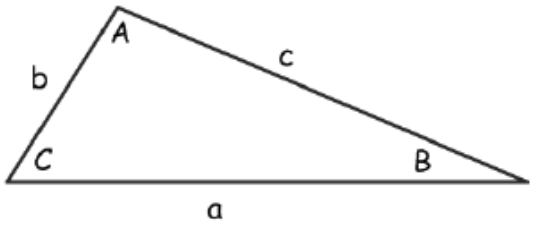


$$Sin\theta = \frac{Opp}{Hyp}$$

$$Cos\theta = \frac{Adj}{Hyp}$$

$$Tan\theta = \frac{Opp}{Adj}$$

Sine & Cosine Rules



The Sine Rule

$$\frac{a}{SinA} = \frac{b}{SinB} = \frac{c}{SinC}$$

$$\frac{SinA}{a} = \frac{SinB}{b} = \frac{SinC}{c}$$

The Cosine Rule

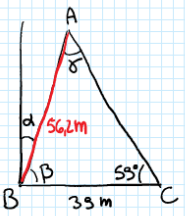
$$a^2 = b^2 + c^2 - 2bcCosA$$

$$CosA = \frac{b^2 + c^2 - a^2}{2bc}$$

Area of a Triangle

$$Area = \frac{1}{2}abSinC$$

Ex 1.



For The Sine Rule

$$\frac{AB}{\sin 55°} = \frac{BC}{\sin\gamma} \Rightarrow \sin\gamma = \frac{BC}{AB}\cdot \sin 55°$$

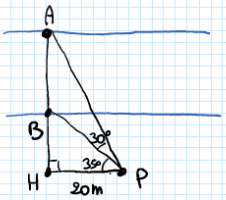
$$\sin\gamma = \frac{39}{56.2}\cdot \sin 55° = 0,595$$

$$\gamma = \sin^{-1}(0,595) = 36,5°$$

$$\beta = 180° - 55° - 36,5° = 84,5°$$

$$\Rightarrow \alpha = 90° - 84,5° = 5,5°$$

Ex 2



$H\hat{P}B = 35°$

$PH = 20\ m$

$H\hat{P}A = 65°$

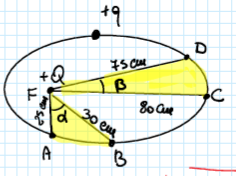
$$\tan\theta = \frac{BH}{HP} \Rightarrow BH = HP\cdot\tan\theta$$

$$\Rightarrow BH = 20\cdot\tan 35° = 14\ m$$

$$AH = PH\cdot\tan H\hat{P}A = 20\tan 65° = 42,9\ m$$

$$\Rightarrow AB = AH - BH = (42,9 - 14)\ m = 28,9\ m$$

Ex 3



Area of a Triangle : $A = \frac{1}{2}ab\sin\alpha$

$$A_{ABF} = \frac{1}{2}\cdot 25\cdot 30\cdot\sin\alpha$$

$$A_{CDF} = \frac{1}{2}\cdot 80\cdot 75\cdot\sin\beta$$

$$\Rightarrow \frac{A_{ABF}}{A_{CDF}} = \frac{1}{8}\frac{\sin\alpha}{\sin\beta}$$

$$\Rightarrow \frac{\sin\alpha}{\sin\beta} = 8$$ because $A_{ABF} = A_{CDF}$ for the II Kepler's law.

If $\alpha = 45°$ $\Rightarrow$ for the COSINE RULE

$$AB^2 = AF^2 + BF^2 - 2AF\cdot BF\cdot\cos\alpha$$

$$\Rightarrow AB = \sqrt{25^2 + 30^2 - 2\cdot 25\cdot 30\cdot\cos 45°} = 21,5\ cm$$

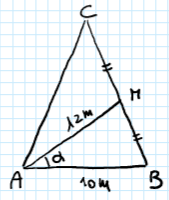
$$CD = \sqrt{80^2 + 75^2 - 2\cdot 80\cdot 75\cdot\cos 5°} = 8,5\ cm$$

because

$$\sin\beta = \frac{\sin\alpha}{8} = \frac{\sqrt{2}/2}{8} = \frac{\sqrt{2}}{16}$$

$$\beta = \sin^{-1}\left(\sqrt{2}/16\right) = 5°$$

Ex. 4



$$\cos\alpha = \frac{5}{16}$$

$$\sin\alpha = \sqrt{1 - \cos^2\alpha} = \sqrt{1 - \left(\frac{5}{16}\right)^2} = 0,93 \Rightarrow \alpha = \sin^{-1}(0,93) = 71,8°$$

For the cosine rule :

$$BM = \sqrt{10^2 + 12^2 - 2\cdot 10\cdot 12\cdot\frac{5}{16}} = 13\ m$$

$BC = 26\ m$

For the sine rule :

$$\frac{AM}{\sin\beta} = \frac{MB}{\sin\alpha} \Rightarrow \sin\beta = \frac{AM}{MB}\sin\alpha = \frac{12}{13}\cdot 0,93 = 0,88$$

$$\beta = \sin^{-1}(0,88) = 61°$$

$\alpha > \beta$ impossible

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2020-1-BE02-KA229-074698

STEM AND CREATIVITY

Giuseppina Addeo - Polo Liceale “R. Mattioli” – Vasto (CH), Italy

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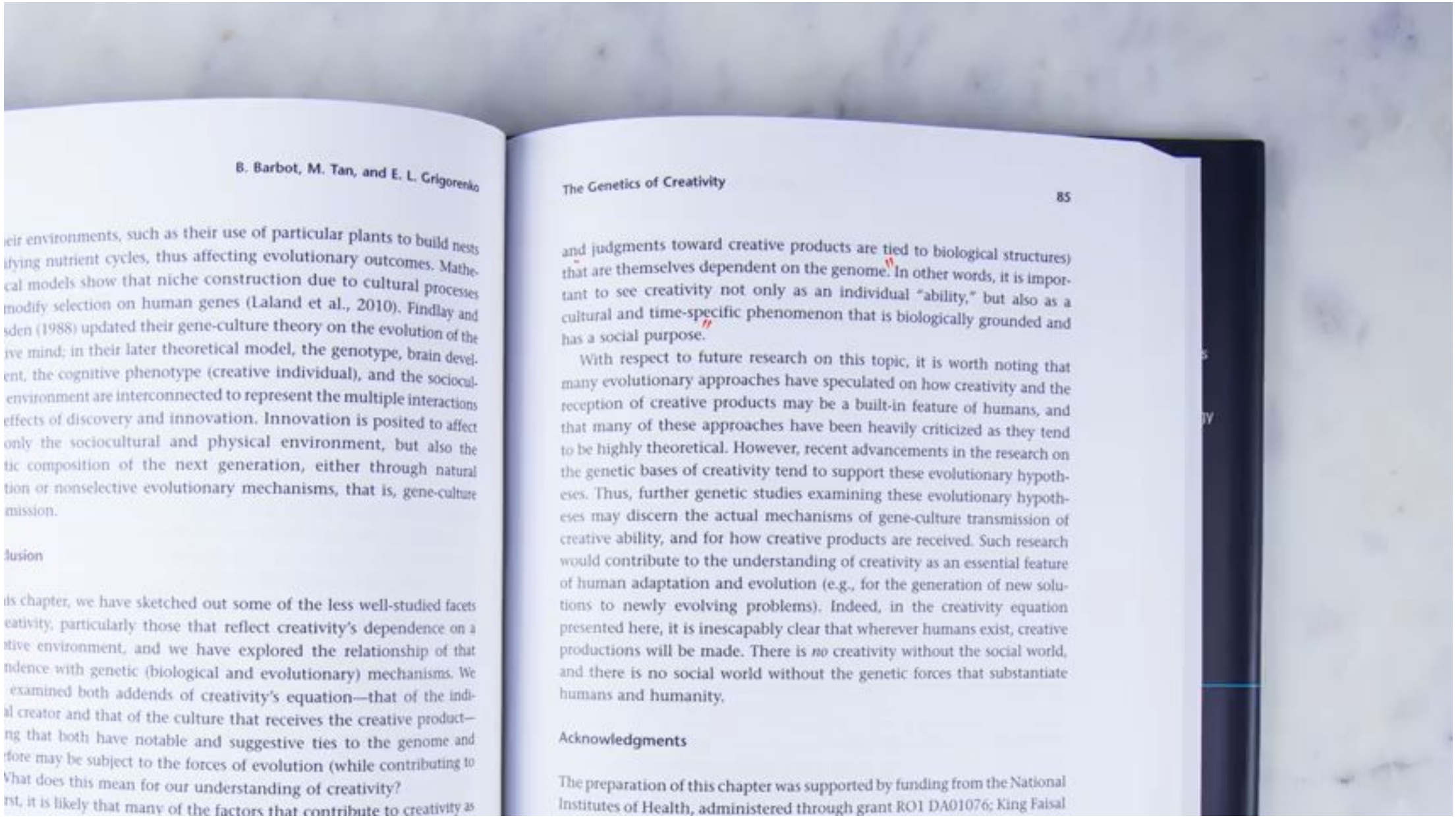
Video 1



B. Barbot, M. Tan, and E. L. Grigorenko

eir environments, such as their use of particular plants to build nests
ifying nutrient cycles, thus affecting evolutionary outcomes. Mathe-
cal models show that niche construction due to cultural processes
modify selection on human genes (Laland et al., 2010). Findlay and
sden (1988) updated their gene-culture theory on the evolution of the
ive mind; in their later theoretical model, the genotype, brain devel-
ent, the cognitive phenotype (creative individual), and the sociocul-
environment are interconnected to represent the multiple interactions
effects of discovery and innovation. Innovation is posited to affect
only the sociocultural and physical environment, but also the
tic composition of the next generation, either through natural
tion or nonselective evolutionary mechanisms, that is, gene-culture
mission.

lusion

is chapter, we have sketched out some of the less well-studied facets
eativity, particularly those that reflect creativity's dependence on a
tive environment, and we have explored the relationship of that
ndence with genetic (biological and evolutionary) mechanisms. We
examined both addends of creativity's equation—that of the indi-
al creator and that of the culture that receives the creative product—
ng that both have notable and suggestive ties to the genome and
fore may be subject to the forces of evolution (while contributing to
What does this mean for our understanding of creativity?
rst, it is likely that many of the factors that contribute to creativity as

The Genetics of Creativity 85

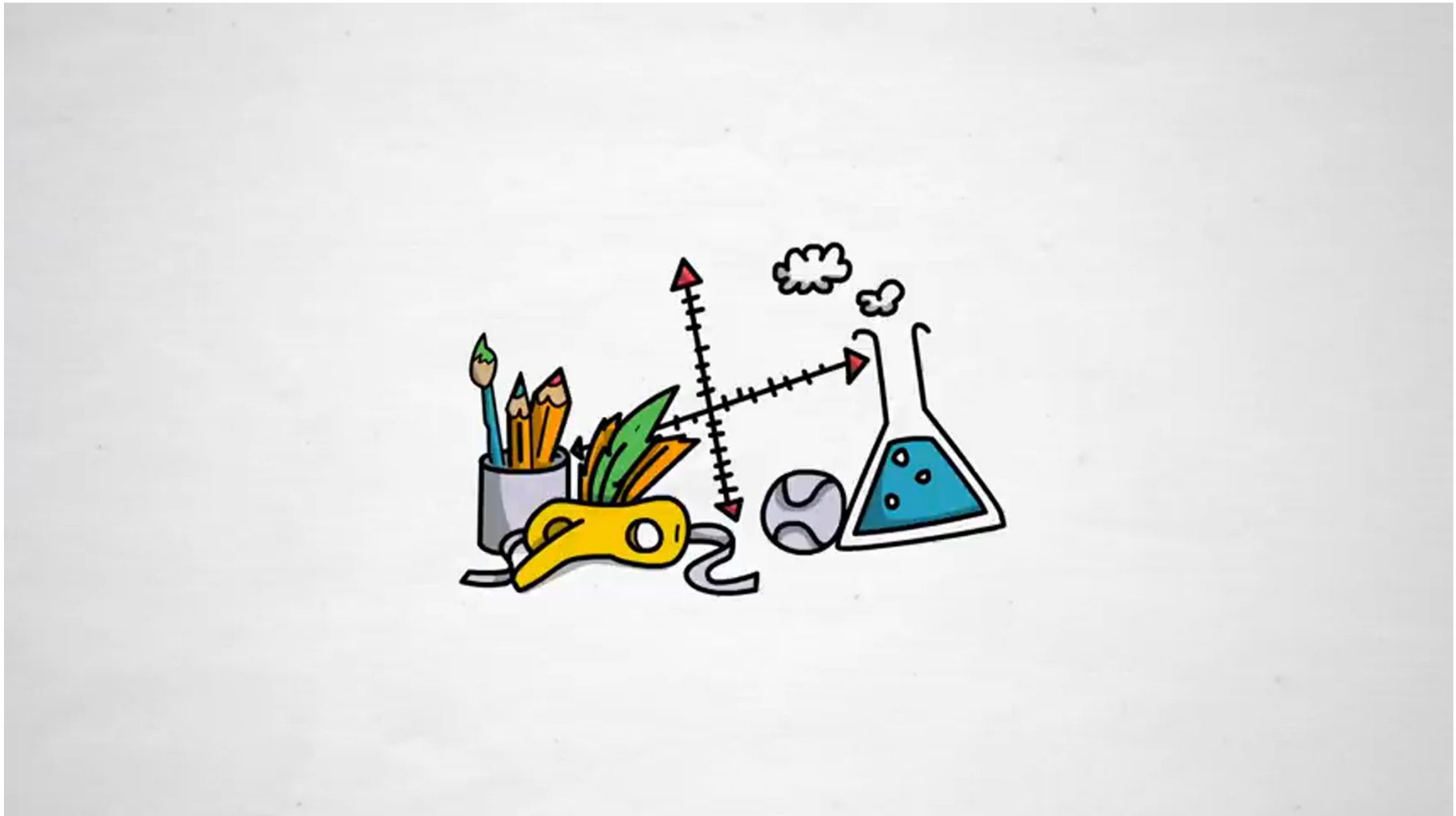
and judgments toward creative products are tied to biological structures) that are themselves dependent on the genome. In other words, it is important to see creativity not only as an individual "ability," but also as a cultural and time-specific phenomenon that is biologically grounded and has a social purpose.

With respect to future research on this topic, it is worth noting that many evolutionary approaches have speculated on how creativity and the reception of creative products may be a built-in feature of humans, and that many of these approaches have been heavily criticized as they tend to be highly theoretical. However, recent advancements in the research on the genetic bases of creativity tend to support these evolutionary hypotheses. Thus, further genetic studies examining these evolutionary hypotheses may discern the actual mechanisms of gene-culture transmission of creative ability, and for how creative products are received. Such research would contribute to the understanding of creativity as an essential feature of human adaptation and evolution (e.g., for the generation of new solutions to newly evolving problems). Indeed, in the creativity equation presented here, it is inescapably clear that wherever humans exist, creative productions will be made. There is *no* creativity without the social world, and there is no social world without the genetic forces that substantiate humans and humanity.

Acknowledgments

The preparation of this chapter was supported by funding from the National Institutes of Health, administered through grant RO1 DA01076; King Faisal

Video 2



Video 3


GROWTH
HUMAN RESOURCES
Benefits
Skill
Promotion
Career
TEAMWORK
Vision
PARTNER
Bonus


GROWTH
HUMAN
RESOURCES
Benefits
Skill
Promotion
Career
TEAMWORK
Vision
PARTNER
Travel
Bonus

...CREATI
!

creativity

[kriːeɪˈtɪvɪti]

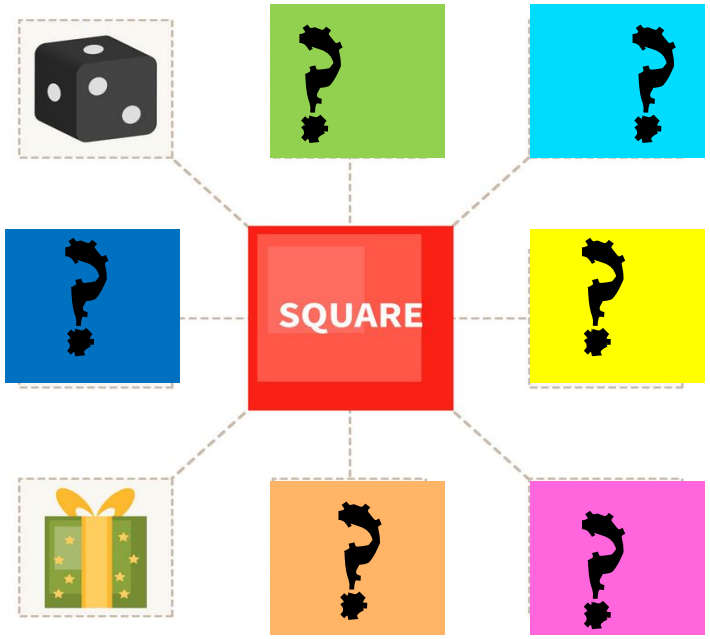
noun .....

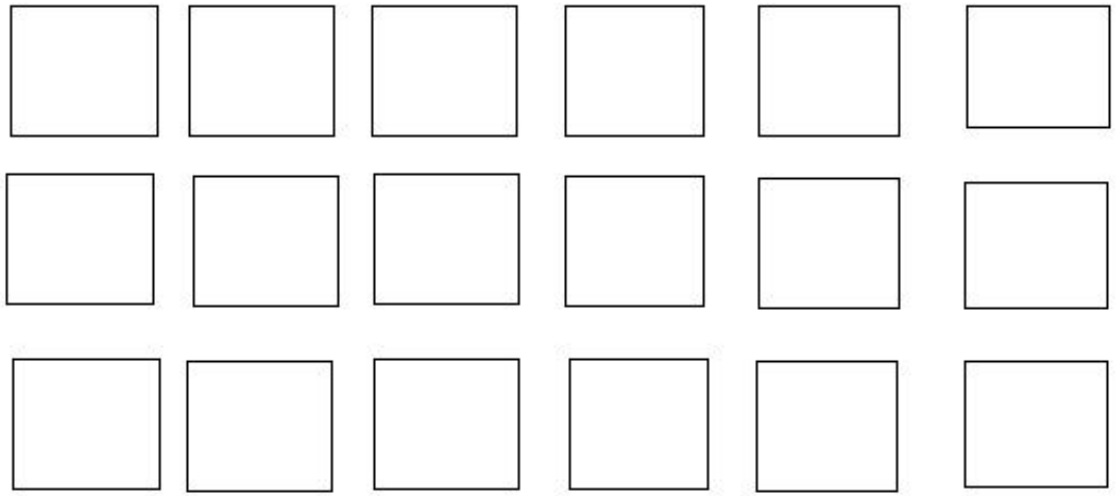
WHAT IS CREATIVITY FOR YOU? ARE YOU A CREATIVE PERSON? DO SOMETHING TO IMPROVE THIS SKILL?

WHAT SCIENTISTS KNOW ABOUT

Creativity task 1: you just need to note your creativity!

1. Draw 18 squares on a piece of paper, as you can see below
2. When I say ‘Go!’, you have **five minutes** to turn each of the squares into a recognisable object, e.g. a present or a house
3. Is your work an evidence of your creativity?





TEAMWORK

Creativity task 2 : Are you creative?

Compare your completed squares with your partners and discuss about your work and your attitude to be creative.

Some of you are more creative than others? How can you become more creative?

Write down your answers in the chat

YOU have 7 minutes to complete the task


Left
$E=mc^2$
Right

Creativity task 3: learning creativity…

In your group

Read the articles, watch the video and decide all together which tools are the best tips to enhance young creativity.

10 minutes

5 advice

A Get your legs moving

In a recent experiment, scientists gave the same task to a group of people who stayed sitting down and to a group who went for a stroll outside. What they found supports what many people believe, that getting out and about is very good for creativity. In fact, 100 per cent of the group that went for a walk produced better quality ideas and produced them more quickly.

The researchers then compared a group walking on a treadmill inside with those stretching their legs outside and found that while being outside was good for creativity, even walking on a treadmill helped, which suggests that it is the movement which is most important.

B. Daydream

Your teacher may tell you off for staring out of the window at nothing, but having a wandering mind may be a sign of intelligence and creativity, according to a new study. The scientists recorded brain activity while people lay still, but not asleep, and concluded that daydreaming can help people become better problem-solvers. However, if you're simply not paying attention when you should be, that clearly isn't beneficial.

C Think outside the box

Be willing to challenge things that you have always done. A group of Japanese watermelon farmers had an issue with the way that watermelons were difficult to pack and store. Their round shape meant that they took up a lot of space, making their transport more expensive. But why do watermelons actually need to be round? thought the farmers. They began growing the fruit in square glass boxes, thus creating square watermelons. They just needed to think differently to find the perfect solution.

D Have a good laugh

Believe it or not, more than one research study has shown that people who watch a comedy film are much better afterwards at coming up with a creative solution to a problem than those who watched a horror film. It appears that having a chuckle makes us feel more relaxed, which helps the creative process. It is very difficult to be creative when you're stressed, because the mind is too focused on survival.

E Noise

You might imagine that you will be at your most creative if you are able to work in complete silence, but you'd be wrong. Research shows that for most creative tasks, a low level of noise, like the chatter that you get in a café, is best. Complete silence is good when you need to focus on a difficult task, but when you want to come up with ideas, try a little hubbub.

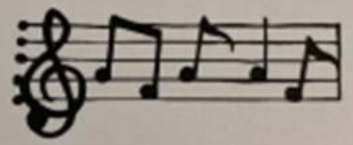
8 tips

MAKE 5

SING IT

Choose a simple, common melody and make up lyrics that describe your idea. Use a song that everyone knows:

- Jingle Bells
- Happy Birthday To You



Or, write a 30-second catchy advertising jingle for your idea.

MAKE 1

DRAW A PICTURE

Anyone can doodle! Even the most abstract problems benefit from visualization.

- **Cartoonify** your idea: use bold, exaggerated shapes
- **Iconize** your idea with simple symbols

Adding color helps: Use colored crayons or felt-tip markers.

NCUBATE

…ople work harder …other people. But …lly, they also take …off—because they …ll have their best ideas …re not working. Make …e weekend days off, …ur annual vacation.

DO SOMETHING FOR THE FIRST TIME

When was the last time you did something for the first time? Try...

- Hula-Hooping
- Baking bread
- Building a card tower
- Volunteering

2

1 get a piece of … minutes to lis… uses as you c…

CHO… and idea improvement.

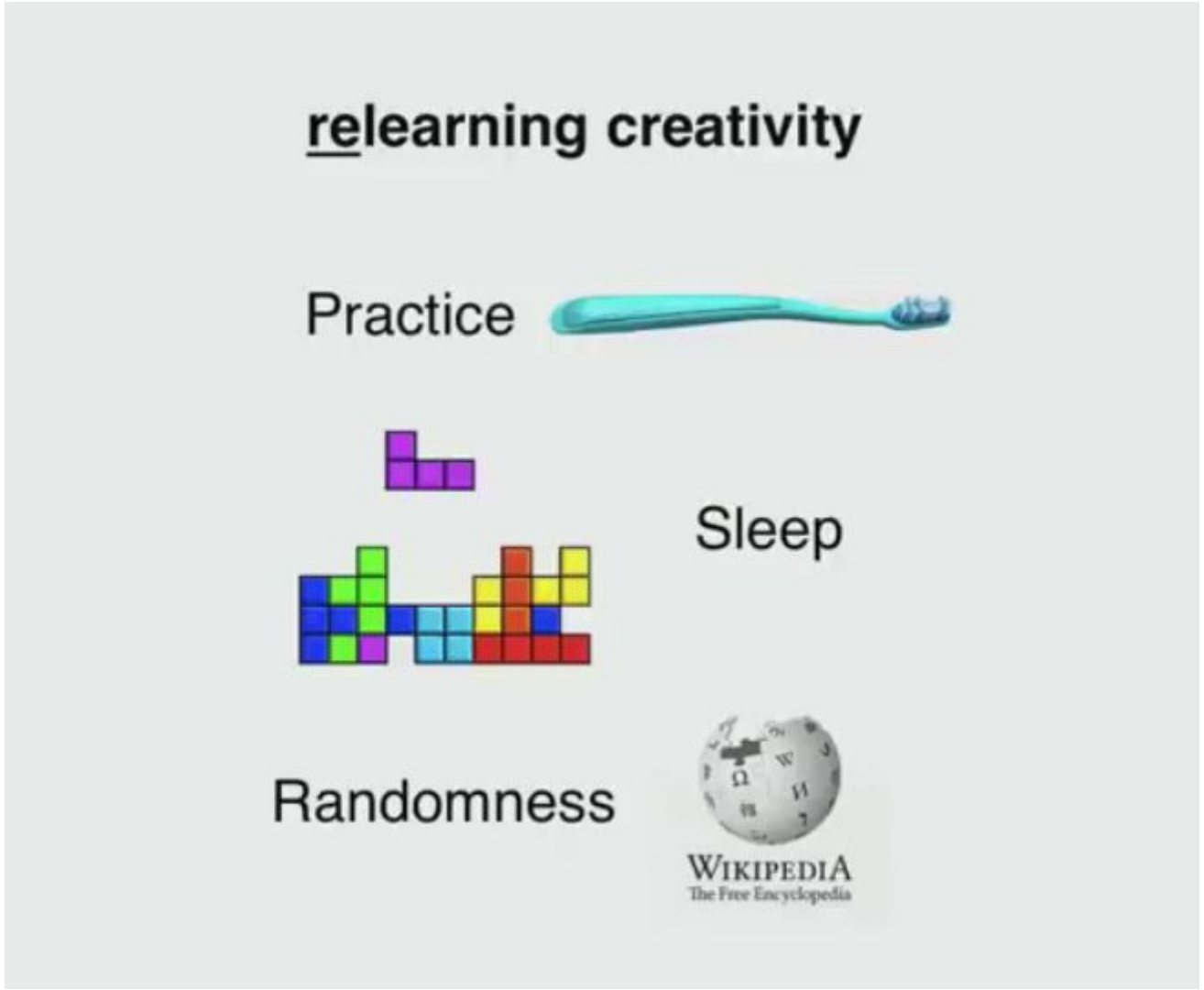
+	-	!

4

IDENTIFY THREE BENEFITS

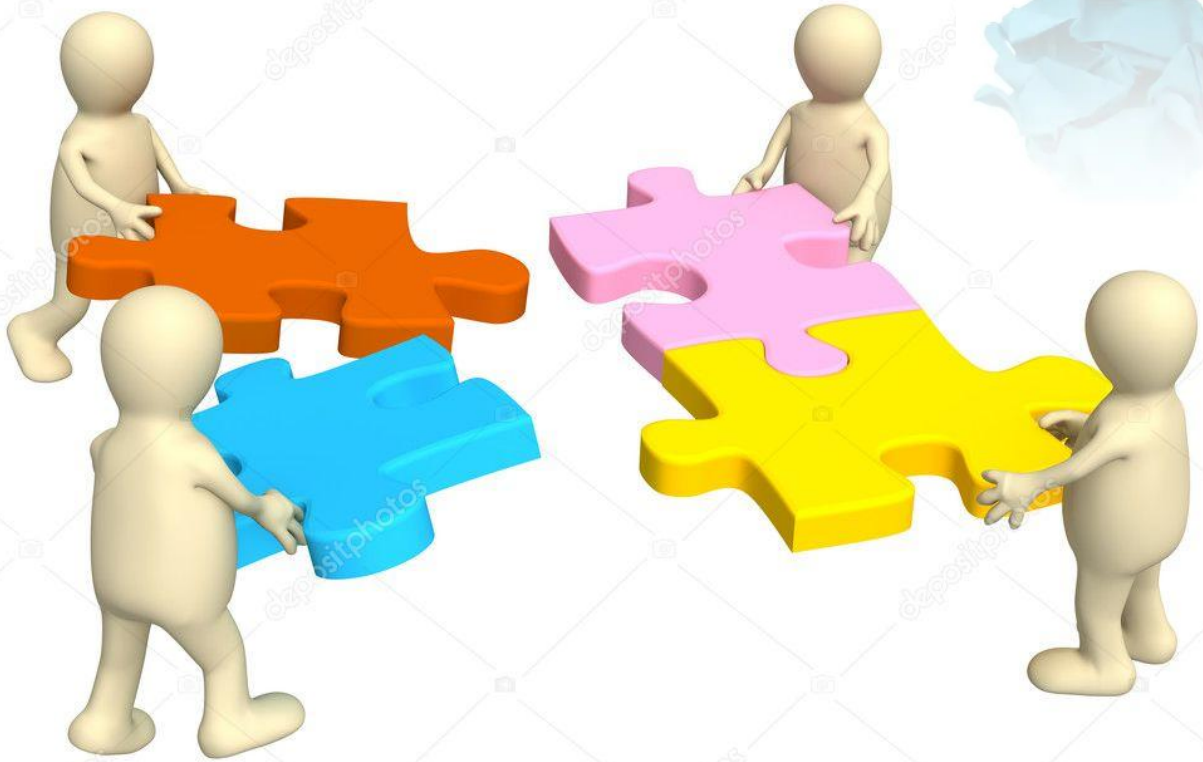
Start with an idea that you're attracted to and you're not sure why, because you're pretty sure it's not worth pursuing.

1. List at least three benefits to the idea. Think about each one a few minutes, and then ask yourself: Do you like the idea any more now?
2. What practical steps would you have to take to make this idea a reality? List at least three. Ask yourself: Did generating this list make you more receptive to the idea?



Tools from video

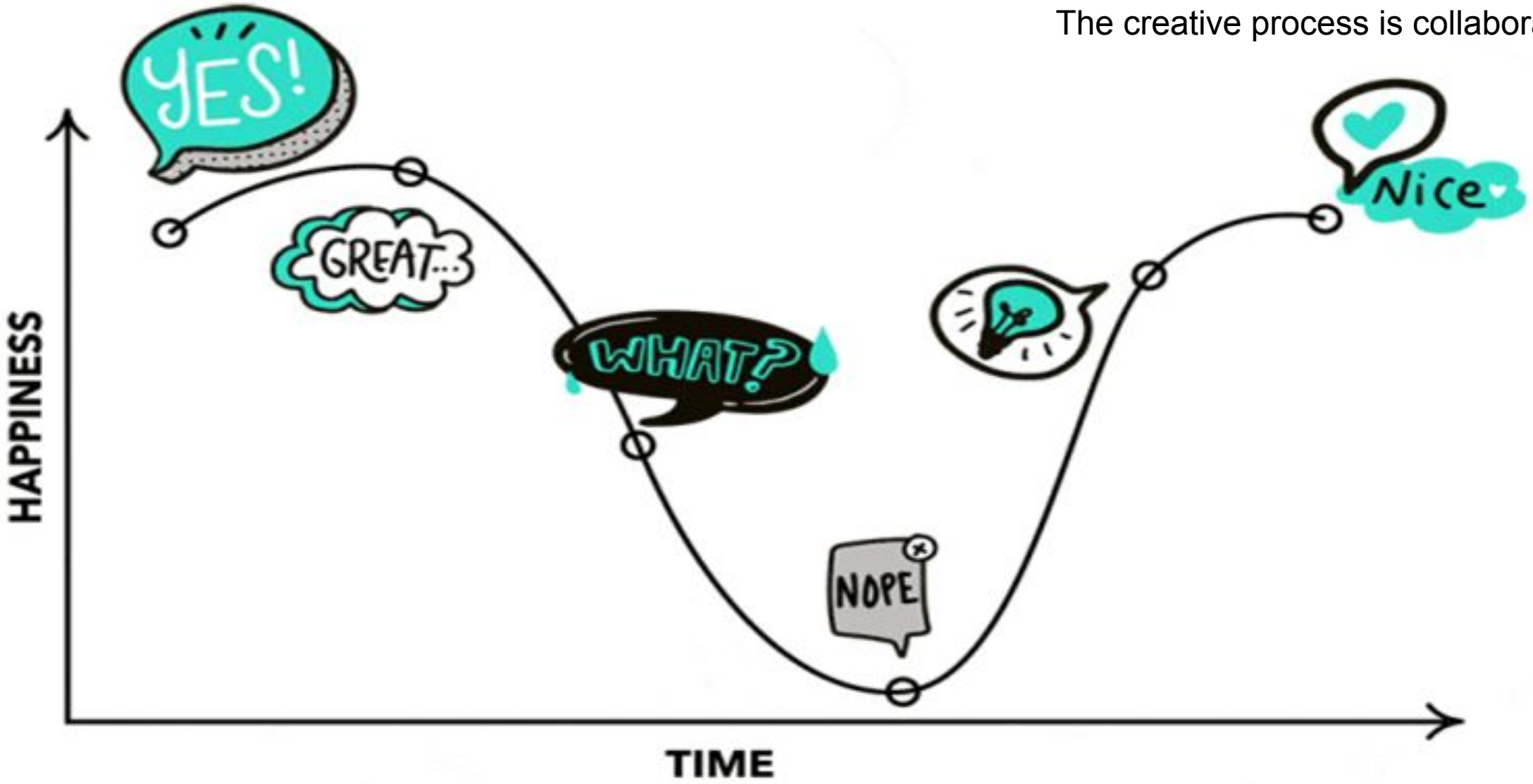
Which is the best tool to young people?



Fill in the form at the link!

creative skill!

The creative process is collaborative!



The creative process could be hard!

THANK you very much!

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LESSON PLAN

LESSON: Science – Creativity

DURATION: 50'

Students' class: 11th – 12th grade

Number of students: 20 – 30

Teacher: Giuseppina Addeo

DESCRIPTION

To encourage students to think about their own creativity and how they could develop it further. Methodology: project-based learning working online.

Tasks

Objectives

1. To encourage students to think about themselves
2. To provide reading and speaking practice using the topics of creativity and innovation
3. To promote the cooperation among students

PROCEDURE

Warm-up

1. Show the students the opening slide with the title. Tell them that this lesson is about creativity. Ask students if they think they are creative people.
2. Ask them to watch the video of slide 4.
3. Tell the students to answer the questions on slide 5. Allow three minutes to write individually in the chatbox.
4. Ask them to watch the video of slide 6 to learn something more about creativity.

Task 1: You just need to note your creativity!

1 Tell every student that they are going to test their creativity. Allow three minutes to doodle in the squares they have just drawn.

2 Ask the students for their feedback at the end of the activity.

Task 2: Are you creative?

1 Tell the students to work in a team. Use ‘breakout rooms’ (where students work separately in smaller groups).
2 Show the students slide 9.
3 Ask them to discuss their answers in their groups.
4 Give the students 7 minutes for this activity and ask them to post their feedback in the chatbox.

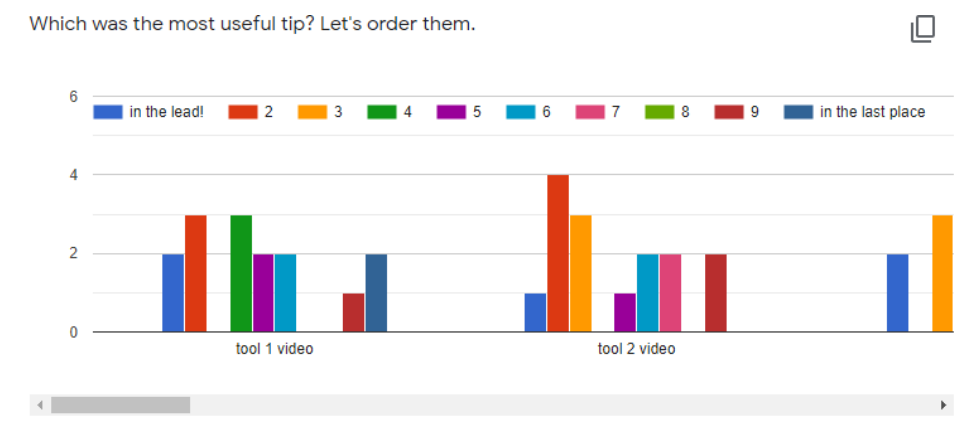
Task 3: Learning creativity..

1 Ask the students to watch the video of slide 10.
2 Tell the students to work in a team again using the same ‘breakout rooms’. Tell the students you are going to show them three tools to learn creativity. They offer some different ways to become more creative.
3 The students should read the articles, watch the video and decide altogether which tools are the best tips to enhance their creativity.
4 They have to write their answers in a Google form (link on slide 16) Give them 10 minutes to complete this task.

ASSESSMENT

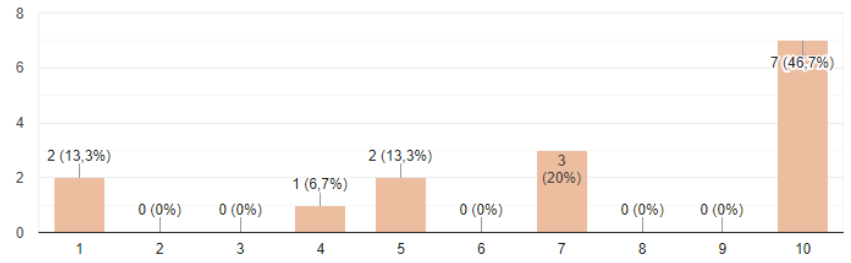
At the end of the activity, not all the teams had entered their answers on the Google form provided. However, there was time to discuss the students’ feedback.

The system generated a detailed report with their answers to same questions:



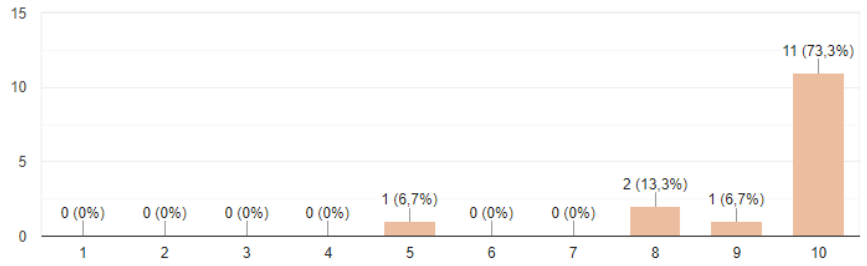
We have worked together and we have all contributed

15 risposte



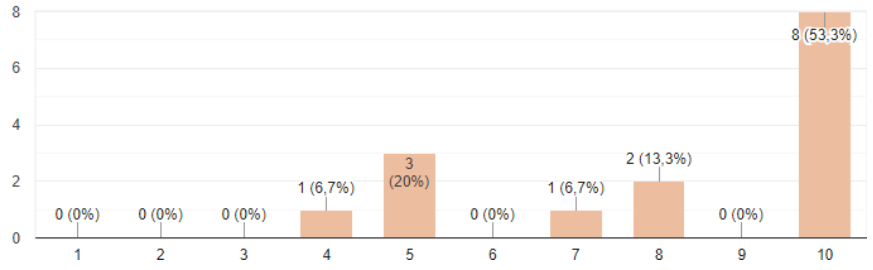
There was mutual respect and respect among us

15 risposte



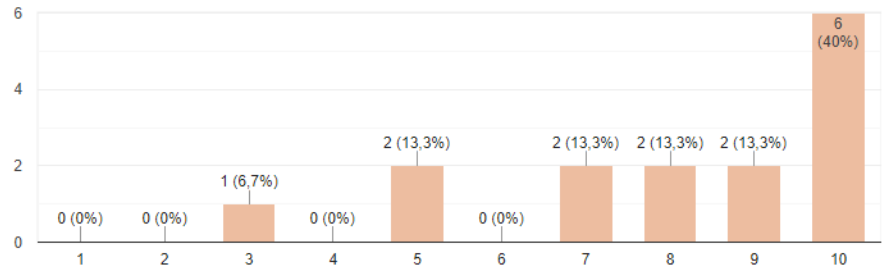
The procedure adopted by the group to achieve the objective was optimal

15 risposte



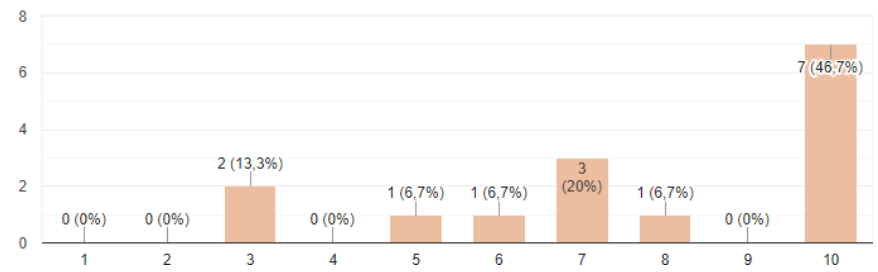
The result pleased us

15 risposte



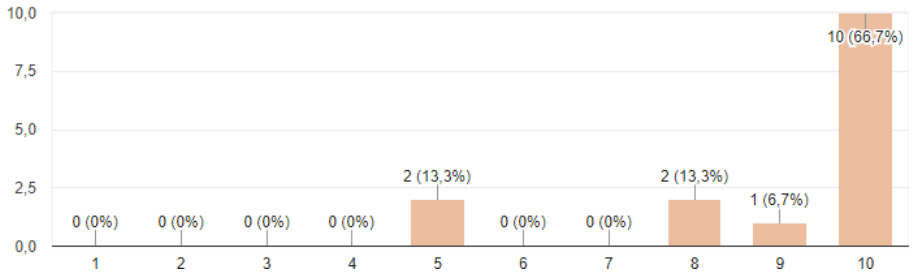
I was available to collaborate with the other members of the group

15 risposte



We enjoyed the project and would like to repeat the experience

15 risposte



The assessment meets the objective of the activity. Working on a team introduces a concept called distributed reasoning, which is a type of reasoning shared and conducted by a group of people. Teamwork helps with associative thinking that contributes to creativity. Problem-based learning can help students think like scientists. In fact, science is creative in much the same way as art, music, or literature are creative.

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LESSON PLAN

LESSON: Science – Extracting DNA from onions

DURATION: 50'

Students' class: 10^{th} – 12^{th} grade

Number of students: 20 – 25

Teacher: Donato Berarducci

DESCRIPTION

To teach how to extract DNA from onions using the flipped-classroom methodology.

Tasks

1. The students observe first-hand that DNA is in the food that they eat
2. Students learn the simple method to extract DNA and why each step is necessary due to the complex organization of DNA in cells.
3. The students learn why it is important for scientists to extract DNA from organisms.

Objectives

1. Using standard safety procedures for laboratory investigations
2. Using tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
3. Analyzing the nature of the relationships between structures and functions in living cells.
4. Promoting cooperation among the students

PROCEDURE

1. **Engagement**

   The students are asked to submit answers to the general questions:

   1. What do you think looks like?
   2. Where is DNA found?

2. Explanation

The students watch videos before the lab activity. In these videos, the whole procedure is explained in detail, emphasizing the handling of the material, the theoretical concepts and the safety procedures.

https://www.youtube.com/watch?v=arSWvp8zFTM

https://www.youtube.com/watch?v=0lZRAShqft0

https://www.youtube.com/watch?v=f9hC8lpPNTg

In the following discussion, key terms from the videos are explained eliciting the students' answers about the extraction of DNA.

Then, the teachers review the steps of the laboratory activity with the students to ensure they understand the instructions and they begin working on the activity in groups of three.

2. Activities

Step 1

Place one onion, soft and easy to pulverize (80-100 gr cut into small pieces), in the mortar; add 10 ml of liquid soap. The soap helps to dissolve the phospholipid bilayers of the cell membrane and organelles.

Prepare a solution with 3 gr of salt and 100 ml of distilled water and place it in the mortar where you have already put the onion; use a pestle to pulverize the onion for approximately 10 seconds. Then, filter the mixture and pour it into the test tube, filling it halfway. The salt is used to break up protein chains that bind around the nucleic acids.

Step 2

When the students add ethanol to their onion extract, they will see the fine white strands of DNA precipitate. DNA is not soluble in ethanol. The colder the ethanol, the less soluble the DNA will be in it. Thus, make sure to keep the ethanol in the freezer or on ice.

The DNA will separate from the solution at the dividing point between the mixture and alcohol, float to the top, and appear like a white jellyfish. Retrieve the jelly with a plastic stick and place it on the glass slide. Colour the jelly with blue methylene and place the coverslip over it. Observe the DNA under a microscope.

ASSESSMENT

The discussion was important to assess the students' understanding and their ability to communicate scientific concepts. In particular, understanding the steps in the extraction procedure and why each step was necessary. Each step in the procedure helped isolate the DNA from other cellular materials. The discussion was about why each step was needed and how this relates to the organization of genetic material.

What did the DNA look like? What happened in the final step when you added ethanol to your onion extract? Why is it important for scientists to be able to remove DNA from an organism? Is there DNA in your food, if there is, how do you know?

The discussion was also about extension: the DNA in this lab activity could be compared to that of bananas or strawberries extracted in a similar lab activity and how this may relate to the amount of DNA obtained. By using varying concentrations of ethanol (70-100%) you can determine how ethanol concentration qualitatively affects the amount of DNA you extract.

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LESSON PLAN

LESSON: Science – Identifying proteins

DURATION: 50'

Students' class: 10^{th} – 12^{th} grade

Number of students: 20 - 25

Teacher's Name: Giuseppina Addeo

DESCRIPTION

To teach how to identify proteins in milk using the flipped-classroom methodology.

Tasks

1. The students observe first-hand that proteins are in the food that they eat
2. The students learn the simple method of identifying proteins and why each step is necessary
3. The students learn why it is important to identify proteins in food.

Objectives

1. Using standard safety procedures for laboratory investigations
2. Using tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
3. Analyzing the nature of the proteins and their components.
4. Promoting cooperation among the students

PROCEDURE

1. **Engagement**

   The students are asked to submit answers to the general questions:

   1. What is a protein?
   2. Which foods contain proteins?

2. Explanation

The students watch videos before the lab classes. In these videos, the whole procedure is explained in detail, emphasizing the handling of the material, the theoretical concepts and the safety procedures.

https://www.youtube.com/watch?v=arSWvp8zFTM
https://www.youtube.com/watch?v=wvTv8TqWC48
https://www.youtube.com/watch?v=ufec89A47uM

In the following discussion, key terms from the videos are explained eliciting the students' answers about the identification of proteins.

Then, the teachers review the steps of the laboratory activity with the students to ensure they understand the instructions and they begin working on the activity in groups of three.

2. Activities

Use two test tubes.

- Fill tube Nr. 1 with 2 cc of water
- Fill tube Nr. 2 with 2 cc of milk.
- Add 2 cc of NaOH solution to both test tubes and gently shake the solution in the tube from side to side.
- Add 0,5 cc of $CuSO_4$ to each test tube.

The liquid in test tube Nr. 1 will turn light blue. The liquid in tube Nr. 2 will turn blue-violet, which after a short time will develop copper insoluble deposits at the bottom of the tube. The fact that the liquid in the second test tube turns blue-violet proves the presence of proteins in milk.

ASSESSMENT

The discussion was important to assess the students' understanding and their ability to communicate scientific concepts. In particular, understanding that the amino acids in proteins form chemical bonds with copper salts, allowing the resulting colour effect.

The discussion was about what happened in the final step when you added NaOH solution and $CuSO_4$ solution to each test tube.

The discussion was also about extension: in which foods there are proteins, which are their functions, why we need proteins in our diet.