LEARNERS' GUIDELINE
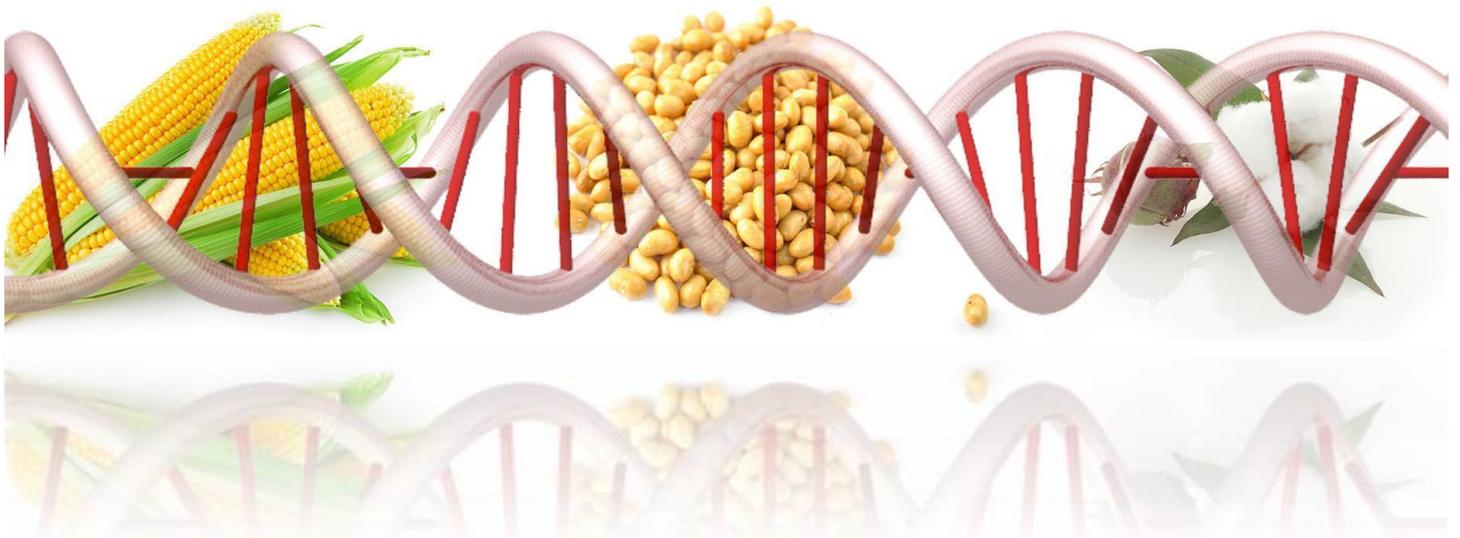
CHIMERAS, MUTANTS AND HYBRIDS – ARE WE DOOMED TO A GENETICALLY-MODIFIED FUTURE?

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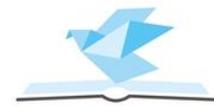|	
SCHOOL YEAR	2017-2018
SCHOOL YEAR LEVEL	Grade 9
TERM	
SESSIONS	26-30 h
TITLE	**CHIMERAS, MUTANTS AND HYBRIDS – ARE WE DOOMED TO A GENETICALLY-MODIFIED FUTURE?**
SUBJECTS	Biology, Mathematics, Geography, English, Art, ICT, Design and Technology
UNIFYING THREADS (DRIVING QUESTIONS)	How are genetic modifications possible? Is our world genetically modified? What are the pros and cons of GMOs?
KEY COMPETENCES	A: TRANSVERSAL COMPETENCES

A: TRANSVERSAL COMPETENCES

COMPETENCE (EU)	TASKS
1. Learning to learn	6-8-9-10-11-13-14-15-16
2. Sense of initiative and entrepreneurship	6-7-12-20
3. Social and civic	1-2-4-5-7-12-19-20-21

B: SUBJECT COMPETENCES

COMPETENCE (EU)	TASKS
4. Communicating in the mother tongue	12-15-16-19-21
5. Communicating in a foreign language	13-15-16-18-20
6. Digital	17-18
7. Mathematical, scientific and technological	8-9-10-13-14-15-16-17
8. Cultural awareness and expression	

INTELLIGENCE	TASKS
1. Interpersonal	1-2-4-5-6-7-18-20
2. Intrapersonal	5-6-7-18-20
3. Visual-spatial	4-13-14-15-16-17-18
4. Bodily-kinesthetic	4-9-10
5. Musical-rhythmic	9-16-17
6. Verbal-linguistic	3-4-11-12-13-14-15-16-18-19-20
7. Logical-mathematical	4-8-9-10-13-14-15-18
8. Naturalistic	8-9-10-11-14-16-17

MULTIPLE INTELLIGENCES

DISCIPLINARY OBJECTIVES and CROSS-DISCIPLINARY OBJECTIVES

What do we want students to understand?

(COMPREHENSION GOALS)

DISCIPLINARY OBJECTIVES and CROSS-DISCIPLINARY OBJECTIVES

MAIN OBJECTIVE

To study what transgenic organisms are, what part they play in our lives; to learn about the inheritance laws in order to understand how mutations and modifications are possible in nature; to become aware what the advantages and disadvantages of creating transgenic organism are

0. General objectives

0.1. Learning to work in teams

1. Science

1.1. Biology: Analyse and learn about genes, DNA, Mendelian inheritance and genetics to understand the notions of modifications in nature

1.2. Biology: Learn about the role of transgenic organisms in food production to see their advantages

1.3. Geography: Learn about world food production and the ways genetics can help

solve the problem of famine

2.Mathematics

2.1. Probability theory as a means of predicting the possibilities of mutations in nature, etc.

2.2. Calculating the size of an area; converting area units (metric and imperial); calculating the yield and food production efficiency

2.3. Analysing and presenting data in forms of charts, graphs, etc. to understand texts containing statistical data, e.g. about food production

3.Foreign Language (English)

3.1. Learn specific vocabulary: gene, modification, hybrid, chimera, food production, mutations, etc.

3.2. Improve reading skills – skimming, scanning, presenting and justifying arguments in favour and against a thesis etc. to understand scientific texts about genetics

4.ICT

4.1. Learn to use software to make newspapers to present the findings of the research project

5.Art

5.1. Develop creativity in sketching and drawing transgenic organisms

6.Mother tongue

6.1. Improve communicating and writing skills to perfect the ways of presenting ideas and opinions

6.2. Develop argumentative skills in order to hold a discussions/debate about GMOs

PROJECT PRESENTATION	A speech given by a dietician/biologist/geneticist to make students aware of genetic modifications they encounter in their everyday lives
FINAL PRODUCT	A newspaper issue about life in a genetically-modified world

SEQUENCE OF TASKS

Tasks in bold are necessary, and the rest are optional. They depend on the teachers involved in the project and the school facilities.

A. PREVIOUS TASKS

1. **Task: Team dynamics**
2. **Task: Active listening - assertiveness**
3. **Task: Project presentation**
4. **Task: Creativity in problem-solving**
5. **Task: How to deal with stress and anxiety**
6. **Task: What I know, what I need to learn**
7. **Task: Planning group work and dividing the responsibilities**

B. RESEARCH / DEVELOPING TASKS

8. **Task: DNA as a medium of genetic information**
9. **Task: The first Mendelian Law of Segregation**
10. **Task: Probability**
11. **Task: Transgenic organisms**
12. **Task: Work evaluation**
13. **Task: Is GM food production a solution to famine?**
14. **Task: Calculating the size of an area; converting area units (metric and imperial); calculating the yield and food production efficiency**
15. **Task: Analysing statistical data in forms of charts and graphs**
16. **Task: Camouflage**
17. **Task: Let's create a transgenic organism**
18. **Task: Producing the newspaper issue**

C. FINAL TASKS

19. **Task: Presentation of the final result**
20. **Task: Dissemination of the final product**
21. **Task: Final team planning assessment**
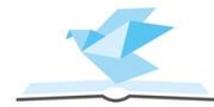
INDICATORS

MAIN OBJECTIVE

To study what transgenic organisms are, what part they play in our lives and to become aware what the advantages and disadvantages of creating such organisms are

0. General objectives

0.1.1. The student achieves team objectives.

0.1.2. The student achieves individual objectives.

0.1.3. The student fulfils his/ her responsibilities.

1. Science

1.1.1. Knows the composition of DNA

1.1.2. Knows the Mendelian law of inheritance

2. Mathematics

2.1.1. Knows how to sort out, analyse and present data to be able to read texts with statistical data

2.1.2. Knows how to use probability theory to predict the possibilities of modifications in nature

2.1.3. Calculates the size of an area; converts area units (metric and imperial); calculates the yield and food production efficiency

3. Foreign language (English)

3.1.1. Knows words: gene, modification, hybrid, chimera, food production, mutations, etc. in the foreign language

4. Art

4.1.1. Draws and sketches models of transgenic organisms: hybrids, chimeras and mutants

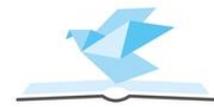### 5. ICT

5.1.1. Makes an online newspaper issue

6. Mother Tongue

6.1.1. Knows how to express and justify opinions

6.1.2. Knows how to take part in a debate, group discussion, etc.

TOOLS:

- **Rubrics**
- **Reflections and evidences**

TASKS

PREVIOUS TASKS

1. Task: Team dynamics			Session: 1 h
COMPETENCES	Social and civic	**INTELLIGENCES**	Interpersonal
GOALS	The students learn how to work in a group		

Task description:

At the beginning of the class you will take part in a survey.

Sit in a circle and discuss the rules of cooperation that will apply during the project. After choosing the most important ones, write them down on a poster, vote their approval and put it up on the wall. Next, you will play a game 'Chair Swap' in which you will have to swap your seats when the person standing in the middle of the circle says e.g. 'Swap your seat with a person who likes dogs.' There will be fewer chairs than participants so that every time there's someone left without a seat. You can play the game a few times. Afterwards, the teacher writes down the word 'group' on the board, and you will be asked to say what comes to their mind and writes down all the answers.
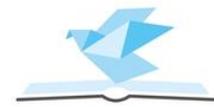
Next the class is divided into small groups of 4-6 people. Each group has to work on the topic: 'Imagine that you're going to a desert island. Make a list of necessary things that you're going to take.' After a few minutes each group presents their ideas. Then, there will be a discussion about group work: how did you decide to make your choice? / what helped and what made it difficult to decide? All the answers are written on the board. Then you have to decide what it takes to create a 'good' group which can work effectively. A volunteer writes down the features of a 'good' group on a poster and puts it on the wall.

Assessment tools (rubrics…):

Survey1.docx / Survey1.docx

2. Task: Active listening - assertiveness			Session: 1 h
COMPETENCES	Social and civic	**INTELLIGENCES**	Interpersonal

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GOALS	Students are aware how important assertiveness is in developing a good relationship with others. They learn how to listen actively

Task description:

Try to remember the rules you formulated in the previous class. Play a game 'Chinese whispers'. The teacher starts the game by whispering a short message to one of the students, who in turn has to whisper it to the next person in the circle, and so on, until the last person says it out loud. Afterwards, you have to brainstorm ideas: what made it difficult to hear the message? What is necessary to listen carefully? - Everything is written down on the board in two columns. Next, in groups of 4-6, you have to come up with the characteristics of a good and bad listener. Present your ideas.

After that, work in pair. You have to express your opinion on the following topic: 'what do you think about the conditions of life on Earth?' During the conversations try to use paraphrases, e.g. 'So you think that …', 'If I understand you correctly …', 'Do you mean that …'. Afterwards, every participant repeats the opinions they heard and comments on the exercise.

3. Task: Presentation of the project			Session: 1 h
COMPETENCES		INTELLIGENCES	Verbal-linguistic
GOALS	To introduce the project		

Task description:

You will be introduced to the main topic of the project listening to a speech given by a guest - a dietician/biologist/geneticist who will try to make you aware of genetic modifications you encounter in your everyday lives. It seems that we are living surrounded by GMOs and soon the world will be full of chimeras, hybrids and mutants. The guest speaker will assign you with a challenging task - researching the genetic structure of organisms, learning about modifications and mutations in nature, discovering the advantages and disadvantages of transgenic organisms, as well as designing a hybrid. The final project will be an online newspaper which will include information about life in a genetically-modified world.
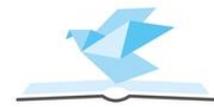
4. Task: Creativity in problem-solving			Session: 2 h
COMPETENCES	Social and civic	**INTELLIGENCES**	Interpersonal Visual-spatial Bodily-kinesthetic Logical-mathematical Verbal-linguistic
GOALS	Students learn about creativity They are motivated to be imaginative		

Task description:

You will be divided into groups of 4-6. Get pieces of paper and brainstorm their ideas on 'what is creativity'. Write everything down and then present your ideas to the rest of the class, trying to come up with the definition of 'creativity'. Afterwards, the best definition is chosen, written on a poster and put up on the wall.

In the next activity, the teacher distributes among the groups an everyday object, e.g. a spoon, keys, a hammer, and asks you to think of unusual ways it could be used. You have to write down their ideas, decide on the best one and present it to the rest of the class. Next, you will discuss the importance of creativity in everyday life.

Get back in a circle and play a game, finishing the sentence 'Creativity is like … because …' After a few minutes, get into small groups and a representative of each group draws a question, e.g. 'What would happen if … all animals were hybrids?', 'What would happen if … it was possible for people to become mutants with a superpower?'. Each group chooses the best answer and presents it to the rest of the class.

The last task involves writing a short text in the mother tongue (100 words) which includes the following words: man, water, fly, invisible, earth, predator, life, DNA, genes, chameleon. When you finish, you read out your texts and put up on the wall.

5. Task: How to deal with stress and anxiety			Session: 1 h
COMPETENCES	Social and civic	**INTELLIGENCES**	Interpersonal Intrapersonal
GOALS	Students learn how to deal with stress		

Task description:
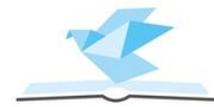
You will have a discussion about feelings. Create a list of feelings. Then answer the question 'What is stress?'. After a short discussion, start working in small groups - each has to answer a different question:

1 - What is the cause of stress?

2 - What are the positive and negative results of stress?

 3 - What comes to your mind when you think of stress? What's its definition?

4 - What are the symptoms of stress? how can you recognise it?

5 - How to deal with stress (use your own experiences)?

When you finish, present your answers and present them on a poster.

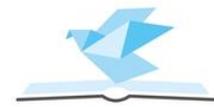| 6. Task: What I know, what I need to learn			Session: 1 h
COMPETENCES	Learning to learn Sense of initiative and entrepreneurship	**INTELLIGENCES**	Interpersonal Intrapersonal
GOALS	Students learn to work in teams		

Task description:

Work in groups and brainstorm ideas on what you know about the genes, DNA and genetic modifications. Ask yourselves questions about what you need to learn in greater detail in order to solve the main problem. Representatives of the groups present their findings to the rest of the class and together you have to make a list.

7. Task: Planning group work and dividing the responsibilities			Session: 1 h
COMPETENCES	Sense of initiative and entrepreneurship Social and civic	**INTELLIGENCES**	Interpersonal Intrapersonal
GOALS	Students learn to work in teams		

Task description:

Now you have to plan your work. Discuss the project objectives and decide what your group objectives are. Fill in a survey so that later you can evaluate your work and progress.

RESEARCH / DEVELOPING TASKS

8. Task: DNA as a medium of genetic information			**Session:** 1 h
COMPETENCES	Learning to learn Mathematical, scientific and technological	**INTELLIGENCES**	Logical-mathematical Naturalistic
GOALS	Students learn about the history of genetics, find out what a gene is and know the structure of DNA and its function in carrying genetic information which determines the features of all organisms		

Task description:

Divide into groups of 3. Each group tries to define what a gene is and figure out what DNA stands for. Next watch one of the following videos (https://youtu.be/o_-6JXLYS-k, https://youtu.be/C1CRrtkWwu0, https://youtu.be/uXdzuz5Q-hs) to find the answers. Try to remember what elements DNA consists of and how complementarity works. Take a look at the pictures and photos of DNA models and create your own model using coloured beads or gummy bears, wires and threads.

Assessment tools (rubrics…):

DNA rubric.doc

9. Task: The first Mendelian Law of Segregation			**Session:** 1 h
COMPETENCES	Learning to learn Mathematical, scientific and technological	**INTELLIGENCES**	Naturalistic Bodily-kinesthetic
GOALS	Students know the law of segregation They can tell the difference between phenotype and genotype, a homozygous and heterozygous cell, as well as dominant and recessive alleles which determine the features of all organisms		

Task description:

Divide into groups of 8. Watch a video about the inheritance https://youtu.be/Mehz7tCxjSE and give examples of alleles. Next, try to solve the following problems on the basis of what you have learnt from the movie:
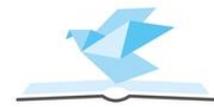
Task 1) Dark eyes are dominant alleles over blue recessive ones. Can dark-eyed parents have a blue-eyed child? Use the Punnett square diagram.

Task 2) A right-handed woman (heterozygous) married a left-handed man. What is the genotype of each person and their children? What is the probability of their having a left-handed child? Draw the Punnett square diagram.

Task 3) A dark-haired woman (heterozygous) married a blond-haired man. What is the genotype of each person and their children? What is the probability of their having a blond-haired child? Draw the Punnett square diagram.

Now prepare a pantomime illustrating one of the tasks. Students who represent alleles from the mother stick a red card to their shirt, and those representing the father's alleles use yellow cards. You walk around the classroom to the sound of music and when it stops, you have to find a pair. Remember that in each pair there must be alleles from both parents.

Assessment tools (rubrics…):

Mendelian Law of Segregation rubric.doc

10. Task: Probability			**Session:** 1-2 h	
COMPETENCES	Learning to learn Mathematical, scientific and technological	**INTELLIGENCES**	Naturalistic Logical-mathematical Bodily-kinesthetic	
GOALS	Students know how to calculate the probability of the occurrence of a genetic feature in offspring			

Task description:

Try to recall what probability is and if you don't remember take a look in the course book. Next, get into groups of 2-3, take some coins and try to calculate the probability of: 1) getting heads in one flip of a coin, 2) getting an odd number in one roll of dice, 3) getting 2 heads in 3 flips of a coin, 4) getting two prime numbers in two rolls of dice. After a few experiments, try to calculate the probability and compare the results with others.

Now think about the data you need to calculate the probability of getting a certain genetic trait. Next, watch a video https://youtu.be/Qcmdb25Rnyo and in small groups try to solve the following problems in English:
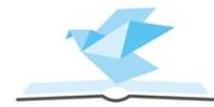
Problem 1. Let's imagine that we breed two dogs with the genotype *BbCc*, where dominant allele *B* specifies black coat colour (versus *b*, yellow coat colour) and dominant allele *C* specifies straight fur (versus *c*, curly fur). Assuming that the two genes assort independently and are not sex-linked, how can we predict the number of *BbCc* puppies among the offspring? What's the probability of getting a Bb genotype? What's the probability of getting a Cc genotype? What's the probability of getting an BbCc genotype?

Problem 2. In dogs, black coat colour (B) is dominant to yellow coat colour (b), and straight fur (C) is dominant to curly fur (c). The coat colour gene and the fur texture gene are on different chromosomes, so they assort independently, and are not sex linked. In a cross between two BbCc parents, predict the fraction of offspring with black coat colour and straight fur.

Compare the results with the other groups. Think of the ways scientists and geneticists can use the probability in their work. Discuss in groups, then share your thoughts with the rest of the class.

Assessment tools (rubrics…):

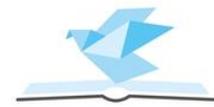The teacher evaluates the correctness of calculations in the problems

11. Task: Transgenic organisms			Session: 2 h
COMPETENCES	Learning to learn Mathematical, scientific, technological	**INTELLIGENCES**	Naturalistic Verbal-linguistic
GOALS	Students know the terms: transgenic organisms, genetic engineering and GMO They try to answer the questions: Are we aware of what we eat? Are GMOs dangerous and harmful?		

Task description:

You were asked to bring some labels of products and foods which are eaten most frequently in your family. Put them in a box. Now, in groups, try to say what a transgenic organism is, what GMO stands for. Next, with the whole class brainstorm ideas to figure out what a transgenic organism is. Now, get into groups of three, pick a label from the box and try to analyse the contents of the product and find out if it is genetically modified. Each group presents their findings. Next, discuss the following: do you know what you eat? Do you read the labels of the products you buy? Has this workshop changed your habits? Are you going to read the labels?

Next, watch videos presenting different opinions about GMOs: https://youtu.be/sH4bi60alZU, https://youtu.be/TkD20jgmsP8. Now, divide into two groups: supporters and opponents of GMO. Sit in the opposite sides of the classroom and prepare arguments supporting your point of view. You have 5

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minutes to convince the other group. After the exchange of opinions and arguments, each student can change the group if they were convinced by the opposing arguments.

12. Task: Work evaluation (self-evaluation)			**Session:** 1 h	
COMPETENCES	Sense of initiative and entrepreneurship Social and civic Communicating in the mother tongue	**INTELLIGENCES**	Verbal-linguistic	
GOALS	Students self-reflect about their work in the project and try to evaluate it in order to improve it			

Task description:

Take part in a debate which will help you to evaluate what has been achieved in the project so far. It is based on the 'Six Thinking Hats' by Edward de Bono. It will enable you to creatively deal with problems, focusing on six different perspectives from which they can be analysed. During the debate, assess your work and involvement in the project from different viewpoints, depending on the colour. It will introduce a certain order by focusing on one aspect at a time. Different colours symbolise different approaches to dealing with a problem. By changing the colours, you should try to change your way of thinking. All the conclusions, ideas and comments should be written down.

The meaning of the colours:

The Red Hat signifies feelings, hunches and intuition. When using this hat you can express emotions and feelings and share fears, likes, dislikes, loves, and hates.

The White Hat calls for information known or needed. It's the opposite of the 'red hat'. Its motto is "The facts, just the facts." The participants focus just on facts.

The Black Hat is judgment - the devil's advocate or why something may not work. Spot the difficulties and dangers; where things might go wrong. Probably the most powerful and useful of the Hats but a problem if overused.

The Yellow Hat symbolizes brightness and optimism. Under this hat you explore the positives and probe for value and benefit.

The Green Hat focuses on creativity; the possibilities, alternatives, and new ideas. It's an opportunity to express new concepts and new perceptions.
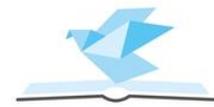
The Blue Hat is used to manage the thinking process. It's the control mechanism that ensures the Six Thinking Hats guidelines are observed.

13. Task: Is GM food production a solution to famine?		Session: 1 h
COMPETENCES	Learning to learn Mathematical, scientific and technological Communicating in a foreign language	**INTELLIGENCES** Visual-spatial Logical-mathematical Verbal-linguistic
GOALS	Students know what world hunger means, they learn which countries suffer the most and try to find out if GM foods could provide a solution to the problem	

Task description:

Work in small groups and make a mind map of what you know about famine/world hunger. Compare your ideas with the other groups. Next, read an article in English "Understanding key definitions for hunger" and take a quiz (https://goo.gl/6drvCa) to find out what you remember. Then, read another part of the article "How many people are hungry in the world?" and take the next quiz (https://goo.gl/jjazYT). Now, look at the map and label the countries which suffer from undernourishment.

Next, read an article (https://goo.gl/ieFqu5) and talk in groups about the ways GM food production could help fight the problem of famine.

14. Task: Calculating the size of an area; converting area units (metric and imperial); calculating the yield and food production efficiency		Session: 1 h
COMPETENCES	Learning to learn Mathematical, scientific and technological	**INTELLIGENCES** Naturalistic Logical-mathematical Visual-spatial Verbal-linguistic
GOALS	Students can calculate the size of an area, convert the metrical and imperial units, and calculate the yield in the food production	

Task description:

Think what measurements units you know and what you use them for. Have the units always been the same? What are imperial units? Discuss in pairs and next watch a video in English: https://youtu.be/oAtDAoqdExw to check your answers.
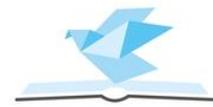
What units of area and volume do you know? Watch a video https://youtu.be/5EcNAxweb44 and solve the tasks *(maths01.doc)*. You can use the calculator if you need help https://goo.gl/YF3mvU.

Compare the results with the other students. Think if the knowledge you used to solve the problems can be useful for a farmer and how it can be used.

Assessment tools (rubrics…):

maths01.doc

| 15. Task: Analysing statistical data in forms of charts and graphs			Session: 1 h	
COMPETENCES	Learning to learn Mathematical, scientific and technological Communicating in the mother tongue Communicating in a foreign language	**INTELLIGENCES**	Visual-spatial Logical-mathematical Verbal-linguistic	
GOALS	Students learn how to analyse data in the form of diagrams and graphs to be able to read texts with statistical data			

Task description:

Watch the presentation and think about the ways in which you can present statistical data. https://youtu.be/IxqoOfSQIAs . What have you learnt from it?

Visit the website http://www.fao.org/faostat/en/#rankings/commodities_by_country and analyse the data commodities production of your country in the year 2013. Compare it to the year 1977 and 2005. What conclusions can you draw? Discuss in groups. Next, compare the data (from year 2013) with other countries, e.g. the USA, Holland, India, etc. Draw conclusions.

16. Task: Camouflage			Session: 1-2 h	
COMPETENCES	Learning to learn Mathematical, scientific and technological Communicating in the mother tongue Communicating in a foreign language	**INTELLIGENCES**	Visual-spatial Naturalistic Musical-rhythmic Verbal-linguistic	
GOALS	Students learn how nature allows species to adjust and modify their appearance			

Task description:
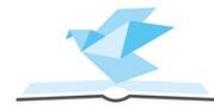
The lesson starts with a brainstorming activity - do you know any ways animals and plants can adjust and blend in with the surroundings in order to survive or hunt? Try to come up with the examples in groups. Then, watch the video in English https://youtu.be/qkkCORFI-0g to check your guesses. Now read an article http://someinterestingfacts.net/animal-camouflage-facts/ to study the ways animals disguise themselves. In groups, make up your own plant or animal and describe it, focusing on the camouflage methods it might use to survive.

| 17. Task: Let's create a transgenic organism			Session: 2-3 h
COMPETENCES	Mathematical, scientific, technological Digital	**INTELLIGENCES**	Visual-spatial Naturalistic Musical-rhythmic
GOALS	Students design and create models of transgenic organisms		

Task description:

Use your knowledge and research done in previous classes to design a model of chimera, hybrid or mutant. You can make drawings, pictures, 3-D models, etc.

18. Task: Producing the newspaper issue			Session: 3-4 h
COMPETENCES	Digital Communicating in a foreign language	**INTELLIGENCES**	Logical-mathematical Visual-spatial Verbal-linguistic
GOALS	Students learn to make a digital newspaper to show the results of their project work		

Task description:

Decide what sections your newspaper will have. Divide tasks and write necessary articles. Collect all the materials that you have created in the previous classes. In ICT class, choose software to make a digital newspaper which will document your work and findings. Finally, create the newspaper issue.
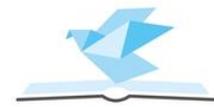
FINAL TASKS

19. Task: Presentation of the final result			Session: 1 h
COMPETENCES	Communicating in the mother tongue Social and civic	**INTELLIGENCES**	Interpersonal Intrapersonal Verbal linguistic
GOALS	Students present their newspaper issue		

Task description:

During a school assembly you will present your project and the final result to your school friends and guests. You should share your experiences, talk about what you learnt, what was the most difficult/the easiest part, and what you managed to achieve.

Assessment tools (rubrics…):

Assessed according to the school system

20. Task: Dissemination of the final product			Session: 1 h
COMPETENCES	Communicating in a foreign language Social and civic Sense of initiative and entrepreneurship	**INTELLIGENCES**	Verbal-linguistic
GOALS	Students disseminate the result of the project		

Task description:

Send an email to local schools in which you will explain your project, its aims and final result.

21. Task: Final team planning assessment			Session: 1 h
COMPETENCES	Communicating in the mother tongue Social and civic	**INTELLIGENCES**	Interpersonal Intrapersonal
GOALS	Students learn to evaluate their work		
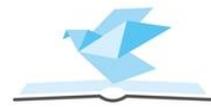
Task description:

Carry out the evaluation of the project, your participation and the final result. Fill in a questionnaire and have a discussion about your participation in the project.

Assessment tools (rubrics …):

Survey2.docx