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The Art of Genetic Crafting

BIOS4YOU AR 2.0

BIO-INSPIRED STEM TOPICS FOR ENGAGING YOUNG GENERATIONS
THANKS TO THE USE OF AUGMENTED REALITY

Project Number: KA220-BW-23-30-126516

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Introduction

This document's purpose is to create guidelines to help the project staff who work with schoolchildren, 14-19 years old, create and re-adapt exercises using Augmented Reality technology.

To this end, a series of templates have been created that define exercises from a methodological, pedagogical and technological point of view.

A good written description, along with images, videos or sketches of the exercise is very important for experts to understand the idea. This will be part of the “General Information” template.

On the other hand, it will be important to define what STEM topic/subject each exercise is intended for and how AR technology can help students or staff or people interested in it when they use these exercises. In addition, people interested in the exercise can understand the usefulness of augmented information, and it will be necessary to explain the benefits.

During the process of defining the augmented information that each exercise will offer, staff working with teachers will be able to develop innovative ideas that make it easier to learn teaching concepts more easily.

All students will be able to view the contents explained by professionals projected in the real world in the form of text, 3D model, image, video, sound… This will help them focus their attention on exercise and more easily assimilate the associated concepts.

This document consists of the following points:

- Information about AR technology
- How to define AR exercise thanks to the template:
    - General information
    - Pedagogical specifications

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o Technical specifications

General information

In this part, it will be necessary to report the generic information of the exercise so that it can be recognised.

Name of the exercise:	***The art of genetic grafting***
Description of the exercises:	The activity uses Augmented Reality to virtually transport you into a virtual laboratory where it will be shown and explained how to do a genetic graft using the CRISPR-Cas9 technique. The mission: to modify a cell's DNA to correct a faulty gene." Through their mobile devices or tablets, students interact with a virtual guide doctor. Students must watch and interact by taking a final quiz by clicking on the various panels.
Participants:	The activity is designed to be carried out individually, with subsequent optional group reflection. Individual participation ensures that each student makes their own decisions during the experience, promoting personal responsibility in thinking about biotheconologies. Group discussions at the end (optional) allow comparison of results and reasoning behind choices, reinforcing collaborative learning and peer feedback.
Participants' age range:	Minimum age: 17, Maximum age: 19 The exercise presupposes preliminary basic knowledge of the bio architectures of sustainable water management systems and familiarity with the use of smartphones/tablets. Students

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	at this age are cognitively ready to engage in abstract thinking, ethical reasoning, and the real world problem-solving.
STEM subject and specific topic:	The exercise addresses the challenge of clarifying the concept of CRISPR grafts, close to science subject and engineering. Augmented reality helps simplify this process by showing each step clearly and interactively.
Gamification process:	Overlay of information: interactive panels, visual feedback effects (setting within a laboratory) and explanatory audio. Floating 3D Choices: Students select panels, interact with characters, animate 3D models, and take a quiz. Static AR environments: 3D laboratory The augmented reality experience is based on image recognition or QR markers and does not require any physical movement — it is designed to be used at the desk or classroom table.
Written or graphic description of Augmented info:	Overlay of information: interactive panels, visual feedback effects (setting within a laboratory) and explanatory audio. Floating 3D Choices: Students select panels, interact with characters, animate 3D models, and take a quiz. Static AR environments: 3D laboratory The augmented reality experience is based on image recognition or QR markers and does not require any physical movement — it is designed to be used at the desk or classroom table.
External (or extra) tools required	Mobile device or tablet with AR capabilities. Internet connection for initial file loading. Printed AR marker sheet (optional) or screen-displayed trigger image.

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Links (video, images, text online and so on).

Pedagogical specifications

Here we will collect information on how to use the exercise in the learning session and the results and benefits of using it, from a pedagogical perspective.

How can this augmented information be used to address a STEAM topic in a more interesting way for students?

Using a mobile device (tablet or phone), students will scan the QR code that will bring them into the game. Once inside the game they will find themselves immersed in a laboratory where they can explore their surroundings to interact with augmented reality. Through interaction with the driver character, they will learn in a fun and playful way the use of CRISPR-Cas9 technology (or variants thereof) to insert (grafted) genetic material in a targeted way within the DNA of an organism.

Which pedagogical objectives are addressed through this scenario?

The educational objective of this game is to improve students' logical skills. In addition to acquiring new knowledge on the subject matter, students will have to figure out for themselves how to interact with the surrounding space and what order of information will be useful for completing the game.

Which results are expected to be reached with its use?

Many students are not familiar with CRISPR-Cas9 technology. The game can improve the understanding of this specific topic, improving the memory and learning skills of the student, who will be more involved in the topic through the game.

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Which benefits are expected to be reached with its use?

Students can improve their technical and IT skills through the use of augmented reality. By improving their proprioceptive and spatial skills when interacting with a 3D space projected into the surrounding reality. The game mode will make the educational experience more engaging and interesting, even for students with learning difficulties.

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Technical specifications

In this part it is necessary to specify whether the exercise was designed to be implemented with AR technology. This part is fundamental for the translation process. Please include text, audio text and all the necessary materials.

AR INFORMATION

Technology	Augmented Reality base on a marker https://edu.delightex.com/Studio/Spaces
If it's needed a marker, description of the marker	RXB XRE
Hardware and software needed:	pc, smartphone, tablet, camera.

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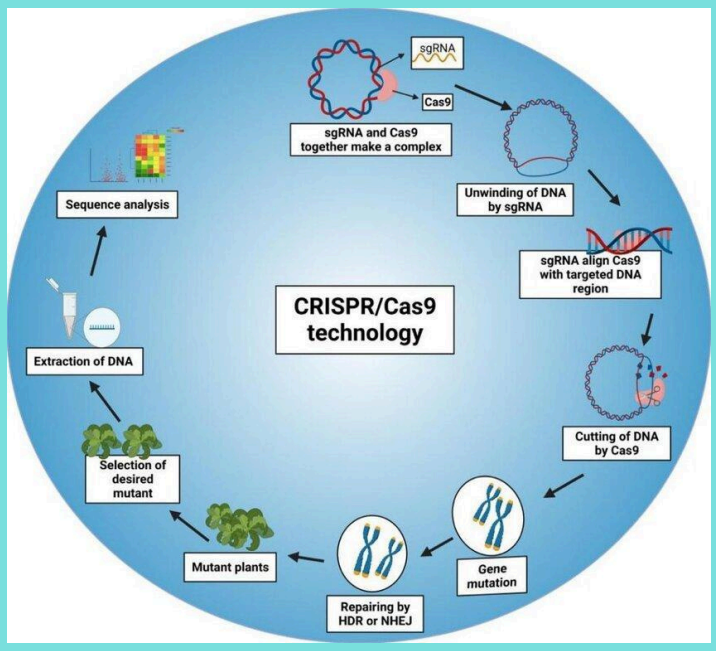
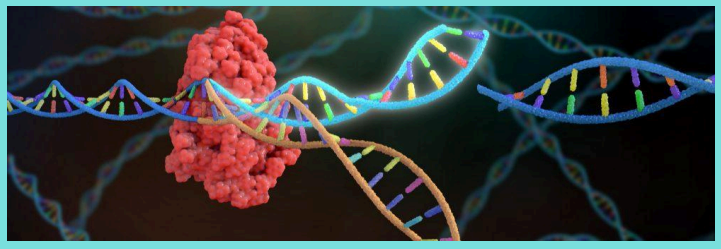
Type of Augmented data	Images; Text; 3D models
Written description of the AR data	Students will begin the experience by scanning a marker or accessing an AR app on their mobile device or tablet. Students will find themselves immersed in the game, which takes place inside a laboratory. The character of the doctor driver will appear on their screen, inviting them to follow him by swimming along an interactive path. Students will click on an element of the game to see what happens and take a quiz to see what they understand from the experiment. The activity takes place in a group and can end with a discussion or reflection in class to compare the results and share ideas.
If Image	 

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If Text

DOCTOR WOMAN

- Welcome to the CRISPR laboratory! Today you will learn how to make a genetic graft using the CRISPR-Cas9 technique. Your mission: to modify a cell's DNA to correct a defective gene.

- Find the mutated gene and use Cas9 to cut the sequence**.**

- Cas9 cut the DNA here!

- Perfect! Cas9 performed the cut. Now let's insert the correct gene.
- Grafting succeeded! We just performed gene therapy using CRISPR. This type of technique can be used to treat genetic diseases, improve crops, and much more.

QUIZ:
What does Cas9 do in the CRISPR process?

1. Draw on DNA
2. Cut the DNA in a specific place

Cas9 is like scissors: it cuts the DNA at the point indicated by the RNA guide.

What is a “graft” in DNA?

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- Virus
- A new gene inserted into DNA

A graft is a piece of DNA added at a specific point.

Why do we use CRISPR?

- To modify DNA precisely
- To do magical experiments

CRISPR is used to modify DNA, for example to treat genetic diseases.

What drives Cas9 to the point to be cut?

- A guide RNA (RNA guide)
- magnet

The guide RNA tells Cas9 where to cut the DNA.

Conclusion

CRISPR-Cas9 is a gene editing technology that allows:
Cut the DNA in specific places.
Remove, modify or add (grafted) DNA sequences.
It was developed from a bacterial defense system against viruses.
"Grafts" in CRISPR: what does it mean?
In the biotechnological context, "grafting" can mean:
1. Insertion of new genes (knock-in gene)
CRISPR is used to make a cut in the genome.
An external DNA sequence (eg a therapeutic gene) is provided.
The cell repair mechanism inserts the new sequence at the desired point.
Example: Insert a gene to produce insulin into bacterial or human cells.
2. Genetic improvement of plants or animals
In agriculture, CRISPR can be used to graft desired traits (disease resistance, increased yield, etc.) without using genes from other species → GMO-free (in some cases).
How does a CRISPR graft technically happen?
RNA Guide (gRNA) directs the Cas9 protein to a specific point in the DNA.
Cas9 cuts the DNA at the indicated point.
A "donor" DNA is provided (with the sequence to be inserted).
The cell repairs the cut by inserting the new gene via homologous repair.
Applications of "CRISPR grafts"
Genetic therapies (eg sickle cell anaemia, dystrophies, etc)
Precision agriculture

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	Synthetic biology (produce drugs, bio-fuels) Animal models for research
If video	-
If audio	
If 3D model	The formats needed are:.glb.

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