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BUILDING A BIONIC HAND

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

The purpose of this document is to create guidelines to help the project staff that are dealing with school children, 14-19 aged, to create and re-adapt exercises.

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 in an easier way.

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 and Bionic Hand
- How to define AR exercise thanks to the template:
    - General information
    - Pedagogical specifications
    - Technical specifications

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Overview of Bionic Hand

In the modern world, **robotics and biotechnology** are revolutionizing healthcare, medicine, and assistive technology. **Bionic hands**, inspired by human anatomy, are one of the most significant innovations in prosthetics, allowing individuals with limb differences to regain functionality and independence.

This lesson will explore the **intersection of robotics and biotechnology** by guiding students through the process of **designing, 3D modeling, and programming a bionic hand**. Students will gain hands-on experience in **3D printing, microcontroller programming (Arduino), and servo motor control**, all while learning how robotic prosthetics are engineered to **mimic human movement**.

Through **Augmented Reality (AR) simulations**, students will visualize and interact with virtual models of bionic hands, testing different configurations before assembling their own prototypes. Additionally, gamification elements such as **missions, challenges, and achievements** will create an engaging and competitive learning environment, encouraging **teamwork, creativity, and problem-solving**.

By the end of the lesson, students will not only understand how **robotics enhances biotechnology**, but also **develop a functional prototype** that demonstrates **the fundamental principles of robotic prosthetics**—bringing them one step closer to the world of biomedical engineering and innovation.

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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:	Building a Bionic Hand: Robotics in Biotechnology
Description of the exercises:	In this task, students will design and assemble a simplified prototype of a bionic hand using 3D modeling and printing techniques, along with basic programming to control finger movements. Augmented Reality (AR) will be incorporated to enhance the understanding of internal mechanisms and test virtual motion before physical assembly. Students will use AR tools like Tinkercad AR Viewer, Merge Cube, and BlippAR to visualize the bionic hand's internal structure, simulate finger movements, and ensure component compatibility. This exercise aims to integrate design, engineering, and biotechnology concepts, making complex mechanical systems more accessible and interactive.
Participants:	Students can work individually or in small teams (2-3), encouraging collaboration and division of tasks such as modeling, programming, and AR visualization.
Participants' age range:	17-19 years old

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STEM subject and specific topic:	STEM Subjects: Biotechnology, Robotics, Physics, Information technology, Biology, Mathematics, 3D Modeling, and Microcontrollers. The focus is on understanding the principles of bionics, mechanical movements, and the integration of 3D modeling with AR visualization.
Gamification process:	The following gamification strategies are applied: • **Mission-Based Learning:** The lesson is structured as a series of missions, where students take on the role of biomedical engineers tasked with designing and programming a bionic hand. Each mission presents new **challenges** that build upon previous knowledge. • **Points & Rewards System:** Students earn points for completing tasks, such as designing 3D models, programming servo motors, and successfully assembling functional bionic hand components. Additional points are awarded for creativity, problem-solving, and teamwork. • **Augmented Reality (AR) Engagement:** AR elements allow students to **interact** with virtual bionic hand components, **visualize** movements, and test different configurations before assembling their real-life prototypes. • **Real-World Application & Reflection:** At the end of the lesson, students present their bionic hand **prototypes** and reflect on their learning journey, simulating a real-world engineering project pitch. Students can participate in a final demonstration session where teams present their bionic hands through AR simulations and real-world testing. Peer evaluation and teacher feedback will be used to award points based on design precision, functionality, and innovation.
Written or graphic description of Augmented info:	• 3D models of a bionic hand (finger joints, tendons, servos, and microcontrollers). • Interactive AR simulation of how electric signals control prosthetic movement.

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	• Virtual circuit design for controlling the robotic hand using microcontrollers.
External (or extra) tools required	Tablets or smartphones with AR capabilities; 3D modeling software (TinkerCAD, Blender, AutoCAD); 3D printers; Arduino Uno and servo motors.
Links (video, images, text online and so on).	https://dronebotworkshop.com/servo-motors-with-arduino/ QR codes and URLs to AR models and simulation platforms will be provided, including sample visualizations on **Tinkercad AR Viewer**, **Merge Cube**, and **Sketchfab**.

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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?

Students can visualize, manipulate, and experiment with 3D models of bionic hand components, bridging the gap between theory and practice.

- **Interactive Visualization**: AR lets students explore a virtual bionic hand in 3D, breaking it into fingers, tendons, servos, and microcontrollers to better understand movement mechanics.
- **Hands-On Learning**: AR overlays show how mechanical parts interact, helping students grasp engineering, physics, and mathematics concepts while reducing trial-and-error in motor programming.
- **Gamified Engagement**: Mission-based challenges and real-time feedback keep students motivated while reinforcing key biomechanics and robotics programming principles.
- **Real-World Applications**: AR allows students to compare human and robotic hand movements, integrating biology with engineering through case studies on prosthetic advancements.
- **Bridging Virtual and Physical Prototyping:** Students can test and optimize 3D designs in AR before printing, reducing material waste and enhancing biomechanical understanding.

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Which pedagogical objectives are addressed through this scenario?

- Develop problem-solving and critical thinking skills.
- Understand the role of robotics in biotechnology.
- Identify key components of a bionic hand and their functions.
- Learn 3D modeling and 3D printing techniques for prosthetic design.
- Program a robotic hand using Arduino microcontrollers.
- Foster creativity through design iterations supported by AR feedback.

Which results are expected to be reached with its use?

- Students will be able to describe how robotics improves biotechnology and healthcare.
- Students will demonstrate the ability to interact with AR models of a bionic hand.
- Students will develop and test a basic prototype of a robotic hand using servo motors.

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Which results are expected to be reached with its use?

Benefits of AR Integration:

- It allows students to interactively inspect and refine their designs, enhancing their understanding of mechanical systems while minimizing material waste and trial-and-error assembly.
- Enhances visual learning by showing interactive 3D models of robotic prosthetics.
- Improves engagement by allowing students to manipulate virtual robotic components.

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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.

AR INFORMATION	
Technology	Markerless AR using **Tinkercad AR Viewer**, **Merge Cube**, **BlippAR**, and **Sketchfab**.
If it's needed a marker, description of the marker	-
Hardware and software needed:	Smartphones or tablets, 3D printers, Arduino microcontroller, Tinkercad software, Merge Cube AR app, BlippAR app, Sketchfab platform.
Type of Augmented data	3D models, interactive mechanical simulations, component overlays. .
Written description of the AR data	Students will use AR viewers to project 3D models of individual bionic hand parts and assembled structures into their physical workspace. They can inspect the placement of internal motors and tendons, simulate finger movement, and assess alignment accuracy. These AR visualizations will assist students during both the design and assembly phases.

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If Image	
If Text	
If video	
If audio	-
If 3D model	https://www.tinkercad.com/things/5Ljramq6cAM- https://www.tinkercad.com/things/kbwMTMjxLq6-

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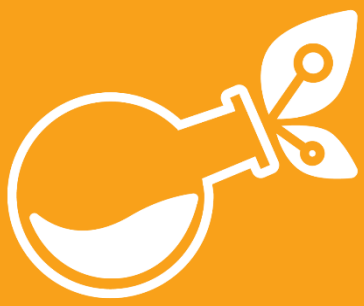

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