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Unit 4. The Risks of Gene Editing: What Could Go Wrong?

BIOS4YOU AR 2.0

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

Project Number: 2023-1-DE03-KA220-SCH-000126516

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General information

Name of the exercise:	Mission Genome: Decode the Human Genome Project
Description of the exercises:	Students scan a marker and enter an AR learning path with short interactive panels. They meet a virtual guide and complete 3 missions: 1. Explore: What the HGP was and why it mattered 2. Execute: How DNA sequencing worked (basic idea) and what “reference genome” means 3. Enhance: Ethics and real-life applications (privacy, medicine) Students finish with a short quiz and a reflection task.
Participants:	Individual AR experience (10–20 minutes) Then pair/group discussion (10–15 minutes)
Participants’ age range:	14–18 years. Basic knowledge: DNA, genes, chromosomes Ability to read short scientific texts in English (B1–B2) Basic smartphone/tablet use
STEM subject and specific topic:	Biology / Biotechnology Human Genome Project, DNA sequencing (basic), reference genome, genomic medicine, ethics (privacy, discrimination)
Gamification process:	Missions & checkpoints (3 missions) Collect 5 “Genome Tokens” (one token after each key panel + quiz token) Instant feedback (correct/incorrect messages in quiz) Optional team leaderboard in class (teacher-managed)

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Written or graphic description of Augmented info:	• AR panels with short text + icons • 3D models (DNA double helix + chromosome) • Clickable hotspots (tap to reveal “Did you know?” facts) • Embedded video links (optional) • Quiz (MCQ)
External (or extra) tools required	Smartphone/tablet with camera Internet connection (for loading media links) Printed marker sheet or marker displayed on screen Optional headphones
Links (video, images, text online and so on).	https://edu.delightex.com DNA basics video (Khan Academy): https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/dna-and-rna-structure/v/dna-structure-and-function NHGRI Human Genome Project page: https://www.genome.gov/human-genome-project TED-Ed HGP video: https://ed.ted.com/lessons/the-human-genome-project-tania-simoncelli NHGRI ELSI overview: https://www.genome.gov/about-genomics/policy-issues/ELSI NHGRI BRCA glossary page (optional gene example): https://www.genome.gov/genetics-glossary/BRCA

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Pedagogical specifications

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

The augmented reality experience transforms an abstract and complex biological topic into an interactive, mission-based learning journey. Instead of passively reading about the Human Genome Project, students actively explore key concepts through AR panels, 3D models, quizzes, and decision-making tasks.

The use of a virtual guide, visual DNA and chromosome models, and short interactive checkpoints helps students better visualize invisible biological processes such as DNA sequencing and genome mapping. Gamification elements (missions, tokens, instant feedback) increase motivation, curiosity, and engagement, while AR allows learning to take place in a familiar, technology-rich environment that aligns with students' everyday digital practices.

By combining biology, technology, ethics, and problem-solving, the activity naturally supports a STEAM approach and encourages interdisciplinary thinking.

Which pedagogical objectives are addressed through this scenario?

This scenario addresses the following pedagogical objectives:

- To develop students' understanding of the Human Genome Project, its goals, and its scientific importance
- To introduce basic principles of DNA sequencing and the concept of a reference genome
- To improve scientific literacy through reading short, age-appropriate texts in English
- To promote ethical awareness by exploring real-life implications of genomics, such as data privacy, discrimination, and medical decision-making
- To foster active learning, critical thinking, and reflection through interactive tasks and guided questions
- To support digital competence and responsible use of emerging technologies in education

Which results are expected to be reached with its use?

After completing the AR activity, students are expected to:

- Explain in simple terms what the Human Genome Project is and why it matters
- Describe the basic idea of DNA sequencing and the purpose of a reference genome
- Recognize key ethical and social issues related to genomics and genomic medicine
- Demonstrate increased engagement and confidence when discussing scientific topics
- Participate more actively in pair or group discussions, using correct terminology
- Reflect on how scientific knowledge can influence society and future generations

Which benefits are expected to be reached with its use?

The expected benefits of using this AR-based learning scenario include:

- Higher student motivation and engagement compared to traditional teaching methods
- Improved conceptual understanding through visualization and interactivity
- Better inclusion of different learning styles (visual, kinaesthetic, reflective)
- Increased autonomy, as students progress through the missions at their own pace
- Stronger connection between theoretical knowledge and real-world applications
- Enhanced classroom discussion and collaboration following the individual AR experience

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Technical specifications

AR INFORMATION

Technology	https://edu.delightex.com/PFG-KCK Marker
If it's needed a marker, description of the marker	-
Hardware and software needed:	• PC for teacher to create the space. • Smartphone or tablet with camera (iOS/Android, AR-enabled). • Internet connection for initial loading.
Type of Augmented data	Images (icons for correct/incorrect feedback). Text (questions, answers, instructions). 3D models (scientist avatar, DNA helix, answer buttons). Optional: short sound cues or video clips.

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Written description of the AR data	Students begin the experience by scanning a marker or simply placing the AR scene on a desk or floor using their mobile device or tablet. On their screen, a **scientist avatar** appears and welcomes them to the mission: to complete the *Gene Editing Quest* and test their knowledge. One by one, **five virtual quiz panels** appear with multiple-choice questions about DNA, coding and noncoding regions, enhancers, and chromatin. Students choose answers by tapping virtual buttons. Each choice triggers **immediate feedback**: a green glow and "Correct!" for the right answer, or a red effect and "Try again!" for the wrong one. The AR environment includes simple **static 3D props**, such as a DNA double helix, that appear next to the avatar to reinforce the scientific theme. At the end of the quiz, a final **information panel** congratulates the learner and offers a reflection question linking the activity to classroom discussion. The activity is carried out individually, ensuring that each student interacts directly with the AR content, and can end with a group reflection where students compare answers and discuss misconceptions.
If Image	-
If Text	*Intro (avatar):* "Welcome to Gene Editing Quest! I will ask you 5 questions about *The Risks of Gene Editing: What Could Go Wrong?*. Choose the correct answers and see if you can complete the mission!" *Sample question:* *Question 1:* What's a risk of gene editing in humans? ● *Answer 1:* Unintended genetic mutations ✅ (set as correct) ● *Answer 2:* Stronger, faster humans ● *Answer 3:* Unlimited reproduction *Question 2:* How could gene editing affect biodiversity?

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	• *Answer 1:* Create new species • *Answer 2:* Reduce genetic diversity ✅ • *Answer 3:* Eliminate diseases *Question 3:* What's an ethical concern with gene editing? • *Answer 1:* Designer babies ✅ • *Answer 2:* Solving environmental problems • *Answer 3:* Creating better societies *Question 4:* What's a risk of gene editing in agriculture? *Answer 1:* Resilient crops • *Answer 2:* Cross-breeding with wild plants✅ • *Answer 3:* Higher yields for all farmers *Question 5:* Why consider long-term effects of gene editing? • *Answer 1:* Technology might fail • *Answer 2:* Impact future generations and ecosystems✅ • *Answer 3:* Only affects the current generation *Final panel:* *"Congratulations, you completed Gene Editing Quest! Think: How does gene editing influence future generation and ecosystem?"*
If video	-
If audio	-
If 3D model	The formats needed are: .obj, .stl, .glb/.gltf

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