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How AI Understands Biology?

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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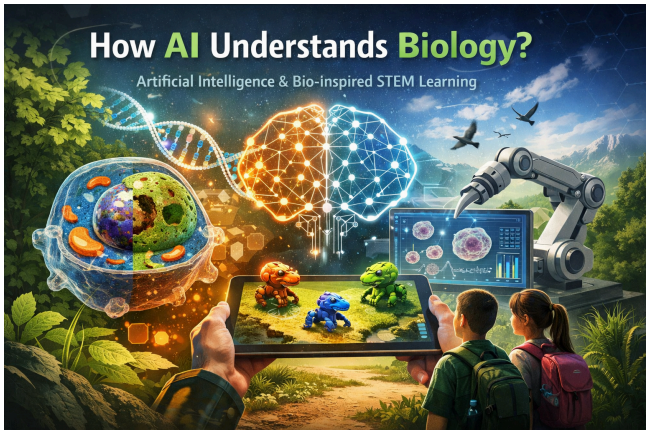

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General topic of the learning path	Artificial Intelligence and Bio-Inspired STEM Learning
Specific name of the learning unit	How AI Understands Biology?
Age of the target users	14-18 years
Requirements for the learner	Basic knowledge of biology concepts (cells, systems, basic genetics). Basic digital literacy and familiarity with using a computer, tablet, or smartphone. Access to an internet-connected device. No prior knowledge of Artificial Intelligence, coding, or Augmented Reality is required.
Description of the learning unit	This interdisciplinary learning unit introduces students to how Artificial Intelligence interprets biological systems by learning from nature. Using a bio-inspired STEM approach and Augmented Reality tools, students explore how biological structures and processes can be transformed into data, patterns, and models that AI systems analyze. The unit combines theoretical exploration with interactive AR-based activities developed in Delightex Edu to support understanding, engagement, and practical application.
Subject: Parties involved	Biology, Computer Science / Digital Literacy, Technology, Mathematics, STEM Education
Keywords	Artificial Intelligence (AI), Biology, Bio-inspiration, Pattern Recognition, Neural Networks, Evolutionary Algorithms, Augmented Reality (AR), Delightex Edu, STEM Learning
Key qualifications, skills and knowledge that can be acquired	• Understanding how AI analyzes biological data and systems. • Awareness of bio-inspired principles underlying AI technologies. • Critical thinking and systems thinking. • Digital literacy and confidence in using AR tools.

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	• Problem-solving and analytical skills. • Ability to connect biological concepts with real-world technological applications.
Resources and didactic aids used	• Mobile devices or tablets with AR capabilities. • Computers with internet access. • Delightex Edu (formerly CoSpaces Edu) AR/VR platform. • 3D models, interactive AR scenes, and visual simulations. • Supporting videos, images, and teacher-prepared materials.
Assessment criteria and evaluation	• Active participation in discussions and AR-based activities. • Completion of interactive tasks and exercises in Delightex Edu. • Observation of students' ability to explain concepts and make connections between biology and AI. • Reflective discussion and formative feedback during and after activities.

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Introduction

This learning unit introduces students to how Artificial Intelligence interprets biological systems by learning from nature. Through a bio-inspired STEM approach and the use of Augmented Reality, students explore the connection between biology and AI, gaining insight into how complex living processes can be analyzed, modeled, and understood using digital technologies.

Explore

1. How AI Understands Biology?

In this section, students are introduced to the fundamental idea that Artificial Intelligence (AI) does not understand biology in the same way humans do. Instead, AI interprets biological systems through data, patterns, and mathematical representations.
The purpose of this Explore phase is to help learners build a conceptual foundation about how biological information is transformed into digital data and how AI systems learn to recognize structures, relationships, and regularities within that data.

1.1 Biology as Data: From Living Systems to Digital Information

Biology traditionally focuses on the study of living systems such as cells, tissues, organs, organisms, and ecosystems. With the rapid development of digital technologies, these living systems are increasingly represented as data that can be stored, processed, and analyzed by computers.

From the perspective of Artificial Intelligence:

- DNA is represented as long sequences of letters (A, T, C, G), e.g., AI analyzes sequences to predict regulatory motifs or splice sites.
- Proteins are described as chains of amino acids and 3D structures, e.g., the AlphaFold model determines a protein's 3D shape from its sequence, enabling the design of new proteins for drugs.
- Microscopic images become pixel-based visual data.
- Biological interactions are transformed into networks and models, e.g., gene regulatory networks where AI identifies "who regulates what" among genes and signaling molecules.

AI systems do not directly observe life; instead, they work with digital representations of biological processes. By processing large volumes of biological data, AI can identify relationships and patterns that are difficult or impossible for humans to detect manually.

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Key idea for students:
From AI's perspective, biology becomes a combination of information, structure, and relationships.

1.2 What Does "Understanding" Mean for Artificial Intelligence?

When humans understand biology, they rely on meaning, context, experience, and reasoning. Artificial Intelligence, however, operates differently.

For AI, "understanding" means:

- Learning from examples and datasets.
- Recognizing patterns and similarities.
- Making predictions based on probabilities.

AI systems are trained using large collections of labeled biological data. Examples:

- Thousands of cell images teach AI to distinguish healthy cells from diseased ones, e.g., detecting cancer signs in pathology images.
- Genetic datasets help AI identify mutations linked to specific diseases, e.g., predicting disease risk from genomics and omics data.
- Biological signals are analyzed to predict functional outcomes, e.g., how mutations or drugs alter gene activity in cells.

This process is known as pattern recognition. AI does not think or reason like a human scientist; instead, it processes information at high speed and detects statistical relationships.

Important clarification for students:
AI does not "think" or "understand" in a human sense, but it can analyze biological data with exceptional speed and accuracy.

1.3 Learning from Nature: Bio-Inspiration and Artificial Intelligence

Interestingly, many AI systems are themselves inspired by biology. This approach is known as bio-inspiration, where natural processes serve as models for technological solutions.

Examples include:

- Artificial neural networks, inspired by the structure and functioning of neurons in the human brain.
- Evolutionary algorithms, which mimic natural selection by progressively improving solutions through variation and selection.
- Self-organizing systems, modeled after biological systems that adapt to changing environments.

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These bio-inspired approaches allow AI systems to:

- Learn from errors.
- Adapt to new biological data, e.g., generating novel molecules for drug design.
- Improve performance over time.

Bio-inspiration creates a strong conceptual bridge between biology, artificial intelligence, and engineering, reinforcing the interdisciplinary nature of modern STEM education.

1.4 Why Is AI Important for Modern Biology?

Modern biology produces vast amounts of data through genome sequencing, medical imaging, environmental monitoring, and laboratory experiments. The scale and complexity of this data exceed what humans can analyze alone.

Artificial Intelligence supports modern biology by:

- Processing millions of genetic sequences efficiently.
- Analyzing complex medical and biological images, e.g., radiology or microscopy data for disease diagnostics.
- Modeling biological processes that cannot be directly observed, e.g., inner cell workings or metabolic pathways in synthetic biology.

AI does not replace biologists—it functions as a powerful analytical tool that extends human capabilities and supports scientific discovery across medicine, biotechnology, and environmental sciences.

1.5 Summary

AI does not replace biological knowledge—it enhances our ability to explore, analyze, and understand life.

Execute

2. Exploring Bio-Inspired AI through Interactive Activities

In this section, students apply what they have learned by exploring how nature inspires Artificial Intelligence and how AI helps us better understand biological systems.
Through simple, interactive activities supported by Augmented Reality (AR) using Delightex Edu, learners develop practical skills such as observation, comparison, reasoning, and decision-making.

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2.1 Bio-Inspiration: Learning from Nature

Nature provides powerful examples of efficient systems that inspire modern AI:

- Neurons in the human brain inspire artificial neural networks, which help AI recognize patterns in biological images like cell microscopy.
- Evolution in nature inspires algorithms that improve solutions over time through trial and selection (evolutionary algorithms).
- Self-organizing biological systems show how complex structures emerge from simple rules, like ant colonies or flocking birds.

Students observe how these biological principles guide technological solutions, strengthening their understanding of bio-inspiration.

2.2 How Augmented Reality Supports Learning Objectives

Augmented Reality helps students visualize and interact with abstract biological and AI concepts that are difficult to observe in real life.

Using Delightex Edu AR/VR platform, activities can:

- display interactive 3D models of cells, neurons, and biological structures (using pre-made templates or drag-and-drop creation);
- show simplified visual explanations of pattern recognition through animated sequences;
- guide students through step-by-step interactive scenes using block-based coding (no advanced programming required);
- support collaborative learning across devices without technical barriers.

Delightex key strengths: AR visualization, 3D world building, educational templates for STEM.

2.3 Practical Activities (Overview with Examples)

Activity 1: Recognizing Patterns in Cells

- **Description**: Students explore interactive 3D cell models in AR (healthy vs. diseased) and observe differences in shape, size, and structure.
- **Task**: Use Delightex AR viewer to rotate/zoom cells; mark visual features AI would use for classification.
- **Bio-inspired concept:** Human visual perception → computer vision pattern recognition.
- **Example:** Use existing biology AR templates from Delightex gallery.

Activity 2: Exploring a Neural Network Model

- **Description**: Through an AR scene built in Delightex, students interact with a simplified neural network (connected nodes/spheres).
- **Task**: Activate input nodes, watch information flow through connections, observe how weights change outcomes (block-code animation).
- **Bio-inspired concept**: Biological neurons and synaptic learning.

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- **Example**: Teacher-created template using Delightex block coding.

Activity 3: Evolution as a Learning Strategy

- **Description**: Students participate in an AR simulation where virtual "creatures" compete, adapt, and evolve over generations.
- **Task**: Adjust parameters (speed, size), run simulations, observe natural selection principles in action.
- **Bio-inspired concept**: Evolution and adaptation → genetic algorithms in AI.
- **Example**: Adapt Delightex evolution/competition templates.

2.4. Summary

By using bio-inspired examples and Delightex Edu-based AR activities (accessible via web/mobile), students move from theory to practice.

They experience how Artificial Intelligence learns from nature and applies biological principles in a simple, intuitive, and interactive way – perfect for STEM classrooms.

Enhance

3. Enhancing Learning through Augmented Reality

The Enhance section explains **how Augmented Reality (AR) strengthens the learning experience** by deepening understanding, increasing engagement, and supporting active participation.
AR is not used as an add-on, but as a **pedagogical tool** that helps students visualize complex biological and AI-related concepts in a meaningful and accessible way.

3.1 How AR Improves Understanding of AI and Biology

Many processes involved in biology and Artificial Intelligence are invisible, abstract, or too complex to observe directly in a traditional classroom. AR helps bridge this gap by turning abstract ideas into interactive visual experiences.
Through AR-supported learning, students can:

- visualize biological structures (cells, neurons, networks) in three dimensions,
- observe relationships and connections rather than isolated facts,
- explore how small changes influence complex systems,
- learn through experimentation and feedback, not memorization.

This approach supports deeper conceptual understanding and long-term knowledge retention.

3.2 Delightex Edu as an Effective AR Learning Tool

Delightex Edu is particularly suitable for this unit because it combines simplicity with creative freedom.

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Using Delightex, students and teachers can:

- create and explore interactive 3D scenes related to biology and AI,
- use drag-and-drop tools and block-based coding without prior programming knowledge,
- access ready-made STEM templates that can be adapted to different learning levels,
- experience content in AR or VR, depending on available devices.

The platform allows students to become active creators, not just passive viewers, strengthening motivation and ownership of learning.

3.3 Gamification and Interactive Learning

AR-based activities in Delightex naturally support gamified learning elements, which increase engagement and participation:

- Points and feedback for completing tasks or making correct observations,
- Challenges that encourage exploration and problem-solving,
- Collaborative tasks that promote teamwork and communication,
- Visual rewards that reinforce progress and achievement.

Gamification helps maintain focus while supporting key competencies such as critical thinking, collaboration, and digital literacy.

3.4 AR-Based Assessment and Reflection

Augmented Reality also enables alternative forms of assessment beyond traditional tests.
Through AR-based activities, students can:

- demonstrate understanding by interacting with models and simulations,
- explain decisions and observations during or after activities,
- reflect on how bio-inspired principles apply to AI systems.

Teachers can use observation, discussion, and completion of AR tasks as formative assessment, gaining insight into students' understanding and reasoning processes.

3.5 Summary

By integrating Augmented Reality through Delightex Edu, this learning unit transforms abstract concepts into tangible learning experiences. AR enhances motivation, supports inclusive learning, and strengthens the connection between biology, Artificial Intelligence, and bio-inspired problem solving. As a result, students gain not only knowledge, but also transferable skills relevant to modern STEM education.

Conclusion:

This learning unit followed the **Explore–Execute–Enhance** approach to introduce students to how Artificial Intelligence understands biological systems through bio-inspired principles. Students explored key concepts linking biology and AI, applied this knowledge through practical, interactive activities, and deepened their understanding using Augmented Reality tools, particularly Delightex Edu. The use of AR made complex and abstract concepts more accessible, supported active engagement, and strengthened the connection between theory and practice. By highlighting bio-inspiration as a source of innovative solutions, the unit encourages further exploration of how nature-inspired AI can address real-world challenges.

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Phase	Description
Explore	- **Research and Discovery:** Students explore how Artificial Intelligence interprets biological systems by transforming living structures (cells, neurons, genetic sequences) into digital data. They investigate how patterns, relationships, and structures in biology can be analyzed by AI systems.
	- **Content Development:** Fundamental concepts of biology, Artificial Intelligence, and bio-inspiration are introduced through clear explanations and visual examples. Topics include biology as data, pattern recognition, bio-inspired AI models (neural networks, evolution, self-organization), and the role of AI in modern biological research.
	- **Needs Analysis:** Students' prior knowledge of biology, basic digital literacy, and understanding of data and systems is identified through discussion and guiding questions. This ensures that learning activities are accessible and appropriately scaffolded for the target age group (14–18 years).
Execute	- **Curriculum Implementation:** Students apply theoretical knowledge through hands-on, bio-inspired activities that demonstrate how AI learns from nature. Learning focuses on observation, comparison, reasoning, and decision-making rather than technical programming.
	- **Interactive Exercises:** Using Augmented Reality activities developed with Delightex Edu, students interact with 3D biological models, simplified neural network representations, and evolution-inspired simulations. These exercises allow learners to explore pattern recognition, learning processes, and adaptation in an intuitive and engaging way.
	- **Feedback Collection:** Students reflect on their observations and decisions during the AR activities through class discussion, peer feedback, and teacher-guided reflection. Immediate visual feedback within the AR environment supports formative assessment.
Enhance	- **AR Integration:** Augmented Reality is used to visualize complex biological and AI-related concepts that are difficult to observe in real life. Delightex Edu enables the creation and exploration of interactive 3D scenes in AR or VR, supporting inclusive and experiential learning.
	- **Interactive Learning:** AR activities promote active learning through exploration, experimentation, and collaboration. Students engage with digital models, manipulate variables, and observe system-level effects, strengthening conceptual understanding and systems thinking.
	Gamified Content: ● **Points and Badges:** Students earn points or visual rewards for completing tasks and making correct observations. ● **Challenges and Level**s: Activities are structured as progressive challenges that increase in complexity. ● **Collaborative Tasks**: Group-based AR activities encourage teamwork, communication, and shared problem-solving.
	AR-Based Assessments: Learning outcomes are assessed through students' interaction with AR models, completion of tasks, and reflective discussion. AR-based assessment supports demonstration of understanding, critical thinking, and application of bio-inspired principles rather than memorization.

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AI-based tools (ChatGPT, Perplexity AI, and NotebookLM) were used to support content drafting, research synthesis, and organization of source materials during the development of this learning unit:

- OpenAI. *ChatGPT* (large language model). https://chat.openai.com
- *Perplexity AI* [AI-powered search and research assistant]. https://www.perplexity.ai
- Google *NotebookLM* [AI-powered research and note-taking tool]. https://notebooklm.google.com

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