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# Lasers and the Eye: How Light Enhances Vision and Corrects Sight

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 exercise introduces students to the fascinating intersection of physics, biology, and medical technology by exploring how lasers are used to optimize human vision. The human eye is a highly sensitive optical system that depends on the precise focusing of light on the retina to create clear images. However, imperfections in the eye's structure, such as myopia (nearsightedness), hyperopia (farsightedness), or astigmatism, can distort vision. Modern laser technologies, such as LASIK and photorefractive keratectomy (PRK), use controlled beams of light to reshape the cornea and improve the way light is focused, restoring clear vision.

Through this exercise, students will use Augmented Reality (AR) to visualize the anatomy of the eye, understand how light travels through its components, and observe how lasers interact with eye tissues to correct refractive errors. They will explore how precise energy from laser light alters corneal curvature, allowing light to properly converge on the retina.

This activity combines optical physics and medical innovation within a STEAM framework, helping students connect the scientific principles of light refraction and laser behavior with their real-world applications in healthcare. By the end of the exercise, students will understand how the eye functions as an optical instrument, how vision problems occur, and how laser technology can enhance visual clarity, offering a powerful example of how science and technology work together to improve human life.

This document consists of the following points:

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

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# General information

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| Name of the exercise: | Lasers and the Eye: How Light Enhances Vision and Corrects Sight |
| Description of the exercises: | *This exercise introduces students to the medical application of laser technology in improving human vision. Using Augmented Reality (AR), students will explore the anatomy of the eye, understand how light travels through its components, and see how lasers are used to correct refractive errors such as myopia, hyperopia, and astigmatism.*<br><br>Through interactive 3D models and animations, students will visualize the structure of the eye, the path of light, and how precisely controlled laser energy reshapes the cornea to optimize focus on the retina. They will also compare normal and defective vision, analyze how refraction errors occur, and observe how laser correction restores proper light convergence.<br><br>The exercise will be structured into:<br><br>1. Exploration: Understanding the anatomy of the human eye and how it processes light.<br>2. Analysis: Observing how different refractive errors affect vision and how laser correction improves optical focus.<br>3. Design Task: Brainstorming how laser-based innovations could be applied in other fields of medicine or imaging technologies. |
| Participants: | This exercise is designed for individual students or small groups (3–5 members) to encourage discussion and collaboration. Group work is recommended for sharing observations and exploring real-world biomedical applications. |

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| Participants' age range: | Minimum 15 years old<br>Basic understanding of optics (light refraction and reflection) and human biology (eye structure) is recommended. |
| STEM subject and specific topic: | *STEM Subject:* Physics & Biology<br>*Specific Topic:* Application of laser technology in medicine, laser-assisted vision correction and optical optimization in the human eye.<br>*Main challenge (stressful aspect) of the topic:*<br>Understanding how laser light interacts with biological tissue and how subtle changes in corneal shape can alter vision can be conceptually challenging. The process involves optical physics, biological anatomy, and medical precision, which are difficult to visualize without advanced tools. Students often struggle to connect the physics of light refractionwith real-world medical technologies<br>*How AR helps simplify the concept:*<br>• Interactive 3D models allow students to explore the internal structure of the eye in detail, showing how light passes through the cornea, lens, and retina.<br>• AR animations illustrate the differences between normal and impaired vision, and how lasers reshape the cornea to correct refractive errors.<br>• Layer-by-layer visualization helps students connect optical behavior with biological anatomy, providing a realistic understanding of the process.<br>• Pop-up explanations simplify complex laser-tissue interactions, allowing students to observe them safely and clearly in a digital simulation.<br>*Pedagogical Aim (Learning Outcomes):*<br>By the end of this exercise, students should be able to:<br>1. Describe the anatomy and optical function of the human eye.<br>2. Explain how light refraction and focusing work in normal and impaired vision.<br>3. Understand the principle of laser correction and how it modifies the corneal curvature to improve vision. |

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| | 4. Identify potential applications of laser technology in other medical or technological contexts.<br>5. Use AR tools to visualize and analyze optical and biomedical processes. |
| Gamification process: | • Challenge-based learning: Students are presented with visual challenges to diagnose refractive errors and simulate laser correction in the AR environment.<br>• Points and Badges: Completing exploration, analysis, and design tasks earns points, motivating engagement.<br>• Interactive Role-Play: Students act as ophthalmic engineers or medical physicists, solving real-world visual problems through optical precision. |
| Written or graphic description of Augmented info: | The AR experience will include:<br>• **3D interactive models** of the eye, allowing students to zoom in on components like the cornea, lens, retina, and optic nerve.<br>• **AR overlays** displaying how light rays travel and focus in normal vs. impaired eyes.<br>• **Animations** showing how laser pulses reshape the corneal surface and adjust the focal point.<br>• **Pop-up text and labels** explaining each step of the process (e.g., “Refraction in the cornea,” “Myopia correction,” “Laser ablation zone”).<br>• **Comparative simulations** between untreated and laser-corrected vision to visualize before-and-after outcomes.<br>• **Progress tracking**, enabling students to advance through exploration, analysis, and application stages. |
| External (or extra) tools required | • AR-compatible devices (smartphones, tablets, or AR glasses).<br>• Delightex platform for hosting and accessing 3D and AR content.<br>• Printable worksheets for students to record findings, diagrams, and conclusions.<br>• Internet access for loading interactive materials. |

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| Links (video, images, text online and so on). | Optional: Supplementary videos explaining LASIK or eye anatomy (e.g., “How does laser eye surgery work?” on YouTube)<br><br>Video: How does laser eye surgery work?<br><br>Link: https://youtu.be/XPDVmBg5DeE?si=rrBxCP3vWaKA3Opw |

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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?

**Interactive 3D Models**

**Goal:**
Help students visualize and interact with detailed 3D models of the human eye to understand how light travels through its structures and how laser technology is used to correct vision.

**Use:**
Students can zoom in, rotate, and explore 3D models of the eye's anatomy, including the cornea, lens, retina, and optic nerve. By tapping on specific components (e.g., cornea or lens), students trigger animations showing how light refracts and focuses within the eye. They can also observe how refractive errors, such as myopia, hyperopia, or astigmatism, distort the light path and how laser correction reshapes the cornea to restore proper focus on the retina. Interactive overlays explain key concepts such as light refraction, corneal curvature, and focal adjustment, making the learning process visual and engaging.

**Interactive Buttons**

**Goal:**
Enable students to actively engage with AR models to better understand the relationship between eye anatomy, light behavior, and laser-based vision correction.

**Use:**
Students can tap on highlighted areas of the AR model to reveal **pop-up explanations**, **comparative visuals**, and **animations** showing the difference between normal and defective vision. Buttons allow students to simulate **laser correction procedures**, adjusting corneal shape and instantly viewing the improvement in light focus. Additional interactive buttons compare various vision errors, helping students recognize how minor structural differences influence optical performance. Progress tracking ensures that students move through learning stages systematically, from anatomy exploration to optical analysis and applied medical design.

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**Possible Classroom Session Plan**

Introduction (5–7 mins)
Goal: Introduce students to how light and laser technology are used to correct vision problems.

- Begin with a real-world question: *"How can light be used to fix vision instead of lenses or glasses?"*
- Show a short introductory video, such as How Does LASIK Work? – TED-Ed.
- Discuss how the human eye works like a camera, focusing light onto the retina, and what happens when the focus is misaligned.

**Main Activity – AR Exercise (30-35 mins)**

Exploring Laser Vision Correction with AR

AR Model Interaction (10–15 mins):

- Students scan a QR code or open the Delightex AR app to access the 3D eye model.
- Hands-on Exploration:
  - Rotate and zoom in on different eye components (cornea, lens, retina).
  - Tap to reveal pop-up explanations such as "How does the cornea bend light?" or "What causes myopia?"
  - Observe the path of light through the eye in both normal and impaired vision.

Guided Learning Tasks (10–15 mins):

- Watch an AR animation showing how laser pulses reshape the cornea to improve focus on the retina.
- Conduct a virtual comparison between normal, nearsighted, and farsighted eyes.
- Gamified challenge: Simulate a laser correction procedure by adjusting corneal curvature in the AR model to achieve clear vision.
- Optional: Brainstorm other medical or technological uses for laser precision, such as surgery or material processing.

**Conclusion & Recap (10-15 mins)**

**Goal**: Reinforce learning through discussion and reflection.
Project the AR model or animations for a shared discussion.
Ask students: *What part of the eye is most important for focusing light?, How does a laser correct the way light enters the eye?, What are the advantages of using light as a medical tool?*
Reflection Task: Write a short paragraph answering:
"How can laser technology demonstrate the connection between physics, biology, and medicine?"End with a discussion about how combining optics and medical engineering through STEAM learning leads to innovative healthcare solutions.

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## Which pedagogical objectives are addressed through this scenario?

**Active Engagement**

Students actively engage with the **3D AR models of the human eye**, allowing them to zoom in, rotate, and explore its anatomical components such as the **cornea, lens, retina, and optic nerve**. This hands-on approach fosters curiosity and exploration, helping students understand how each structure contributes to focusing light and forming clear vision. By interacting with animations and pop-up explanations, students directly connect theoretical knowledge about **optical physics and human biology** with **real-time visual simulations** of how light travels through the eye and how lasers correct vision defects.

**Critical Thinking**

The exercise promotes **critical thinking** as students analyze and compare how **different vision errors** (myopia, hyperopia, astigmatism) affect the path of light inside the eye. By observing AR animations and interactive corrections, they are encouraged to reason through **why certain optical distortions occur** and **how precisely controlled laser energy**reshapes the cornea to improve visual clarity. Students must think critically about the relationship between **optical principles**, **biological structures**, and **technological solutions**, deepening their understanding of how light behavior can be harnessed for medical innovation.

**Application of Knowledge**

Through interactive AR simulations, students apply their understanding of light refraction, optical focus, and tissue interaction in a visual and practical context. The exercise challenges them to connect theoretical principles of physics and biology with medical technology applications, such as laser vision correction and optical engineering. This bridge between science and real-world healthcare strengthens comprehension and knowledge retention, while encouraging students to see how interdisciplinary STEAM principles can be applied to innovative medical solutions that improve human life.

**Multimodal Learning (Visual, Hands-On, Inquiry-Based Learning)**

The scenario combines visual animations, hands-on AR exploration, and inquiry-based activities to appeal to different learning styles. Students engage multiple senses as they observe how light enters and focuses within the eye, and how laser correction restores visual accuracy. This multisensory learning approach transforms abstract optical and biological concepts into concrete, interactive experiences. By merging science, technology, and design thinking, the activity ensures that complex STEAM topics, such as laser-tissue interaction, light refraction, and bioengineering, become accessible, engaging, and memorable.

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**Enhanced Understanding of Eye Structure and Optical Mechanisms**
Students will develop a deeper understanding of how the anatomy of the eye supports vision and how light is refracted and focused to form clear images. By engaging with **interactive 3D AR models**, they will visualize how the **cornea, lens, and retina** work together to process light and how **laser technology** can reshape the cornea to correct vision impairments such as myopia, hyperopia, and astigmatism. This immersive experience helps students connect optical physics and biological anatomy, reinforcing theoretical knowledge through **visualization and hands-on exploration**.

**Increased Engagement and Interest in Medicine and STEAM Fields**
The **interactive and exploratory nature** of the AR exercise is expected to boost student engagement and motivation in **optics, biology, and medical technology**. By transforming complex topics such as **laser-tissue interaction and optical correction** into visually stimulating and interactive learning experiences, students are more likely to develop a positive attitude toward **scientific innovation and biomedical engineering**. They will also recognize the **real-world impact of physics and technology** in improving health and quality of life through medical applications like laser vision correction.

**Improved Retention and Recall of Key Concepts**
The combination of animated pathways, interactive models, and gamification elements is expected to enhance students' ability to retain and recall essential concepts about light refraction, vision correction, and corneal reshaping.
The multisensory learning experience, integrating visual, interactive, and inquiry-based exploration, supports long-term comprehension by linking theoretical optical principles to tangible, real-world medical applications. Students will be able to clearly explain how light behaves within the eye and how laser precision can restore proper vision.

**Increased Confidence in Explaining Optical and Medical Applications**
As students explore how light and laser technology are used to optimize vision through AR and guided learning tasks, they are expected to gain confidence in explaining optical and biomedical processes in their own words. The interactive approach empowers them to discuss how physics and technology converge in **medicine**, particularly in ophthalmology. By connecting scientific understanding with technological innovation, students will develop a deeper appreciation of STEAM's interdisciplinary value and its role in creating life-changing medical solutions such as laser-assisted eye surgeries and precision optical tools.

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# Technical specifications

| AR INFORMATION | |
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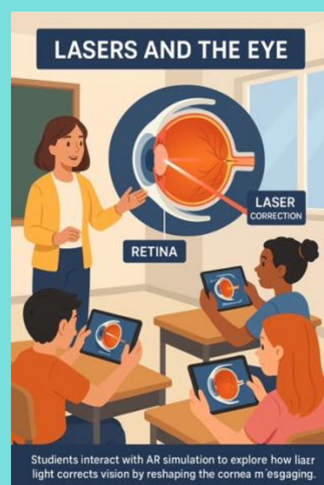
| Technology | **Markerless AR** (no need for a printed marker). |
| If it's needed a marker, description of the marker |  |
| Hardware and software needed: | **Hardware:** PC, smartphone, tablet (for accessing AR content), Camera (for AR functionality), Gyroscope (for AR tracking on mobile devices).<br>**Software:** The **Delightex** AR web-based viewer or mobile app, compatible with both **iOS** and **Android**. |
| Type of Augmented data | • 3D models of the human eye, showing the cornea, lens, iris, retina, and optic nerve.<br>• Text overlays explaining vision mechanisms, refractive errors, and laser correction.<br>• Animations showing light refraction, image formation, and corneal reshaping using laser pulses.<br>• Interactive elements allowing zoom, rotation, and switching between normal and defective vision. |

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| Written description of the AR data | After launching the AR experience, students will see a 3D model of the human eye projected into their environment. The title *"Lasers and the Eye: How Light Enhances Vision and Corrects Sight"* will appear, guiding them through the interactive experience.<br><br>Students can interact with the 3D model by:<br><br>• Zooming in and rotating to explore the anatomy of the eye (cornea, lens, retina).<br>• Tapping on highlighted parts to trigger annotations such as:<br>  ○ "How does the cornea bend light?"<br>  ○ "What happens in myopia or hyperopia?"<br>  ○ "How do lasers reshape the cornea to correct vision?"<br><br>Students can switch between different visual conditions (normal, myopic, hyperopic) and observe how the path of light changes in each case.<br>A navigation arrow allows moving between AR scenes that show vision correction steps, including laser ablation and post-surgery improvement.<br><br>**Additional features:**<br><br>• Animated sequences showing light focusing before and after laser correction.<br>• A biomedical innovation section, where students explore how laser optics are used in other medical and engineering applications.<br>• A "Return to Start" button for replaying and revisiting earlier scenes. |
| Scene | Four scenes:<br><br>**Scene 1: Anatomy of the Eye**<br>Students explore a 3D eye model, identifying main components: cornea, lens, iris, retina, and optic nerve. Pop-up text explains each part's function in focusing light. Navigation arrow moves to Scene 2.<br><br>**Scene 2: Vision Errors**<br>Students observe how light paths differ in myopia, hyperopia, and astigmatism. Interactive overlays and animations show how each condition alters the focal point on the retina. Navigation arrow moves to Scene 3. |



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| | **Scene 3: Laser Correction Process**<br>Students see a simulation of **laser-assisted vision correction** (LASIK/PRK). AR animations demonstrate how the corneal curvature is reshaped by laser pulses to achieve clear focus. Navigation arrow moves to Scene 4.<br><br>**Scene 4: Real-World Applications**<br>The final scene introduces **biomedical and technological uses of lasers** (e.g., precision surgery, imaging). Pop-ups include real-world examples and a short quiz or reflection task. "Return to Start" button resets the AR sequence. |
| If Image | - |
| If Text | **How Vision Works**<br>Light enters the eye through the **cornea** and **lens**, which bend it to focus on the **retina**, forming an image that the brain interprets.<br><br>**What Causes Refractive Errors**<br>When the cornea or lens is irregularly shaped, light doesn't focus properly on the retina, causing blurry vision — known as **myopia**, **hyperopia**, or **astigmatism**.<br><br>**How Laser Correction Works**<br>Laser pulses reshape the cornea's curvature, improving how light focuses on the retina and restoring clear vision.<br><br>**Biomedical Applications of Lasers**<br>Beyond eye surgery, lasers are used in **medical imaging, dermatology, dentistry, and cancer treatment**, showcasing their precision and versatility. |
| If video | - |
| If audio | - |

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| If 3D model | Delightex<br>https://edu.delightex.com/JQZ-LET |

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