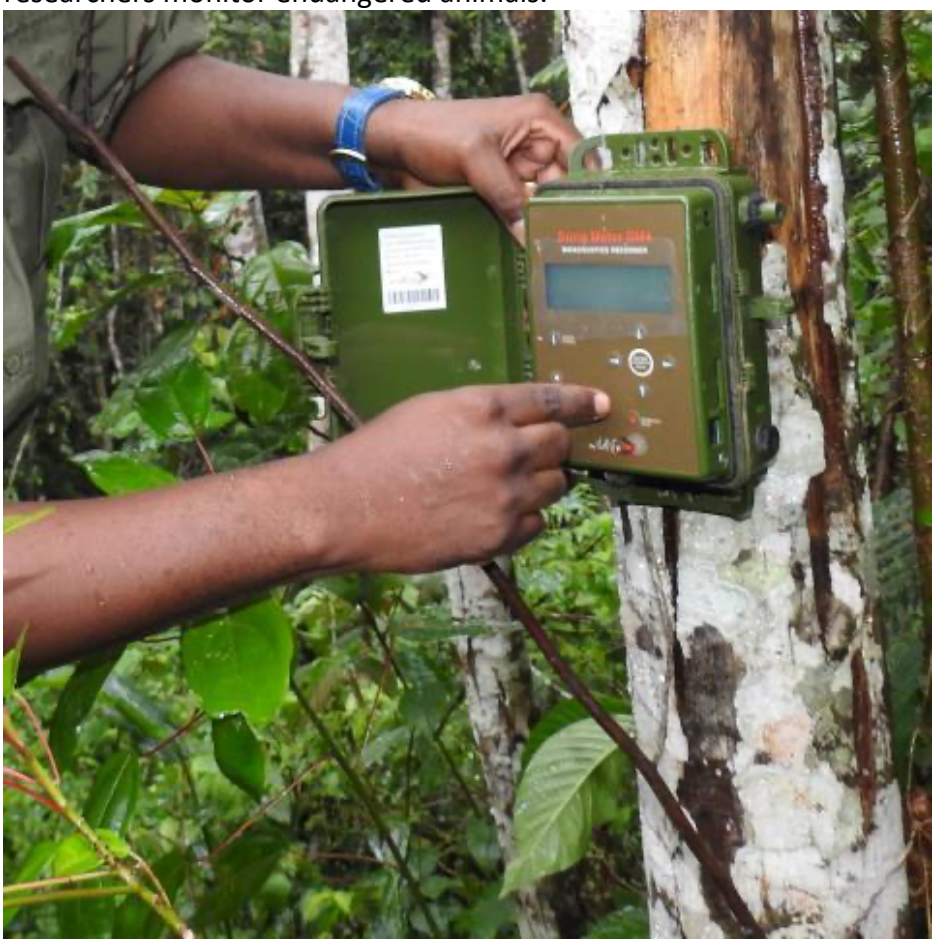
ENGINEERING - LESSON PLAN

Grade:	12 years old (6th-7th Grade)
Subject:	United in Biodiversity – Wildlife Trafficking
Lesson n°:	**2-3**
Topic:	**Anti Poaching Camera Traps** Design and build simple camera traps to simulate how wildlife researchers monitor endangered animals.  *Photo credit: https://www.awf.org/supporting-strategic-anti-poaching*

PROJECT REFERENCE NUMBER:
2022-1-EL01-KA220-SCH-000086967

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	 *Photo credit: https://globalconservationforce.org/5d1a4806-6204-4119-8321-67d1d7de4992/*
Lessons focus and goals:	**Lesson Focus**: **Engineering Design Process**: Students will apply the engineering design process to design and build a functional camera trap. This includes: ● **Identifying the problem**: Understanding the threats of wildlife trafficking and the importance of monitoring endangered animals. ● **Researching solutions**: Exploring how wildlife researchers use camera traps to monitor wildlife populations. ● **Designing a solution**: Sketching and planning their camera trap using recycled materials. ● **Building and testing**: Constructing the camera trap and testing its functionality with motion sensors and capturing images. ● **Refining the design**: Evaluating the initial design and making improvements based on testing results. ● **Recycled Materials and Sustainability**: Students will learn the value of using recycled materials in building functional objects. **Conservation Technology**: The project introduces students to the role of technology in wildlife conservation efforts. **Learning Goals**: ● Students will be able to explain the purpose of camera traps in wildlife research and conservation. ● Students will be able to describe the engineering design process and apply it to their project. ● Students will be able to design and build a functional camera

	trap using recycled materials, smartphones, and motion sensors. ● Students will be able to troubleshoot and refine their designs based on testing results. ● Students will be able to discuss the importance of sustainable practices and using recycled materials. ● Students will gain a deeper understanding of the threats of wildlife trafficking and the importance of protecting endangered species.
Learning objectives:	**Engineering Design**: 1.1 **Define the Problem**: Students will be able to identify the issue of wildlife trafficking and its impact on endangered animals. They will articulate the need for monitoring animal populations. 1.2 **Research Solutions**: Students will research and explain how wildlife researchers use camera traps to monitor animal activity. 1.3 **Design a Solution**: Students will be able to sketch and plan a camera trap design using recycled materials, considering factors like placement, triggering mechanisms, and image capture. 1.4 **Build and Test**: Students will construct their camera traps using recycled materials, smartphones, and motion sensors. They will test the functionality of the camera and sensor triggering mechanism. 1.5 **Refine the Design**: Through testing, students will identify areas for improvement in their camera trap design. They will make adjustments and test again, demonstrating iterative design practices. **Science & Technology**: 2.1 **Understand Motion Sensors**: Students will be able to explain the basic function of motion sensors and their role in triggering the camera trap. 2.2 **Explore Smartphone Technology**: Students will gain experience utilizing smartphone camera functions and potential applications for wildlife monitoring (if applicable to the chosen smartphone model). **Sustainability**: 3.1 **Importance of Recycled Materials**: Students will understand the value of using recycled materials in building functional objects and reducing waste. **Conservation Awareness**: 4.1 **Threats of Wildlife Trafficking**: Students will be able to explain the concept of wildlife trafficking and its impact on animal populations. 4.2 **Importance of Monitoring**: Students will understand the importance of monitoring wildlife populations for conservation efforts. These objectives provide a roadmap for student learning, ensuring they acquire specific skills and knowledge through the project.

Materials	**Recycled Materials**: • **Containers**: Students can choose from various options depending on their design and desired level of camouflage. Examples include: • **Plastic bottles** (consider size and color for camouflage) • **Cardboard boxes** (different sizes can be used creatively) • **Tin cans** (consider ventilation for smartphone heat) • **Other Recycled Materials**: Students can incorporate additional recycled materials to enhance their design: • **Fabric scraps or leaves** (for natural camouflage) • **Cardboard scraps or sticks** (for supports or positioning) • **String or wire** (for securing components) **Electronic Components**: • **Smartphones**: These will act as the camera for capturing images. Ensure they have a functioning camera and the ability to record videos (if desired). A discarded phone can be used if available. • **Motion Sensors**: These will trigger the camera to capture images when movement is detected. There are various options available, some easier to use than others: • **Vibration Sensors**: These simpler sensors react to physical movement (e.g., a tripwire triggering the sensor). These are easier to connect with basic tinkering skills. **Other Materials**: • **Rubber bands or tape**: To secure the smartphone and other components inside the container. • **Scissors and craft knife** (adult supervision required): For cutting and shaping recycled materials. • ***Optional***: **Hot glue gun** (adult supervision recommended) or other adhesives for a more permanent assembly. • **Batteries** (if required by the chosen motion sensor): Ensure proper battery disposal after use. **Considerations**: **Safety**: Adult supervision is recommended when using tools like craft knives and hot glue guns. **Project Difficulty**: The difficulty level can be adjusted based on the chosen motion sensor type.
Structure and activities	This project can be completed within a single class session (if the teacher/students have knowledge of Arduino and Scratch programming) or extended over multiple sessions depending on the desired depth and complexity. Here's a breakdown of the structure and activities for the single class session:

Introduction (10 minutes):
Brainstorming: Begin by facilitating a discussion about wildlife trafficking and its impact on endangered animals (https://www.unodc.org/e4j/en/wildlife-crime/module-1/key-issues/implications-of-wildlife-trafficking.html) . Ask students why monitoring animal populations is important for conservation efforts. Introduce Camera Traps: Show pictures or videos of real camera traps used by wildlife researchers (https://youtu.be/2AZqjEVQWE8?si=taSbFq500KCPoiAn, https://www.worldwildlife.org/initiatives/camera-traps). Explain how they work and their role in monitoring animals.

Engineering Design Process (30 minutes):

- **Define the Problem**: Reiterate the need to design a camera trap to monitor animal activity (https://wabsi.org.au/wp-content/uploads/2019/10/BTBCameraTrappingGuideJune2018.pdf).
- **Research Solutions**: Provide students with resources about camera traps (pictures, diagrams, short videos). They can research different designs and triggering mechanisms.
- **Design Phase:** Students sketch and plan their camera trap designs. Encourage them to consider factors like:
    - Type of recycled container (considering size, sturdiness, and camouflage)
    - Placement of the smartphone camera lens
    - Positioning and triggering mechanism of the motion sensor
    - Any additional features (e.g., weatherproofing)
- **Materials Selection**: Guide students in selecting appropriate recycled materials based on their designs.

Building and Testing (45 minutes):

- **Construction**: Students build their camera traps using the collected recycled materials and following their designs. Provide assistance with tools like craft knives (with adult supervision).
- **Smartphone and Sensor Integration**: Help students integrate the smartphone and motion sensor into their camera traps. For simpler vibration sensors, basic tinkering skills may suffice. (https://youtu.be/fg3HjyOUPxs?si=g6eP_RfYK0KpbOwQ, https://www.instructables.com/Using-Smart-Phone-as-Motion-Sensor-Alarm/,
- **Testing**: Students test their camera traps in a controlled environment (indoors or a safe outdoor space). They can trigger the motion sensor and verify if the smartphone camera captures images successfully.

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	Refinement and Reflection (20 minutes): ● **Evaluation**: Students discuss their testing results. Did the camera trap function as planned? What adjustments or improvements are needed? ● **Redesign and Retesting** (Optional): If time allows, students can refine their designs based on the testing results and retest their improved camera traps. ● **Wrap-up Discussion**: Facilitate a discussion about the challenges and importance of monitoring wildlife populations. Relate this project to the fight against wildlife trafficking. **Extension Activities** (Optional): ● Students can research specific endangered species and design their camera traps to best suit the chosen animal's habitat. ● They can create presentations showcasing their camera trap designs and the importance of wildlife conservation. Remember: ● Emphasize safety throughout the project, especially when using tools. ● Provide age-appropriate guidance and support during the construction phase. ● Encourage creativity and exploration of different designs using recycled materials. ● This project structure provides a framework for engaging students in the engineering design process while raising awareness about wildlife trafficking.
Recommended Technological Tools	1. **Mobile Apps** - **iNaturalist**: - Citizen science platform - Allows users to identify and log wildlife species - Helps students contribute to real scientific research - GPS-tagged observations support ecological monitoring - **Wildlife@Home**: - Specialized wildlife tracking application - Enables systematic observation and data collection - Potential for collaborative research among students - **Fauna Tracker**: - Customizable wildlife observation tool - Allows creating specific monitoring protocols - Potential for tailoring to local ecosystem needs 2. **Advanced Sensor Technologies**

	- **Thermal imaging sensors**:
	  - Detect animal presence in low-visibility conditions
	  - Capture nocturnal animal activities
	  - Higher accuracy than traditional motion sensors
	
	- **Low-light infrared cameras**:
	  - Enhanced night vision capabilities
	  - Minimal disturbance to wildlife
	  - Higher quality image capture in challenging environments
	
	- **GPS-enabled tracking modules**:
	  - Precise location tracking
	  - Migration pattern analysis
	  - Real-time movement monitoring
	
	3. **Data Collection Platforms**
	- **Cloud-based wildlife databases**:
	  - Centralized data storage
	  - Easy data sharing
	  - Standardized research formats
	
	- **Machine learning image recognition**:
	  - Automated species identification
	  - Pattern recognition in wildlife behavior
	  - Scalable research capabilities
	
	- **Open-source ecological monitoring platforms**:
	  - Community-driven research
	  - Collaborative scientific efforts
	  - Transparent data collection and analysis
	
	These technologies transform student learning from passive observation to active scientific participation, bridging classroom education with real-world conservation research.

Assessments:

#1 - Construction and Functionality
Objective: Did students successfully construct a functional camera trap using recycled materials?.
Rubric: Construction from recycled materials

	Initiating (1 pont)	Developing (2 points)	Excelling (3 points)
Description of performance	Uses some recycled materials, but may	Uses a variety of recycled materials	Uses a wide variety of recycled materials

Use of Recycled Materials	not be optimal for the design.	that are appropriate for the camera trap's function and durability.	creatively and effectively to construct the camera trap, considering factors like sturdiness and camouflage.
Construction Quality	Camera trap is loosely assembled and may not be functional.	Camera trap is assembled with some stability, but may have minor flaws that could affect functionality.	Camera trap is well-constructed, sturdy, and unlikely to break easily during use. All parts are securely attached.
Functionality of Camera Trap	Camera trap does not trigger the sensor or capture images consistently.	Camera trap triggers the sensor somewhat reliably, but may have issues with image capture consistency.	Camera trap triggers the sensor reliably and consistently captures images when activated.
Integration of Smartphone and Sensor	Smartphone and sensor are not integrated or integrated poorly, hindering functionality.	Smartphone and sensor are integrated with some success, but may require adjustments for optimal performance.	Smartphone and sensor are seamlessly integrated, functioning together smoothly and reliably.
Total Points: (Possible: 9 points) • **3 - 5 points**: Initiating - The camera trap has some functionality but may have significant flaws or construction issues. • **6 - 8 points**: Developing - The camera trap demonstrates functionality with some room for improvement. • **9 points**: Excelling - The camera trap is well-constructed, functional, and demonstrates a clear understanding of integrating the smartphone and sensor.			
Sample student response	**Use of Recycled Materials**: Uses a cardboard box for the main body, but no other recycled materials. **Construction Quality:** The box may not be well-suited for outdoor use. The cardboard box is loosely taped	**Use of Recycled Materials:** Uses a cardboard box for the main body and a plastic bottle cut in half for the lens cover. Materials are somewhat appropriate but could be improved for durability. **Construction Quality:**	**Use of Recycled Materials:** Uses a cardboard box for the main body, a plastic bottle cut in half for the lens cover, and fabric scraps for natural camouflage Materials are well-chosen for functionality and aesthetics.

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	together and easily falls apart. **Functionality of Camera Trap:** The camera trap is not secure and may not protect the smartphone. The camera trap does not trigger the sensor at all. No images are captured. **Integration of Smartphone and Sensor:** The smartphone and sensor are not connected at all. The camera trap is not functional.	The cardboard box is taped together with some reinforcement, but there are gaps and flimsy areas. The camera trap is somewhat stable but may not withstand rough handling. **Functionality of Camera Trap:** The camera trap sometimes triggers the sensor, but image capture is inconsistent. The camera may not focus properly. **Integration of Smartphone and Sensor:** The smartphone and sensor are loosely connected with wires, but the connection is not secure. The camera trap may malfunction due to a poor connection.	**2. Construction Quality:** The cardboard box is securely glued and reinforced with additional recycled materials like cardboard scraps or sticks. The camera trap is sturdy and unlikely to break easily. **3. Functionality of Camera Trap:** The camera trap consistently triggers the sensor and captures clear images every time. The camera focuses correctly on the target area. **4. Integration of Smartphone and Sensor:** The smartphone and sensor are seamlessly integrated with proper wiring or attachments (depending on sensor type). The connection is secure and reliable.

#2 - Construction and Functionality
Objective: Does the camera trap trigger the sensor and capture images effectively?
Rubric: Effective triggering and capturing

	Initiating	Developing	Excelling
Description of performance	Camera trap rarely triggers the sensor, or	Camera trap triggers the sensor somewhat	Camera trap consistently triggers

Triggering Reliability	the sensor malfunctions frequently.	reliably, but may have occasional malfunctions.	the sensor every time it detects movement within the designated range.
Image Capture Consistency	Camera trap captures no images, or captured images are blurry or unusable.	Camera trap captures some images when triggered, but they may be blurry, out of focus, or incomplete.	Camera trap consistently captures clear and well-focused images whenever the sensor is triggered.
Image Content	Captured images do not clearly show the target area or lack sufficient detail for identification.	Captured images show the target area somewhat clearly, but details may be obscured or out of focus.	Captured images provide a clear and detailed view of the target area, allowing for easy identification of movement or animal presence.
Total Points: (Possible: 6 points) ● **4 - 6 points**: Excelling - The camera trap consistently triggers the sensor and captures clear, informative images. ● **2 - 3 points**: Developing - The camera trap triggers the sensor somewhat reliably and captures some usable images, but there may be inconsistencies. ● **0 - 1 point**: Initiating - The camera trap rarely triggers the sensor or captures unusable images.			
Sample student response	**Triggering Reliability:** The camera trap only triggers the sensor a few times during testing, despite repeated movements in front of it. Sensor malfunctions frequently. **Image Capture Consistency:** No images are captured when the sensor is triggered. Captured images are blurry or completely unusable due to technical issues.	**Triggering Reliability:** The camera trap triggers the sensor occasionally, but not consistently. There may be long gaps between triggers even with movement. **Image Capture Consistency:** The camera trap captures some images when triggered, but many images may be blurry, out of focus, or only partially capture the movement.	**Triggering Reliability:** The camera trap consistently triggers the sensor every time there is movement within the designated range. Sensor functions reliably. **Image Capture Consistency:** The camera trap consistently captures clear and well-focused images whenever the sensor is triggered. Images are not blurry

	Image Content: Captured images are completely dark or lack any details due to poor lighting or incorrect camera positioning. Images do not show the intended area where animal activity would be captured..	**Image Content**: Captured images show the target area somewhat clearly, but details of movement or objects may be obscured by blurriness or darkness.	or distorted. **Image Content**: Captured images provide a clear and detailed view of the target area. Images allow for easy identification of movement or presence of animals within the frame..