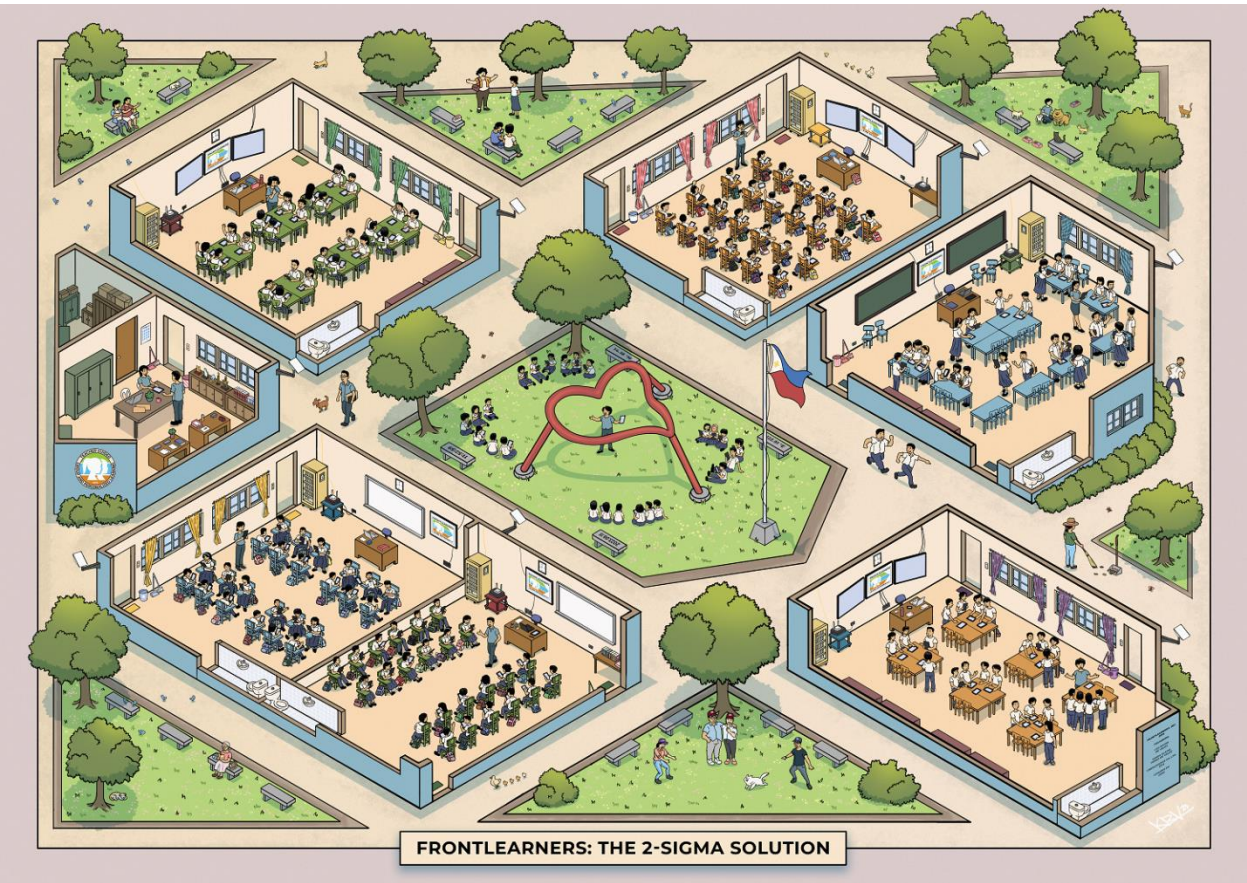
FRONTLEARNERS
MASTERY LEARNING, INTELLIGENT TUTORING

# LESSON EXEMPLARS

## Adapted PISA Released Items

## Science Literacy



**LESSON EXEMPLAR: Science Literacy - Bird Migration**
This exemplar provides a structured approach to teaching the concept of bird migration, focusing on sustainability, scientific principles, and practical problem-solving.

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## I. Curriculum Content, Standards, and Lesson Competencies

### 1. Content Standards

- Understanding the reasons and patterns behind bird migration.
- Recognizing how scientists study and map bird migration routes and the factors that influence their accuracy.

### 2. Performance Standards

By the end of the lesson, learners will be able to analyze bird migration patterns, identify potential factors affecting migration data, and discuss how scientists use tagging and mapping to study migration.

### 3. Learning Competencies and Objectives

- **Identify** the factors influencing bird migration and migration behavior.
    - *Lesson Objective 1*: Describe bird migration and its purposes.
    - *Lesson Objective 2*: Recognize scientific methods used in tracking bird migration, such as tagging and volunteer counts.
- **Evaluate** the reliability of migration data.
    - *Lesson Objective 1*: Identify factors that may affect the accuracy of bird migration counts (e.g., observer error, weather).
    - *Lesson Objective 2*: Analyze data on migration patterns and discuss how scientists interpret this information.
- **Develop Critical Thinking** on scientific reliability.
    - *Lesson Objective 1*: Discuss factors that impact the reliability of scientific observations in migration studies.

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## II. Learning Resources

- **Source Material**
  *Frontlearners, Inc. Adapted Released Items: Science – Bird Migration* (Adapted from OECD PISA 2015 Science Framework)
- **Multimedia Resources**
    - Video: "Why Birds Migrate and How We Track Their Movements" (YouTube)

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## III. Teaching and Learning Procedure

### A. Activating Prior Knowledge

- **Activity**: Group Brainstorm – Students discuss in groups the reasons they think birds migrate and what factors might influence this behavior.
- **Process Questions**:
    1. Why do some animals migrate while others stay in one place year-round?

2. How might weather or food availability affect migration?

*Instructional Note*: This activity introduces students to the basic reasons for migration, linking to later discussions on scientific tracking methods.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will explore the patterns of bird migration, examine scientific techniques used to study these patterns, and consider factors that affect migration data accuracy."
- **Reading Activity**: Students read the passage on bird migration and tracking methods from the source material.

*Discussion Prompt*: "How do scientists track where birds travel, and why might this information be important for conservation?"

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**C. Developing and Deepening Understanding**

**1. Map Analysis and Interpretation**

- **Activity**: Interpreting Migration Maps (Golden Plover case study from Frontlearners data set).
- **Task**: Students examine two maps of golden plover migration—one showing the autumn southward migration and another showing the spring northward return.
- **Guiding Questions**:
    1. What differences do you observe in the routes used during autumn and spring?
    2. How does the size of the migration group (indicated by arrow thickness) change between seasons?

**2. Critical Discussion**

- **Activity**: Accuracy in Bird Counts
- **Scenario**: Volunteers count migrating birds to help scientists understand population and routes. Students brainstorm factors that might make these counts inaccurate.
- **Reflection Question**: "What factors could make bird counts inaccurate, and how might this affect scientists' conclusions about migration patterns?"

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**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their initial KWL chart to add new insights on what they have learned about bird migration and tracking methods.
- **Reflection Activity**: One-minute paper – "Describe one method scientists use to study bird migration and one challenge they face in obtaining accurate data."

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**IV. Evaluating Learning: Formative Assessment**

**A. Multiple-Choice Exercise**

1. Why do most migratory birds travel in groups?

**B. Short Answer**

1. Explain how tagging birds helps scientists understand migration routes.
2. Name one factor that could make migration data less reliable.

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**V. Teacher's Reflection**

- **Reflection Guide**:
    - **Teaching Principles**: Did my methods effectively highlight the scientific aspects of bird migration?
    - **Student Engagement**: How well did students grasp the challenges in collecting accurate migration data?
    - **Next Steps**: What follow-up activities could reinforce students' understanding of migration patterns and scientific reliability?

**LESSON EXEMPLAR: Science Literacy - Data Dinosaurs**

This exemplar provides a structured approach to teaching the analysis of data related to dinosaurs, focusing on interpreting graphs, understanding attributes, and recognizing trends over geological periods.

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## I. Curriculum Content, Standards, and Lesson Competencies

### 1. Content Standards

- Understanding how paleontologists use data to analyze characteristics of dinosaurs.
- Recognizing the relationship between attributes of dinosaurs, such as weight and locomotion, across geological periods.

### 2. Performance Standards

- By the end of the lesson, learners will be able to interpret data visualizations on dinosaur attributes and evaluate trends in paleontological findings.

### 3. Learning Competencies and Objectives

- **Identify** attributes of dinosaurs and their significance in paleontology.
    - *Lesson Objective 1*: Define key attributes of dinosaurs (e.g., weight, diet, hip structure) and understand their classification.
    - *Lesson Objective 2*: Use data to explore relationships between dinosaur attributes and their habitats.
- **Evaluate** trends in dinosaur evolution using data.
    - *Lesson Objective 1*: Analyze data on dinosaur weight and explain observed changes over time.
    - *Lesson Objective 2*: Compare locomotion types and diets across different geological periods.
- **Develop Critical Thinking** in data interpretation.
    - *Lesson Objective 1*: Discuss how data visualization helps in understanding paleontological evidence.

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## II. Learning Resources

- **Source Material**
    - *Frontlearners, Inc. Adapted Released Items: Science – Data Dinosaurs* (Adapted from OECD PISA 2025 Science Framework)
- **Multimedia Resources**
    - Video: "Dinosaurs and Data – Understanding Prehistoric Life Through Visualization" (YouTube)

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## III. Teaching and Learning Procedure

### A. Activating Prior Knowledge

- **Activity**: Think-Pair-Share – Students brainstorm attributes they associate with dinosaurs (e.g., size, diet, walking style) and discuss these in pairs.

- **Process Questions**:
    - How do scientists use data to learn about extinct animals?
    - What are some key characteristics you would expect in dinosaur data?
- **Instructional Note**: This activity helps students recognize data attributes and builds context for analyzing dinosaur information.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will use data visualizations to examine different dinosaur attributes, analyze trends, and learn what these can tell us about the evolution of dinosaurs over time."
- **Reading Activity**: Students read a passage about how paleontologists use data visualization to identify trends in dinosaur evolution.
- **Discussion Prompt**: "Why is data important in studying extinct species like dinosaurs?"

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**C. Developing and Deepening Understanding**

1. **Data Tool Exploration**
    - **Activity**: Exploring Dinosaur Attributes
    - **Task**: Students use the data tool to manipulate dinosaur attributes on a graph, such as hip structure, diet, and geological period.
    - **Guiding Questions**:
        - Of the dinosaurs with lizard hips, how many could walk on both 2 and 4 legs?
        - What type of diet did the longest dinosaur have?
2. **Graph Analysis and Trend Interpretation**
    - **Activity**: Analyzing Weight Trends Over Time
    - **Task**: Students examine a plot showing dinosaur weight across geological periods, looking for any patterns.
    - **Reflection Question**: "Is there a strong relationship between dinosaur weight and the age in which they lived? Explain your answer."

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**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their initial KWL chart to add insights on the relationship between dinosaur attributes and their evolutionary trends.
- **Reflection Activity**: One-minute paper – "Summarize one trend you observed in the dinosaur data and a question you still have about it."

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**IV. Evaluating Learning: Formative Assessment**

**A. Matching Exercise**

- Match dinosaur attributes (e.g., diet, hip structure, geological period) with descriptions.

**B. Short Answer**

1. Explain how weight trends in dinosaurs may relate to their evolutionary adaptations.
2. Identify one factor, other than weight, that might change across geological periods and explain its significance.

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**V. Teacher's Reflection**

**Reflection Guide**:

- **Teaching Principles**: How did the lesson activities support students in understanding data analysis for paleontology?
- **Student Engagement**: Were students able to effectively analyze and interpret the data on dinosaur attributes?
- **Next Steps**: What adjustments could be made to improve the lesson's effectiveness in data interpretation skills?

**LESSON EXEMPLAR: Science Literacy - The Environmental Impact of Eating Meat**
This exemplar provides a structured approach to teaching the environmental and nutritional aspects of meat consumption, focusing on evaluating environmental impact, dietary choices, and scientific analysis.

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## I. Curriculum Content, Standards, and Lesson Competencies

### 1. Content Standards

- Understanding the environmental impact of meat production and consumption.
- Recognizing the nutritional roles of meat and plant-based alternatives.

### 2. Performance Standards

- By the end of the lesson, learners will be able to analyze the environmental costs of meat production and consider plant-based dietary alternatives that meet nutritional needs.

### 3. Learning Competencies and Objectives

- **Identify** the environmental resources required for different types of food production.
    - *Lesson Objective 1*: Compare the environmental impacts of producing beef, poultry, rice, and vegetables.
    - *Lesson Objective 2*: Describe how meat production contributes to land use and greenhouse gas emissions.
- **Evaluate** nutritional alternatives to meat in the context of a balanced diet.
    - *Lesson Objective 1*: Identify plant-based foods that provide essential nutrients similar to meat.
    - *Lesson Objective 2*: Assess the health and environmental benefits of reducing meat consumption.
- **Develop Critical Thinking** on environmental sustainability and dietary choices.
    - *Lesson Objective 1*: Analyze claims about the impact of meat production and the viability of plant-based diets.

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## II. Learning Resources

- **Source Material**
    - *Frontlearners, Inc. Adapted Released Items: Science – The Environmental Impact of Eating Meat* (Adapted from OECD PISA 2025 Science Framework)
- **Multimedia Resources**
    - Video: "The Environmental Impact of Meat Consumption" (YouTube)

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## III. Teaching and Learning Procedure

### A. Activating Prior Knowledge

- **Activity**: Group Discussion – Students discuss reasons people eat meat and alternatives they know of for obtaining nutrients.
- **Process Questions**:
    - Why do people eat meat, and what benefits does it provide?

    - What environmental resources do you think are needed to produce meat?
- **Instructional Note**: This activity helps students consider their own dietary choices and introduces the resource-intensive nature of meat production.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will examine the environmental impact of meat production, explore plant-based dietary alternatives, and consider the balance of nutrients necessary for a healthy diet."
- **Reading Activity**: Students read a passage about how different foods impact the environment and discuss why some people choose to reduce meat consumption.
- **Discussion Prompt**: "What environmental impacts are associated with meat production, and how do plant-based foods compare?"

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**C. Developing and Deepening Understanding**

1. **Data Interpretation and Comparison**
    - **Activity**: Analyzing Land Use and Resources for Food Production
    - **Task**: Students interpret data on the land required for producing beef, poultry, rice, and vegetables.
    - **Guiding Questions**:
        - How much land does it take to produce a kilogram of beef compared to a kilogram of vegetables?
        - What environmental benefits might come from switching to a more plant-based diet?
2. **Structured Discussion**
    - **Activity**: Analyzing Claims about Meat Consumption
    - **Scenario**: Celia and Anton discuss the environmental and nutritional reasons for reducing meat in their diet.
    - **Task**: In groups, students evaluate statements about meat's nutritional value and environmental impact, differentiating between scientific claims and value-based opinions.
    - **Reflection Question**: "What are some scientifically supported reasons to reduce meat consumption, and what reasons might be based on personal values?"

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**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their KWL chart to add new insights on the environmental and dietary impacts of eating meat.
- **Reflection Activity**: One-minute paper – "Summarize one environmental benefit of reducing meat consumption and one question you still have about plant-based diets."

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**IV. Evaluating Learning: Formative Assessment**

**A. Matching Exercise**

- Match each food type (e.g., beef, poultry, vegetables) with its environmental impact and required resources.

**B. Short Answer**

1. Explain why beef production requires more land than vegetables.
2. Name one plant-based food that provides similar nutrients to meat and describe its environmental benefits.

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**V. Teacher's Reflection**

**Reflection Guide**:

- **Teaching Principles**: How did the lesson activities support students in understanding the environmental aspects of food choices?
- **Student Engagement**: Were students able to effectively analyze the environmental impact of different diets?
- **Next Steps**: What additional resources could enhance students' understanding of sustainable food choices?

**LESSON EXEMPLAR: Science Literacy - Greenhouse Effect**
This exemplar provides a structured approach to teaching the concept of greenhouse effect, focusing on evidence analysis, scientific critical thinking, and data interpretation.

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## I. Curriculum Content, Standards, and Lesson Competencies

### 1. Content Standards

- Understanding the greenhouse effect and factors influencing global temperatures.
- Recognizing how human activities, specifically $CO_2$ emissions, affect the Earth's atmosphere and climate.

### 2. Performance Standards

By the end of the lesson, learners will be able to analyze data on atmospheric $CO_2$ levels and temperature trends, and evaluate the evidence supporting climate change and human influence on the greenhouse effect.

### 3. Learning Competencies and Objectives

- **Identify** the mechanisms behind the greenhouse effect and its impact on Earth's temperature.
    - *Lesson Objective 1*: Define the greenhouse effect and differentiate it from the enhanced greenhouse effect.
    - *Lesson Objective 2*: Analyze and interpret graphical data on $CO_2$ emissions and temperature trends.
- **Evaluate** factors that could influence the Earth's climate.
    - *Lesson Objective 1*: Identify alternative factors affecting global temperatures (e.g., volcanic activity, solar radiation changes).
    - *Lesson Objective 2*: Critically assess the strength of evidence linking $CO_2$ emissions to temperature changes.
- **Develop Critical Thinking** through discussion on scientific reliability.
    - *Lesson Objective 1*: Identify reliable sources and practices that ensure scientific data validity.

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## II. Learning Resources

- **Source Material**
  *Frontlearners, Inc. Adapted Released Items: Science – Greenhouse Effect* (Adapted from OECD PISA 2025 Science Framework)
- **Multimedia Resources**
    - Video: "Climate Change and the Greenhouse Effect Explained" (YouTube)

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## III. Teaching and Learning Procedure

### A. Activating Prior Knowledge

- **Activity**: Concept Mapping – Students work in pairs to create a concept map around the terms "Greenhouse Effect," "Carbon Dioxide," and "Climate Change."

- **Process Questions**:
    1. What is the greenhouse effect, and why is it important for life on Earth?
    2. How does carbon dioxide contribute to the greenhouse effect?

*Instructional Note*: This activity sets the stage for introducing the concept of the enhanced greenhouse effect.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will explore how human activities enhance the greenhouse effect, contributing to global warming, and examine the scientific evidence for this relationship."
- **Reading Activity**: Students will read the passage on the greenhouse effect and $CO_2$ impact from the source material.

*Discussion Prompt*: "What role does carbon dioxide play in trapping heat in the atmosphere, and how has this changed over the past century?"

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**C. Developing and Deepening Understanding**

**1. Graph Analysis and Interpretation**

- **Activity**: Analyzing $CO_2$ Emissions and Temperature Trends (from Frontlearners data set)
- **Task**: Students interpret two graphs—one showing global $CO_2$ emissions over time and the other showing average global temperatures.
- **Guiding Questions**:
    1. What patterns do you notice between $CO_2$ levels and temperature changes?
    2. Can we conclusively state that one causes the other? Why or why not?

**2. Critical Discussion**

- **Activity**: Structured Debate on André and Jeanne's conclusions (adapted from source material).
- **Scenario**: André believes increased $CO_2$ is directly responsible for global temperature rises, while Jeanne suggests exploring other factors.
- **Task**: In groups, students list other potential factors affecting temperature (e.g., solar activity, volcanic eruptions) and evaluate the reliability of different sources of scientific information.
- **Reflection Question**: "What makes some scientific findings more reliable than others?"

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**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their initial KWL chart to add new insights on what they have learned about the enhanced greenhouse effect.
- **Reflection Activity**: One-minute paper – "Summarize one piece of evidence that supports the enhanced greenhouse effect and one question you still have."

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**IV. Evaluating Learning: Formative Assessment**

**A. Matching Exercise**

1. Match the descriptions with key terms (Greenhouse Effect, $CO_2$ Emissions, Climate Change, Reliability of Data).

**B. Short Answer**

1. Explain how increased $CO_2$ emissions are thought to contribute to the enhanced greenhouse effect.
2. Name one factor that could affect global temperatures other than $CO_2$ emissions.

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**V. Teacher's Reflection**

- **Reflection Guide**:
    - **Teaching Principles**: How did my approach facilitate understanding of climate science concepts?
    - **Student Engagement**: Were students able to critically evaluate scientific data effectively?
    - **Next Steps**: What adjustments could I make to improve the lesson's effectiveness?

**LESSON EXEMPLAR: Science Literacy - Meteoroids and Craters**

This exemplar provides a structured approach to teaching the science of meteoroids, focusing on their interaction with Earth's atmosphere, the formation of craters, and the influence of atmospheric conditions on meteoroid impacts.

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## I. Curriculum Content, Standards, and Lesson Competencies

### 1. Content Standards

- Understanding the characteristics and behavior of meteoroids as they enter Earth's atmosphere.
- Recognizing the effects of atmospheric conditions on the frequency and size of craters.

### 2. Performance Standards

- By the end of the lesson, learners will be able to describe the process by which meteoroids create craters, analyze the role of Earth's atmosphere in meteoroid impacts, and interpret data on crater formation.

### 3. Learning Competencies and Objectives

- **Identify** the characteristics of meteoroids and their interactions with Earth's atmosphere.
  - *Lesson Objective 1*: Define meteoroids and explain what happens as they enter the atmosphere.
  - *Lesson Objective 2*: Describe how meteoroids create craters upon impact.
- **Evaluate** the impact of atmospheric thickness on crater frequency and size.
  - *Lesson Objective 1*: Analyze how a thicker atmosphere affects the likelihood of meteoroids reaching the surface.
  - *Lesson Objective 2*: Compare the crater formation on planets with different atmospheric conditions.
- **Develop Critical Thinking** about the factors influencing crater formation.
  - *Lesson Objective 1*: Discuss how the size and speed of a meteoroid influence the size of the crater it creates.

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## II. Learning Resources

- **Source Material**
  - *Frontlearners, Inc. Adapted Released Items: Science – Meteoroids and Craters* (Adapted from OECD PISA 2025 Science Framework)
- **Multimedia Resources**
  - Video: "How Meteoroids Create Craters" (YouTube)

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## III. Teaching and Learning Procedure

### A. Activating Prior Knowledge

- **Activity**: Think-Pair-Share – Students discuss what they know about meteoroids and the craters they form.
- **Process Questions**:

  - Why do meteoroids glow as they fall through the atmosphere?
  - How do you think Earth's atmosphere affects meteoroids?
- **Instructional Note**: This activity encourages students to connect prior knowledge with new concepts on meteoroids and atmospheric impact.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will explore how meteoroids interact with Earth's atmosphere, learn about the formation of craters, and examine how a planet's atmosphere affects the frequency of impacts."
- **Reading Activity**: Students read a passage describing meteoroid behavior as they approach Earth and the conditions that lead to crater formation.
- **Discussion Prompt**: "What role does Earth's atmosphere play in determining whether a meteoroid reaches the surface and creates a crater?"

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**C. Developing and Deepening Understanding**

1. **Atmospheric Impact Analysis**
   - **Activity**: Exploring the Role of Atmosphere in Meteoroid Impact
   - **Task**: Students use data to examine how atmospheric thickness affects the number and size of craters.
   - **Guiding Questions**:
     - How does a thicker atmosphere influence the likelihood of meteoroids reaching the surface?
     - Why might planets with thinner atmospheres have more craters?
2. **Crater Size Comparison**
   - **Activity**: Analyzing the Relationship Between Meteoroid Size and Crater Size
   - **Task**: Students arrange a series of craters based on the size of the meteoroids that caused them and the age of the craters.
   - **Reflection Question**: "What factors determine the size of a crater, and why do older craters look different from newer ones?"

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**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their initial KWL chart to add new insights on meteoroids, atmospheric effects, and crater formation.
- **Reflection Activity**: One-minute paper – "Summarize the relationship between a planet's atmosphere and the likelihood of meteoroids creating craters on its surface."

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**IV. Evaluating Learning: Formative Assessment**

**A. Matching Exercise**

- Match each term (e.g., meteoroid, atmosphere, crater) with its definition and role in the process of impact and crater formation.

**B. Short Answer**

1. Explain why some planets have more craters than others.
2. Describe one factor that affects the size of a crater created by a meteoroid.

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**V. Teacher's Reflection**

**Reflection Guide**:

- **Teaching Principles**: How did the lesson activities support students in understanding meteoroid behavior and crater formation?
- **Student Engagement**: Were students able to analyze the influence of atmospheric conditions on meteoroid impacts?
- **Next Steps**: What additional resources or adjustments could enhance students' understanding of meteoroids and atmospheric science?

**LESSON EXEMPLAR: Science Literacy - Running in Hot Weather**
This exemplar provides a structured approach to teaching the physiological effects of running in hot conditions, focusing on dehydration, heat stroke, and the role of hydration in maintaining safe body temperature levels.

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## I. Curriculum Content, Standards, and Lesson Competencies

### 1. Content Standards

- Understanding the impact of physical activity in hot environments on body temperature and hydration.
- Recognizing the physiological responses to high temperatures and how hydration affects them.

### 2. Performance Standards

- By the end of the lesson, learners will be able to analyze factors affecting hydration and body temperature in runners, identify risks associated with running in hot conditions, and interpret data from simulated running scenarios.

### 3. Learning Competencies and Objectives

- **Identify** factors that influence body temperature and water loss during exercise in hot environments.
    - *Lesson Objective 1*: Define dehydration and heat stroke and explain their effects on the body.
    - *Lesson Objective 2*: Describe how air temperature and humidity affect a runner's body temperature and water loss.
- **Evaluate** the effects of hydration on performance and safety in hot weather.
    - *Lesson Objective 1*: Analyze the impact of drinking water on reducing the risk of dehydration and heat stroke.
    - *Lesson Objective 2*: Compare the results of running simulations with and without water intake.
- **Develop Critical Thinking** about the role of hydration and environmental conditions on exercise safety.
    - *Lesson Objective 1*: Discuss why hydration is critical when exercising in hot, humid environments and identify safe practices.

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## II. Learning Resources

- **Source Material**
    - *Frontlearners, Inc. Adapted Released Items: Science – Running in Hot Weather* (Adapted from OECD PISA 2025 Science Framework)
- **Multimedia Resources**
    - Video: "Staying Hydrated During Exercise in Hot Weather" (YouTube)

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## III. Teaching and Learning Procedure

**A. Activating Prior Knowledge**

- **Activity**: Group Discussion – Students discuss what they know about the importance of hydration and how it affects performance in sports or outdoor activities.
- **Process Questions**:
  - Why is it essential to stay hydrated when running in hot weather?
  - What signs might indicate that a runner is becoming dehydrated?
- **Instructional Note**: This activity introduces students to hydration's role in athletic performance and safety in warm environments.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will learn how hot weather affects runners, explore the risks of dehydration and heat stroke, and examine how drinking water can reduce these risks."
- **Reading Activity**: Students read a passage describing the physiological responses to running in hot weather and the risks associated with dehydration and heat stroke.
- **Discussion Prompt**: "How does the body respond to hot weather during exercise, and why is hydration important?"

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**C. Developing and Deepening Understanding**

1. **Simulation Analysis**
   - **Activity**: Running in Different Weather Conditions Simulation
   - **Task**: Students adjust variables in a simulation (air temperature, humidity, water intake) and observe the effects on water loss and body temperature.
   - **Guiding Questions**:
     - How does drinking water affect the risk of dehydration?
     - At what temperature and humidity levels does the risk of heat stroke become significant?
2. **Data Interpretation**
   - **Activity**: Analyzing Results of Hydration on Running Performance
   - **Task**: Using simulation data, students compare body temperature and sweat volume for scenarios with and without water intake.
   - **Reflection Question**: "What data from the simulation supports the idea that hydration is essential for safe exercise in hot conditions?"

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**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their KWL chart to add new insights on the effects of temperature, humidity, and hydration on physical activity.
- **Reflection Activity**: One-minute paper – "Summarize why hydration is crucial during exercise in hot weather and a question you still have about staying safe in such conditions."

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**IV. Evaluating Learning: Formative Assessment**

**A. Matching Exercise**

- Match each term (e.g., dehydration, heat stroke, body temperature) with its definition and significance in the context of running in hot weather.

**B. Short Answer**

1. Explain why running in high temperatures without drinking water is dangerous.
2. Describe one effect of drinking water on body temperature during exercise.

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**V. Teacher's Reflection**

**Reflection Guide**:

- **Teaching Principles**: How did the lesson activities support students in understanding the importance of hydration?
- **Student Engagement**: Were students able to effectively analyze the effects of hydration on body temperature?
- **Next Steps**: What additional resources or adjustments could reinforce students' understanding of exercise safety in hot weather?

**LESSON EXEMPLAR: Science Literacy - Slope-Face Investigation**
This exemplar provides a structured approach to teaching environmental data collection and analysis, focusing on understanding how slope orientation affects vegetation and soil moisture.

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## I. Curriculum Content, Standards, and Lesson Competencies

### 1. Content Standards

- Understanding environmental factors that influence vegetation growth, such as solar radiation, soil moisture, and rainfall.
- Recognizing how slope orientation can create microclimates within a given area.

### 2. Performance Standards

- By the end of the lesson, learners will be able to analyze environmental data to explain differences in vegetation between two slopes, evaluate the roles of solar radiation and rainfall, and interpret soil moisture data.

### 3. Learning Competencies and Objectives

- **Identify** environmental factors that contribute to differences in vegetation.
    - *Lesson Objective 1*: Define solar radiation, soil moisture, and rainfall and describe their effects on plant growth.
    - *Lesson Objective 2*: Explain how slope orientation can affect the amount of sunlight and rainfall received.
- **Evaluate** data to determine the primary factor influencing vegetation differences.
    - *Lesson Objective 1*: Analyze data on solar radiation and soil moisture and interpret their correlation with vegetation health.
    - *Lesson Objective 2*: Compare rainfall data across two slopes to identify patterns.
- **Develop Critical Thinking** about environmental investigations and data interpretation.
    - *Lesson Objective 1*: Discuss how differences in environmental factors contribute to microclimates on each slope.

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## II. Learning Resources

- **Source Material**
    - *Frontlearners, Inc. Adapted Released Items: Science – Slope-Face Investigation* (Adapted from OECD PISA 2025 Science Framework)
- **Multimedia Resources**
    - Video: "The Role of Slope Orientation in Environmental Science" (YouTube)

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## III. Teaching and Learning Procedure

### A. Activating Prior Knowledge

- **Activity**: Group Brainstorm – Students discuss why certain areas in nature, like valley slopes, might have different vegetation.
- **Process Questions**:

    - What factors might cause one side of a valley to have more vegetation than the other?
    - How might the direction a slope faces impact the plants that grow there?
- **Instructional Note**: This activity introduces students to microclimates and the idea that environmental factors can vary significantly over short distances.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will examine why vegetation differs between two slopes by collecting and analyzing data on sunlight, soil moisture, and rainfall."
- **Reading Activity**: Students read a passage describing how slope orientation affects sunlight exposure and rainfall, influencing soil moisture and vegetation growth.
- **Discussion Prompt**: "Why might slope orientation lead to one side of a valley being greener than the other?"

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**C. Developing and Deepening Understanding**

1. **Data Collection and Instrument Placement**
    - **Activity**: Placing Instruments on Each Slope
    - **Task**: Students examine a diagram showing the placement of solar radiation meters, soil moisture sensors, and rainfall gauges on both slopes to understand why two of each instrument are needed.
    - **Guiding Questions**:
        - Why did the students place multiple instruments on each slope?
        - How does instrument placement ensure data accuracy?
2. **Data Interpretation**
    - **Activity**: Analyzing Solar Radiation and Soil Moisture Data
    - **Task**: Students analyze data collected from both slopes to decide whether sunlight or rainfall is more influential in creating differences in soil moisture and vegetation.
    - **Reflection Question**: "Based on the data, which factor – solar radiation or rainfall – seems to have a stronger effect on the difference in vegetation?"

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**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their KWL chart to add new insights on how environmental factors affect vegetation on different slopes.
- **Reflection Activity**: One-minute paper – "Summarize what you learned about how slope orientation affects vegetation and mention any questions you still have about environmental factors."

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**IV. Evaluating Learning: Formative Assessment**

**A. Matching Exercise**

- Match each environmental factor (e.g., solar radiation, soil moisture, rainfall) with its effect on vegetation and its relevance in the investigation.

**B. Short Answer**

1. Explain why slope A has more vegetation than slope B based on the environmental data collected.
2. Describe the importance of placing multiple instruments on each slope during the investigation.

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**V. Teacher's Reflection**

**Reflection Guide**:

- **Teaching Principles**: How did the lesson activities help students understand the influence of environmental factors on vegetation?
- **Student Engagement**: Were students able to analyze data effectively to draw conclusions about the differences in vegetation?
- **Next Steps**: What additional resources or adjustments could enhance students' understanding of microclimates and environmental science?

**LESSON EXEMPLAR: Science Literacy - Smoking and Health Risks**
This exemplar provides a structured approach to teaching about the health risks of smoking, focusing on evaluating scientific evidence, understanding historical perspectives, and analyzing data on smoking and its effects.

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**I. Curriculum Content, Standards, and Lesson Competencies**
**1. Content Standards**

- Understanding the health risks associated with smoking and the role of scientific evidence in health recommendations.
- Recognizing how historical perspectives and scientific studies influence public health awareness.

**2. Performance Standards**

- By the end of the lesson, learners will be able to analyze data on smoking and its effects, evaluate the strength of scientific evidence, and understand how scientific information can be used to assess health risks.

**3. Learning Competencies and Objectives**

- **Identify** key scientific evidence on the health risks of smoking.
    - *Lesson Objective 1*: Describe evidence showing the link between smoking and cancer.
    - *Lesson Objective 2*: Recognize the limitations of historical studies and how they influenced public perception.
- **Evaluate** the reliability of different types of health information and studies.
    - *Lesson Objective 1*: Analyze historical and current data on smoking to determine the strength of evidence.
    - *Lesson Objective 2*: Compare various sources of information and their impact on public health policies.
- **Develop Critical Thinking** regarding scientific claims and health risks.
    - *Lesson Objective 1*: Discuss why it is essential to critically assess the evidence behind health recommendations.

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**II. Learning Resources**

- **Source Material**
    - *Frontlearners, Inc. Adapted Released Items: Science – Smoking and Health Risks* (Adapted from OECD PISA 2025 Science Framework)
- **Multimedia Resources**
    - Video: "Understanding the Health Risks of Smoking" (YouTube)

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**III. Teaching and Learning Procedure**
**A. Activating Prior Knowledge**

- **Activity**: Group Discussion – Students discuss what they know about smoking, its health risks, and any evidence they have heard regarding its effects.
- **Process Questions**:
    - Why do some people believe smoking is dangerous?
    - What types of evidence would help determine if smoking is harmful?
- **Instructional Note**: This activity prepares students to explore the historical and scientific perspectives on smoking and its health implications.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will examine the health risks of smoking, analyze scientific evidence from past and present studies, and discuss how scientific data can influence health policies."
- **Reading Activity**: Students read a passage on early studies linking smoking to cancer and the response of tobacco companies, focusing on how evidence was interpreted.
- **Discussion Prompt**: "Why did tobacco companies claim there was no evidence that smoking caused cancer in humans, and how does this compare with what we know today?"

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**C. Developing and Deepening Understanding**

1. **Data Analysis and Historical Context**
    - **Activity**: Reviewing Graphs and Research Claims
    - **Task**: Students analyze a graph showing trends in smoking and cancer rates and evaluate statements made by tobacco companies in the 1950s.
    - **Guiding Questions**:
        - What does the data suggest about the relationship between smoking and cancer?
        - Why might tobacco companies have contested this evidence?
2. **Evidence-Based Reasoning**
    - **Activity**: Identifying Scientific Evidence
    - **Task**: Students examine a list of potential evidence sources and determine which ones would be considered scientifically valid for demonstrating smoking's health risks.
    - **Reflection Question**: "What types of evidence are most reliable for understanding health risks, and why?"

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**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their KWL chart to add new insights on the role of evidence in understanding health risks.

- **Reflection Activity**: One-minute paper – "Summarize the importance of reliable scientific evidence in public health and a question you still have about the evidence surrounding smoking."

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**IV. Evaluating Learning: Formative Assessment**

**A. Matching Exercise**

- Match each term (e.g., scientific evidence, cancer, tar) with its significance in the context of smoking and health risks.

**B. Short Answer**

1. Explain why historical studies on animals were not sufficient evidence for humans.
2. Describe one type of scientific evidence that supports the claim that smoking is dangerous.

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**V. Teacher's Reflection**

**Reflection Guide**:

- **Teaching Principles**: How did the lesson activities help students understand the importance of scientific evidence in assessing health risks?
- **Student Engagement**: Were students able to effectively analyze and interpret data related to smoking?
- **Next Steps**: What additional resources or adjustments could further enhance students' understanding of public health evidence?

**LESSON EXEMPLAR: Science Literacy - Sustainable Fish Farming**
This exemplar provides a structured approach to teaching the science of sustainable fish farming, focusing on ecological balance, resource management, and water quality in aquaculture.

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**I. Curriculum Content, Standards, and Lesson Competencies**

**1. Content Standards**

- Understanding the principles and challenges of sustainable fish farming.
- Recognizing how ecological balance is maintained in an aquaculture setting.

**2. Performance Standards**

- By the end of the lesson, learners will be able to analyze the components of a sustainable fish farm, describe the processes that support sustainability, and propose methods for waste management and resource efficiency.

**3. Learning Competencies and Objectives**

- **Identify** the components and organisms essential to a sustainable fish farm.
    - *Lesson Objective 1*: Describe the roles of different organisms (e.g., fish, algae, shellfish) in maintaining water quality and supporting a food chain in a fish farm.
    - *Lesson Objective 2*: Explain the importance of maintaining a balanced ecosystem within a fish farm.
- **Evaluate** strategies for sustainable aquaculture.
    - *Lesson Objective 1*: Analyze the flow of resources and waste in a fish farm and assess how each stage contributes to sustainability.
    - *Lesson Objective 2*: Propose solutions for improving water quality and reducing environmental impact in fish farms.
- **Develop Critical Thinking** about environmental sustainability and resource management.
    - *Lesson Objective 1*: Discuss the challenges of sustainable fish farming and evaluate methods to overcome them.

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**II. Learning Resources**

- **Source Material**
    - *Frontlearners, Inc. Adapted Released Items: Science – Sustainable Fish Farming* (Adapted from OECD PISA 2025 Science Framework)
- **Multimedia Resources**
    - Video: "The Basics of Sustainable Fish Farming" (YouTube)

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**III. Teaching and Learning Procedure**

**A. Activating Prior Knowledge**

- **Activity**: Brainstorming – Students discuss how fish are typically raised and identify potential environmental impacts of fish farming.
- **Process Questions**:

    - What might be some challenges in raising fish sustainably?
    - How could fish farms impact the environment if not managed properly?
- **Instructional Note**: This activity helps students understand the need for sustainable practices in aquaculture and sets the stage for exploring sustainable fish farming techniques.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will explore how sustainable fish farming works, learn about the organisms and processes that support it, and examine how fish farms can be designed to reduce environmental impact."
- **Reading Activity**: Students read a passage on the basic components and goals of a sustainable fish farm, focusing on water quality and food chain balance.
- **Discussion Prompt**: "Why is it important to manage waste and maintain water quality in fish farms?"

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**C. Developing and Deepening Understanding**

1. **Data Analysis and Organism Placement**
    - **Activity**: Designing a Sustainable Fish Farm
    - **Task**: Using a diagram of a fish farm with three tanks, students decide where each organism (e.g., ragworms, shellfish, marsh grass) should be placed to support the fish and maintain water quality.
    - **Guiding Questions**:
        - Why are certain organisms essential for water quality in a fish farm?
        - How does each organism contribute to the farm's sustainability?
2. **Scenario Analysis**
    - **Activity**: Problem-Solving in Water Management
    - **Scenario**: Researchers observe an excess of nutrients in the water returned to the ocean. Students discuss which additions to the farm (e.g., marsh grass) could reduce this problem.
    - **Reflection Question**: "How can we manage nutrient levels in fish farms to protect the surrounding environment?"

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**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their KWL chart to add new insights on sustainable practices in fish farming.
- **Reflection Activity**: One-minute paper – "Summarize one method used in fish farming to maintain sustainability and a question you still have about sustainable aquaculture."

---

**IV. Evaluating Learning: Formative Assessment**

**A. Matching Exercise**

- Match each component (e.g., fish, algae, shellfish) with its role in maintaining water quality and supporting the ecosystem.

**B. Short Answer**

1. Explain why it is important to control waste and nutrient levels in fish farms.
2. Name one organism used in fish farms that helps maintain water quality and describe its function.

---

**V. Teacher's Reflection**

**Reflection Guide**:

- **Teaching Principles**: How did the lesson activities support students in understanding sustainable aquaculture?
- **Student Engagement**: Were students able to effectively analyze the components of a sustainable fish farm?
- **Next Steps**: What additional resources or adjustments could reinforce students' understanding of sustainable fish farming?

**LESSON EXEMPLAR: Science Literacy - Top Predators and Ecosystem Balance**
This exemplar provides a structured approach to teaching about the role of top predators in ecosystems, focusing on trophic relationships, biodiversity, and the use of scientific evidence in environmental decision-making.

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**I. Curriculum Content, Standards, and Lesson Competencies**

**1. Content Standards**

- Understanding the ecological roles of top predators in maintaining biodiversity and ecosystem stability.
- Recognizing the effects of predator reintroduction on ecosystem dynamics and the value of scientific evidence in environmental management.

**2. Performance Standards**

- By the end of the lesson, learners will be able to analyze ecosystem relationships involving top predators, evaluate the potential impact of reintroducing species, and differentiate between scientific and non-scientific arguments in environmental debates.

**3. Learning Competencies and Objectives**

- **Identify** the direct and indirect effects of top predators on ecosystem components.
    - *Lesson Objective 1*: Describe the trophic relationships between predators, prey, and vegetation within an ecosystem.
    - *Lesson Objective 2*: Interpret diagrams showing the ecological impact of predator reintroduction.
- **Evaluate** scientific and non-scientific perspectives on environmental management.
    - *Lesson Objective 1*: Analyze scientific evidence on the effects of predator presence on biodiversity.
    - *Lesson Objective 2*: Distinguish between evidence-based scientific arguments and values-based opinions.
- **Develop Critical Thinking** about conservation and ecosystem management.
    - *Lesson Objective 1*: Discuss the complexities of reintroducing predators and the potential impacts on human interests, such as farming and tourism.

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**II. Learning Resources**

- **Source Material**
    - *Frontlearners, Inc. Adapted Released Items: Science – Top Predators* (Adapted from OECD PISA 2025 Science Framework)
- **Multimedia Resources**
    - Video: "The Role of Top Predators in Ecosystem Health" (YouTube)

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**III. Teaching and Learning Procedure**

**A. Activating Prior Knowledge**

- **Activity**: Think-Pair-Share – Students discuss why predators, like wolves or dingoes, are essential in natural ecosystems.
- **Process Questions**:
    - How do top predators influence the populations of other species?
    - What might happen if a top predator is removed from or reintroduced to an ecosystem?
- **Instructional Note**: This activity introduces students to the concept of trophic cascades and the role of predators in ecological balance.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will explore how top predators affect biodiversity, examine scientific evidence on predator reintroduction, and evaluate different perspectives on managing ecosystems with top predators."
- **Reading Activity**: Students read a passage describing the reintroduction of dingoes in Australia and its potential ecological effects, focusing on trophic relationships.
- **Discussion Prompt**: "How could reintroducing a top predator like the dingo affect other species in the ecosystem?"

---

**C. Developing and Deepening Understanding**

1. **Diagram Analysis**
    - **Activity**: Interpreting Ecological Impact Diagrams
    - **Task**: Using a diagram that shows direct and indirect effects of dingo reintroduction, students identify positive and negative impacts on various species in the ecosystem.
    - **Guiding Questions**:
        - What species are directly affected by the dingoes, and how?
        - How do changes in prey populations indirectly influence plant life?
2. **Evidence-Based Discussion**
    - **Activity**: Distinguishing Scientific and Non-Scientific Arguments
    - **Task**: Students review statements for and against dingo reintroduction, categorizing each as either evidence-based (scientific) or value-based (non-scientific).
    - **Reflection Question**: "Why is it essential to differentiate scientific evidence from personal or cultural values in environmental management?"

---

**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their KWL chart to add new insights on the impact of predator presence on biodiversity.
- **Reflection Activity**: One-minute paper – "Summarize the ecological role of top predators and any questions you still have about managing ecosystems with predators."

---

**IV. Evaluating Learning: Formative Assessment**

**A. Matching Exercise**

- Match each species in the diagram (e.g., dingo, prey species, vegetation) with its ecological role and the impact of predator presence.

**B. Short Answer**

1. Explain how the presence of a top predator can indirectly affect plant populations.
2. Describe one scientific and one non-scientific argument regarding dingo reintroduction.

---

**V. Teacher's Reflection**

**Reflection Guide**:

- **Teaching Principles**: How did the lesson activities help students understand the ecological role of top predators?
- **Student Engagement**: Were students able to differentiate between evidence-based arguments and value-based perspectives?
- **Next Steps**: What additional resources or modifications could deepen students' understanding of ecosystem management?

**LESSON EXEMPLAR: Science Literacy - Who Should We Believe?**
This exemplar provides a structured approach to teaching the skills of evaluating information credibility, focusing on critical thinking, reliability assessment, and source evaluation.

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## I. Curriculum Content, Standards, and Lesson Competencies

### 1. Content Standards

- Understanding the importance of evaluating the credibility of information sources, particularly in science.
- Recognizing key indicators of reliable scientific information, especially in topics related to public health and safety.

### 2. Performance Standards

- By the end of the lesson, learners will be able to assess the credibility of information sources, differentiate between reliable and unreliable sources, and explain how to verify scientific information effectively.

### 3. Learning Competencies and Objectives

- **Identify** characteristics of credible scientific information and sources.
    - *Lesson Objective 1*: Define credibility and explain why it is crucial in scientific information.
    - *Lesson Objective 2*: Identify factors that contribute to or detract from an article's credibility.
- **Evaluate** information sources based on key indicators of reliability.
    - *Lesson Objective 1*: Analyze sample information sources for credibility, accuracy, and bias.
    - *Lesson Objective 2*: Develop strategies for verifying information from diverse sources.
- **Develop Critical Thinking** about information in online and social media contexts.
    - *Lesson Objective 1*: Discuss why it is essential to critically evaluate social media posts and articles about scientific topics.

---

## II. Learning Resources

- **Source Material**
    - *Frontlearners, Inc. Adapted Released Items: Science – Who Should We Believe?* (Adapted from OECD PISA 2025 Science Framework)
- **Multimedia Resources**
    - Video: "How to Spot Fake News and Evaluate Sources" (YouTube)

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## III. Teaching and Learning Procedure

### A. Activating Prior Knowledge

- **Activity**: Brainstorming – Students discuss in small groups where they usually get information on health and science topics (e.g., social media, news, school).

- **Process Questions**:
    - How do you decide if a source is trustworthy?
    - Have you ever come across information that seemed incorrect or biased?
- **Instructional Note**: This activity encourages students to think about their information sources and prepares them to evaluate source credibility.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will learn how to evaluate the credibility of information sources, especially for scientific topics, and explore why this is important for making informed decisions."
- **Reading Activity**: Students read a short excerpt on how scientists verify information and why this process is critical for public understanding.
- **Discussion Prompt**: "Why do we need to carefully examine the sources of information we read online, particularly in science?"

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**C. Developing and Deepening Understanding**

1. **Analyzing Source Credibility**
    - **Activity**: Identifying Reliable vs. Unreliable Sources
    - **Task**: Students examine different sample articles, including one claiming that vaccines are dangerous, to identify factors that make a source credible or unreliable.
    - **Guiding Questions**:
        - What makes some articles more credible than others?
        - How can we identify if a source is biased or misleading?
2. **Multimedia Analysis**
    - **Activity**: Watching "How to Spot Fake News and Evaluate Sources" (YouTube)
    - **Task**: After viewing, students discuss key takeaways on evaluating online information and identifying red flags in sources.
    - **Reflection Question**: "What new strategies did you learn from the video for verifying online information?"

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**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their KWL chart to add new insights on how to evaluate the credibility of information.
- **Reflection Activity**: One-minute paper – "Describe one thing you will now look for when evaluating an information source, and explain why it's important."

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**IV. Evaluating Learning: Formative Assessment**

**A. Matching Exercise**

- Match each term (e.g., bias, credibility, evidence) with its definition and relevance in evaluating information.

**B. Short Answer**

1. Explain why it is essential to evaluate the credibility of a source, especially on health topics.
2. Name one characteristic of a reliable scientific source and one of an unreliable one.

---

**V. Teacher's Reflection**

**Reflection Guide**:

- **Teaching Principles**: Did the lesson activities help students develop a better understanding of information credibility?
- **Student Engagement**: How engaged were students in discussions on evaluating online information?
- **Next Steps**: What additional topics or resources could reinforce students' critical thinking about information sources?

**LESSON EXEMPLAR: Science Literacy - Zeer Pot Refrigeration**
This exemplar provides a structured approach to teaching the concept of zeer pot refrigerator, focusing on sustainability, scientific principles, and practical problem-solving.

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## I. Curriculum Content, Standards, and Lesson Competencies

### 1. Content Standards

- Understanding the principles of evaporative cooling and its application in sustainable refrigeration.
- Recognizing how local resources and technology can create practical solutions for environmental and economic challenges.

### 2. Performance Standards

By the end of the lesson, learners will be able to analyze the working principles of a zeer pot refrigerator, describe the scientific process behind evaporative cooling, and evaluate the impact of locally sourced technology in sustainable practices.

### 3. Learning Competencies and Objectives

- **Identify** the components and functionality of a zeer pot and the principle of evaporative cooling.
    - *Lesson Objective 1*: Describe the materials and setup of a zeer pot refrigerator.
    - *Lesson Objective 2*: Explain how evaporative cooling reduces temperature within the zeer pot.
- **Evaluate** the effectiveness of traditional cooling technology.
    - *Lesson Objective 1*: Assess how environmental factors, such as humidity, affect the efficiency of the zeer pot.
    - *Lesson Objective 2*: Compare zeer pot cooling with conventional refrigeration in terms of sustainability and accessibility.
- **Develop Problem-Solving Skills** by considering limitations and adaptations for local environments.
    - *Lesson Objective 1*: Propose modifications to enhance the zeer pot's cooling capacity in varying climates.

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## II. Learning Resources

- **Source Material**
  *Frontlearners, Inc. Adapted Released Items: Science – Zeer Pot Refrigerator* (Adapted from OECD PISA 2025 Science Framework)
- **Multimedia Resources**
    - Video: "How a Zeer Pot Refrigerator Works and its Impact on Communities" (YouTube)

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## III. Teaching and Learning Procedure

### A. Activating Prior Knowledge

- **Activity**: Group Discussion – Students brainstorm methods used to keep food cool in areas without electricity and discuss their effectiveness.
- **Process Questions**:
    1. What are some traditional methods for food preservation in warm climates?
    2. How do you think water and evaporation might help in cooling?

*Instructional Note*: This activity helps students recognize the problem of food preservation without electricity, setting the stage for introducing the zeer pot as an innovative, sustainable solution.

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**B. Establishing Lesson Purpose**

- **Purpose Statement**: "In this lesson, we will explore how a zeer pot refrigerator works to keep food cool without electricity, study the process of evaporative cooling, and discuss the significance of sustainable technology in resource-limited settings."
- **Reading Activity**: Students read the passage on the zeer pot's design and its use of local resources for refrigeration.

*Discussion Prompt*: "What makes the zeer pot a sustainable choice for refrigeration, and why is it particularly useful in certain regions?"

---

**C. Developing and Deepening Understanding**

**1. Diagram Analysis**

- **Activity**: Labeling the Zeer Pot Components
- **Task**: Students label parts of a zeer pot (inner pot, outer pot, sand layer, water) and describe their functions.
- **Guiding Questions**:
    1. How does each component of the zeer pot contribute to the cooling effect?
    2. Why is it important to keep the sand layer damp?

**2. Simulation and Data Interpretation**

- **Activity**: Interactive Temperature Simulation
- **Task**: Using a simulation tool, students adjust variables like humidity and temperature to observe the effect on cooling inside the zeer pot.
- **Reflection Question**: "How does high humidity impact the effectiveness of evaporative cooling in the zeer pot?"

---

**D. Making Generalizations**

- **KWL Chart Update**: Students revisit their initial KWL chart to add insights on how evaporative cooling is applied in the zeer pot.
- **Reflection Activity**: One-minute paper – "Summarize how a zeer pot refrigerator cools items without electricity and suggest one possible improvement for humid climates."

---

**IV. Evaluating Learning: Formative Assessment**

**A. Matching Exercise**

1. Match each component of the zeer pot (e.g., inner pot, sand layer) with its function.

**B. Short Answer**

1. Explain how evaporative cooling helps to keep the inner pot cool in a zeer pot refrigerator.
2. Name one limitation of the zeer pot refrigerator and propose a solution.

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**V. Teacher's Reflection**

- **Reflection Guide**:
    - **Teaching Principles**: Did the lesson activities effectively illustrate sustainable cooling technology?
    - **Student Engagement**: Were students able to relate evaporative cooling to real-world applications?
    - **Next Steps**: What additional resources or modifications could enhance understanding of sustainable cooling solutions?