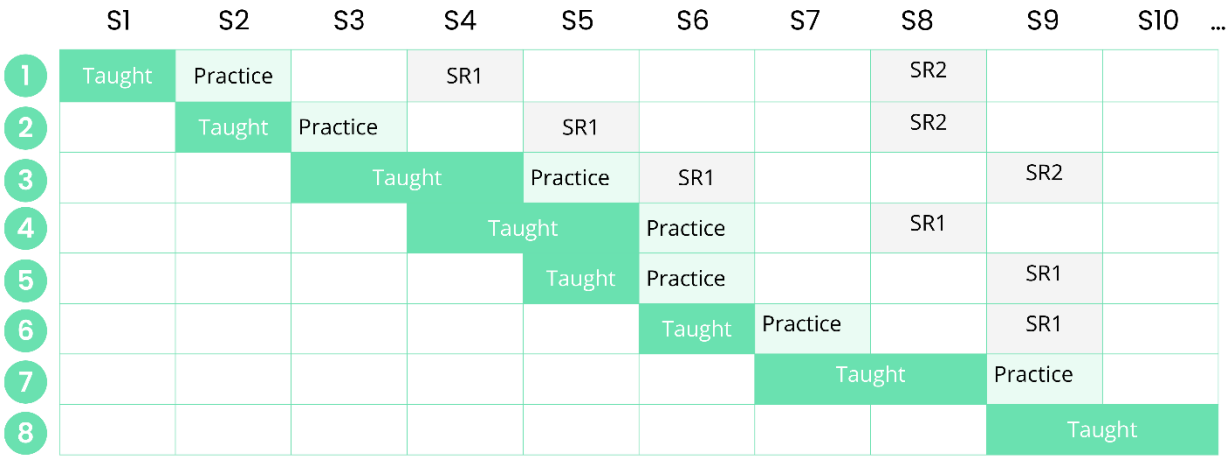
Spacing and Retrieval Practice

Free resource for educators

Spaced Retrieval Plan

Provided by Dr. Cynthia Nebel, Director of Learning Services for the St. Louis University School of Medicine, the below framework helps educators strengthen learning and ensure retention using evidence-based techniques.



Sample Lesson Plan

Science • 8th Grade

The below lesson plan provides practical insights for implementing spacing and retrieval practice in their classrooms.

Prepared by Peg Mischler, Director of Education & Research at CheckIT Learning, this plan was generated with the help of Cleo, the neuroscience-informed AI mentor available within CheckIT LMS.

💭 Essential Questions

1. How do large-scale patterns in the universe influence life and daily experiences on Earth?
2. In what ways do our observations of the sky shape how humans understand time, place, and motion?
3. How can building and using models deepen our understanding of complex systems in the natural world?

🔤 Key Vocabulary

1. Tilt – The angle at which Earth's axis is positioned relative to its orbit.
2. Revolution – Earth's movement around the Sun in an orbit.
3. Season – A period marked by specific weather patterns and daylight hours caused by Earth's tilt and revolution.
4. Sunlight Intensity – How concentrated or direct sunlight is on a surface.
5. Shadow Length – The distance a shadow stretches depending on the Sun's angle.
6. Equinox/Solstice – Times of year marking equal daylight or extreme tilt positions.

🎯 Student Learning Objectives

1. Explain how Earth's tilt and revolution cause seasonal changes (DOK 3).
2. Model how sunlight angle and intensity change throughout the year (DOK 2–3).
3. Analyze patterns in daylight hours to explain seasonal differences across locations (DOK 3–4).

📏 Standards Aligned

1. NGSS MS-ESS1-1: Develop and use a model to describe cyclic patterns of seasons.
2. NGSS MS-ESS1-2: Develop and use a model to describe forces and motions within the solar system.

Direct Presentation (10 minutes)

📚 Materials

1. Lamp (Sun model)
2. Globe with marked axis tilt

3. Chart paper
4. Markers

📋 Instructions for Teachers

1. Hold up the globe. Say: “Many people believe seasons happen because Earth moves closer or farther from the Sun—but that is a misconception. The real reason is Earth’s tilt.”
2. Tilt the globe and rotate it around the lamp.
3. Say: “Notice how sometimes the Northern Hemisphere leans toward the Sun and sometimes away. That changes two things: sunlight intensity and daylight length.”
4. On chart paper, draw an exaggerated tilted Earth. Label “More direct light” and “Less direct light.”
5. Say: “If your location tilts toward the Sun, you get more intense sunlight and longer days—this is summer. If it tilts away, sunlight spreads out and days get shorter—this is winter.”
6. Ask: “Would seasons still happen if Earth were not tilted?”

✅ Expected Student Responses

a. “No, every place would get the same sunlight all year.”
b. “Daylight wouldn’t change much.”
c. “We wouldn’t really have seasons.”

Anticipated Misconceptions

Students may think distance causes seasons. Say: “Earth is actually closest to the Sun in January! Seasons depend on tilt, not distance.”

🌎 Transcendent Thinking “How might understanding Earth’s tilt help communities prepare for seasonal changes like extreme temperatures or daylight differences?”

✅ Expected Student Responses

a. “Helps plan energy use.”
b. “Helps farmers know when to plant.”
c. “Helps people prepare for storms or long nights.”

Quick Check Ask: “When your part of Earth leans away from the Sun, what happens to sunlight intensity?”

✅ Expected Student Responses

a. “It spreads out more.”
b. “It becomes weaker.”
c. “Shadows get longer.”

Guided Practice (15 minutes)

📚 Materials

1. Globes or styrofoam Earths
2. Lamp or flashlight
3. Rulers or toothpicks (to measure shadow length)
4. Markers
5. Chart paper

📋 Instructions for Teachers

1. Say: “Today you’ll use a model to see how tilt changes the angle of sunlight and creates seasons.”
2. Give each group a lamp (Sun) and tilted globe.
3. Place small objects (pencil, stick) upright on the globe to model “shadow poles.”
4. Say: “Point your location toward the Sun. What season would this be?”
5. Rotate the globe.
6. Say: “Now tilt your location away. What season is likely here?”
7. Circulate with prompts:
    a. “How does the sunlight hit your location now—more direct or more spread out?”
    b. “What do you notice about shadow size?”
    c. “How does this help explain temperature changes?”

✅ Expected Student Responses

a. “Shadows grow when the Sun is lower in the sky.”
b. “Direct sunlight means more energy.”

c. “Longer daylight means more warmth.”

Quick Check Ask: “If another planet had no tilt, what would seasons be like?”

✅ Expected Student Responses

a. “There wouldn’t be seasons.”
b. “The weather would stay the same.”

🪜 Differentiation

Language Learners

1. Use gestures to show “tilting toward/away.”
2. Provide stems:
   a. “My location has more/less sunlight because ___.”
   b. “The shadow is longer/shorter when ___.”

Students Needing Support

1. Provide pre-labeled globes with hemispheres marked.
2. Give a “season wheel” visual with pictures for each position.

Go Deeper

1. Ask students to model solstices and equinoxes.
2. Challenge: “How would seasons differ at the equator? The poles?”

✅ Expected Student Responses

At the equator:

a. “Seasons would not change very much because sunlight is almost direct all year.”
b. “Day length stays nearly the same, so temperatures don’t vary much from season to season.”
c. “The equator gets consistent sunlight, so it has warm weather year-round instead of dramatic seasonal shifts.”

At the poles:

a. "Seasons would be extremely different because the poles tilt toward or away from the Sun more dramatically."
b. "In summer, the pole can have 24 hours of daylight (midnight sun)."
c. "In winter, the pole can have 24 hours of darkness (polar night)."
d. "Temperature changes would be very extreme because sunlight angle changes so much."

🤝 Accommodations & Modifications

General Supports:

1. Offer materials in contrasting colors to highlight tilted vs. untilted positions.
2. Allow oral explanations or model demonstrations instead of written responses.
3. Provide step-by-step graphic organizers for modeling tilt and shadow angles.

Individual Supports:

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a. Provide word-to-word dictionary support, colored overlays/screens, and simplified diagrams with high-contrast lines.
b. Offer sentence frames for instructions and explanations:
    i. "This location gets more sunlight because ___."
    ii. "The days are longer in this season because ___."
    iii. "Shadows change because ___."

Independent Practice (20 minutes)

📚 Materials

1. Paper
2. Pencils
3. Graph with daylight hours for 3 cities
4. Shadow diagram template

Purpose: Strengthen long-term understanding of how Earth's tilt and revolution create seasonal patterns—specifically changes in sunlight angle, daylight hours, and temperature—while helping students apply reasoning independently.

📋 Instructions for Teachers

Task 1: Seasonal Sunlight Reasoning (DOK 3)

Teacher Notes: This activity connects directly to today's Direct Presentation about how Earth's tilt changes sunlight intensity throughout the year. Students must explain the *cause-and-effect* relationship, not just name the seasons.

Say: "On your paper, explain in 3–4 sentences how Earth's tilt affects the amount of sunlight a location receives during different seasons. Use the phrases *'tilted toward…'* and *'sunlight is more/less direct because…'* in your explanation."

✅ Expected Student Responses

a. "During summer, our location is tilted toward the Sun, so sunlight is more direct and days are longer. In winter, we tilt away, making sunlight less direct and days shorter. The tilt changes how concentrated the Sun's energy is."

Success Criteria

a. Student identifies which direction the hemisphere is tilted.
b. Student explains how tilt affects sunlight angle or intensity.
c. Response shows the relationship between tilt → sunlight → season.

Task 2: Shadow Pattern Analysis (DOK 2–3)

Teacher Notes: This task applies modeling skills to real-world shadow changes and reinforces that the Sun's angle is a result of Earth's tilt and rotation.

Say: "Draw a simple diagram showing how a shadow changes at three points in a day: morning, noon, and afternoon. Then write 2–3 sentences explaining how Earth's rotation and Sun angle cause these differences."

✅ Expected Student Responses

a. "Shadows are long in the morning and afternoon because the Sun is low in the sky. At noon, the Sun is highest, so shadows are shortest. Rotation changes the Sun's angle throughout the day."

Success Criteria

a. Student accurately sequences shadow length.
b. Student links shadow changes to Sun angle.
c. Student explains rotation as the cause of angle changes.

Task 3: Compare Seasons at Two Locations (DOK 3–4)

Teacher Notes: This task builds conceptual understanding of *latitude* and *tilt* by having students reason about seasonal differences between two locations.

Say: "Choose one location near the equator and one near the poles. Write 4–5 sentences comparing how their seasons differ and explaining why tilt affects them differently."

✅ Expected Student Responses

a. "Near the equator, sunlight stays direct all year, so seasons don't change much. Near the poles, the tilt causes huge changes—long days in summer and long nights in winter. Sunlight angle changes more the farther you are from the equator."

Success Criteria

a. Student describes how sunlight differs by latitude.
b. Student explains why seasons are mild at the equator and extreme at the poles.
c. Student uses tilt to justify differences.

🔎 Reflection

1. "How well did I stay focused while modeling Earth's tilt and seasons today?" (Self-Regulation)
2. "What strategies helped me keep going when the concepts of tilt and sunlight angle felt challenging?" (Self-Regulation)
3. "How does learning about Earth's tilt help us understand our own lives and routines?" (Transcendence)
4. "How does knowing about daylight patterns help real communities make decisions about energy, farming, or travel?" (Transcendence)

Early Finishers

Create a “Season Profile” for one location on Earth and describe:

1. How daylight changes across the year
2. How sunlight angle changes in different seasons
3. What weather patterns you would expect in each season
4. How the location’s distance from the equator affects its seasonal differences

Students must use accurate concepts about Earth’s tilt, sunlight intensity, and latitude to justify each detail.

Review & Spaced Retrieval (5 minutes)

📚 Materials

None

Teacher Notes: This strategy strengthens retention through active recall and helps students connect today’s ideas about Earth’s tilt, sunlight intensity, and seasonal patterns to prior knowledge from the previous unit on the Sun’s motion and daylight patterns. The spaced retrieval prompt requires students to retrieve what they remember about Sun-path patterns and daylight changes, then link that prior learning to today’s explanation of how Earth’s tilt drives seasonal differences. The transcendent reflection encourages students to recognize how understanding seasonal patterns influences agriculture, travel, energy use, and long-term planning on Earth, reinforcing the conceptual link between Earth’s physical orientation and the predictable patterns humans rely on.

📋 Instructions for Teachers

Active Recall

Say: *“Before we wrap up, turn to a partner and answer this question: Why does Earth have seasons?”*

- ✅ Expected Student Responses

a. "Because Earth is tilted on its axis."
b. "When we tilt toward the Sun, we get more direct sunlight."
c. "Tilt changes sunlight intensity and daylight length."

Correct Common Misconceptions

If a student says, *"Seasons happen because Earth gets closer to the Sun,"* respond: *"Earth's distance barely changes. Seasons come from how much direct sunlight we get, which is caused by tilt—not how near or far we are from the Sun.*

Essential Question Connection

Say: *"Think about our big question: How do large-scale patterns in the universe influence life and daily experiences on Earth? What did today's investigation help you understand about that?"*

✅ Expected Student Responses

a. "It explains why seasons happen at the same time every year."
b. "It shows how Earth's tilt affects temperature and daylight."
c. "It helps explain why different places have different kinds of seasons."

🌎 Transcendent Thinking

Say: *"How might understanding seasons and sunlight patterns matter outside of science class? How could this knowledge shape human decisions in the future?"*

✅ Expected Student Responses

a. "Farmers need to know when seasons change to grow crops."
b. "Communities plan energy use based on daylight and temperature changes."
c. "Scientists use sunlight patterns to plan missions, habitats, or living conditions on other planets."

⏳ Spaced Retrieval (Draws from Unit 1, Lesson 4)

Say: *"Without looking at your notes, recall one key idea we learned in our previous unit about patterns of the Sun's motion—such as how the Sun's path changes in the sky or how daylight length varies across the year. Now explain how that idea helps you understand today's lesson about how Earth's tilt creates the seasons."*

✅ Expected Student Responses

a. "I remember learning that the Sun's path gets higher in the sky in summer and lower in winter. Today I learned that happens because Earth is tilted."
b. "Earlier we learned daylight changes in a predictable pattern. Now I understand that those changes happen because the tilt gives us longer or shorter days."
c. "I recall that sunrise and sunset times shift across the year. Today I connected that to Earth tilting toward or away from the Sun."

Formative Assessment

Prompt 1 (DOK 1): "What is Earth's axis?"

✅ Expected Student Responses: "An imaginary line Earth rotates and tilts around."

Prompt 2 (DOK 2): "How does sunlight angle change during different seasons?"

✅ Expected Student Responses: "It's more direct in summer and more spread out in winter."

Prompt 3 (DOK 3): "Explain how Earth's tilt affects daylight hours."

✅ Expected Student Responses: "When we tilt toward the Sun, days get longer; tilt away and days get shorter."

Prompt 4 (DOK 4): "How could changes in Earth's tilt change global climate patterns?"

✅ Expected Student Responses: "More tilt would make seasons more extreme; less tilt would make them milder."

🖉 Student Practice

Teacher Notes: These tasks reinforce today's learning about Earth's tilt, sunlight intensity, daylight length, and seasonal patterns by asking students to observe real-world changes and explain them using the concepts introduced in class. By applying tilt-based reasoning independently, students strengthen long-term retention and build the ability to transfer scientific thinking to everyday experiences such as temperature changes, seasonal daylight differences, and how sunlight angle affects life on Earth.

1. (DOK 2) Today, observe an outdoor object (such as a tree, sign, or building) at two different times—once in the morning and once in the afternoon. Write 3–4 sentences describing how the shadow changed and how Earth's tilt and the Sun's angle help explain what you saw.

    ✅ Expected Student Responses

    a. Student notes that the shadow was longer when the Sun was lower and shorter when the Sun was higher.
    b. Explains that Earth's rotation changes the Sun's angle during the day.
    c. Connects sunlight angle to Earth's tilt ("The Sun appears higher in some seasons because of tilt.").
    d. Uses correct vocabulary such as tilt, Sun angle, or shadow length.

2. (DOK 3) Choose two locations—one near the equator and one near the poles. Write 4–5 sentences explaining how their seasons differ and how Earth's tilt causes those differences.

    ✅ Expected Student Responses

    a. Near the equator, seasons change very little because sunlight is direct all year.
    b. Near the poles, seasons are extreme, with long periods of daylight in summer and long darkness in winter.
    c. Earth's tilt changes sunlight angle more dramatically at higher latitudes.
    d. Students correctly connect latitude + tilt → seasonal differences.

3. (DOK 3) Use the season diagram to compare summer and winter at your location. Write 3–4 sentences explaining why one season is warmer and has longer days than the other.

    ✅ Expected Student Responses

    a. Summer happens when the hemisphere is tilted toward the Sun, making sunlight more direct.
    b. Days are longer in summer because tilt makes the Sun spend more time above the horizon.
    c. Winter occurs when the hemisphere is tilted away, causing sunlight to spread out and daylight hours to shorten.
    d. Students correctly explain the relationship between tilt → sunlight intensity → daylight duration.

🔎 Reflection:

Write 2–3 sentences responding to one prompt:

1. “What evidence of seasonal change can you observe in your daily life?”
2. “How does understanding Earth’s tilt change the way you think about sunlight and temperature?”
3. “What challenges did you face during today’s practice, and how did you overcome them?”
4. “How might knowledge of seasons and sunlight patterns shape human decisions about farming, energy use, or travel?