LESSON 9

What causes precipitation along a cold front?

Adaptations for:

STEP 1: How does the air change as a front moves through a place? (pg. 32)
STEP 2: Make observations of what happens to the warm and cool fluids in the tank (pg. 32)
STEP 3: Develop a model for explaining precipitation during the cold front (pg. 33)

EXPLANATION:

Key phenomena (such as warm air rising, cold air undercutting, and boundary location) are communicated primarily through color, motion, and spatial positioning, which limits access for students who are blind or have low vision. Students must be able to hear the teacher narration during the demonstration, follow oral prompts, and engage in verbal group reasoning to refine the consensus model. Without consistent written, visual, or symbolic alternatives, students with hearing impairments may miss essential explanations, discussion-based reasoning, and clarification of abstract ideas. Learning activities in this lesson require sustained hand use (e.g., illustrating weather conditions over time, sketching cross sections, and labeling models) and quick visual-motor responses to a fast-moving demonstration, which may be limiting for students with motor challenges.

ADAPTATIONS FOR STEP 1:

UDL Principle: Multiple Means of Representation

- Create tactile or 3D weather symbols using the provided printable symbol pictures with magnets or felt to represent temperature, humidity, and air movement. Students move the symbols to create the scenes on a large poster board or whiteboard for before, during, and after a cold front moves through the area.
- Use scent cues to represent air masses. For example, warm air = cinnamon and cool air = mint. Create a jar for each stage: before (cinnamon only), during (cinnamon and mint), and after (mint only). Ask students to sequence the jars based on scent.
- Allow students to record 10–20 second voice notes for each of the three days describing temperature, humidity, and wind conditions.
- Have students act out changing atmospheric conditions, without relying on visuals. Divide the class into three groups: before, during, and after a cold front. Before a cold front, students hold warm packs (e.g., tube socks with rice heated in the microwave or the shakeable hot hand packs). During a cold front, students hold both warm and cold packs (e.g., ice packs or resealable plastic bags with ice). After a cold front, students hold only cold packs. Describe the conditions on each day as students arrange themselves along the room timeline in the correct order (before, during, and after)
- Provide written and icon-based directions alongside verbal instructions.

UDL Principle: Multiple Means of Action and Expression

- Allow students to construct the weather conditions before, during, and after a cold front using manipulatives, magnets, or drag-and-drop digital tools instead of drawing.
- Permit oral explanations, voice recordings, or paired scribing to communicate understanding.
- Provide pre-made labels, arrows (linked below), and symbols.
- Allow digital tools with speech-to-text or touch-based interfaces.
- Provide large grip markers and angled drawing boards.

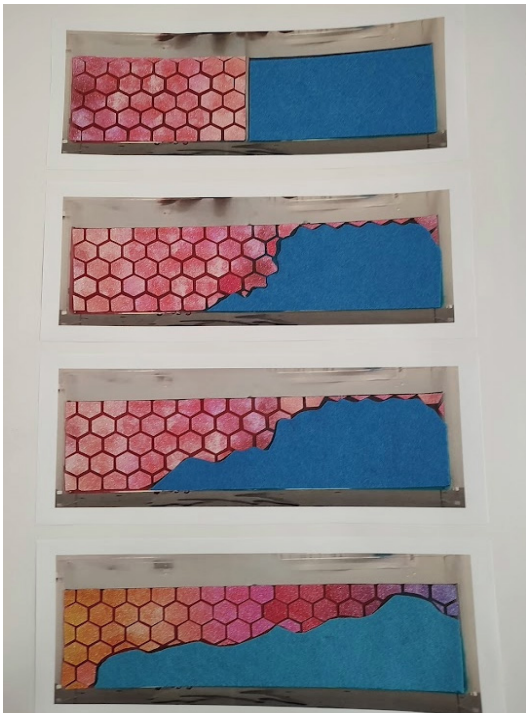
UDL Principle: Multiple Means of Engagement

- Offer choice in how students represent the weather sequence (e.g., drawing, building, acting, or narrating).
- Connect the task to real-world weather experiences that students recognize.
- Use collaborative pairing to help students share cognitive load and ideas.

ADAPTATIONS FOR STEP 2:

UDL Principle: Multiple Means of Representation

- Supplement the live demonstration with the slow-motion video (linked from Lesson 9) and provide still-frame images of the tank demonstration (linked below).
- Create tactile models showing cold air undercutting warm air (right) and allow students to use them as you discuss the demonstration.
- Have students touch and trace the divider and tank with their hands before filling it to orient themselves to the demo. Add the hot and cold water and allow students to touch the warm and cool sides of the tank during the demo to support understanding of temperature and density differences.
- Use explicit narration of what is happening during the demonstration, including watermovement, direction, and cause-and-effect).
- Provide written summaries or visual-symbol sequences that give cues about what to look for during the demo.



This model consists of four tactile frames representing key moments from the density tank demonstration. Each frame uses distinct textures to allow students to feel the difference between the warm and cold sides of the tank. The warm side is represented with raised, hexagonal, rough-textured stickers, while the cold side is represented with soft felt. Each frame is about 10 inches long and about 5 inches tall.

UDL Principle: Multiple Means of Action and Expression

- Allow students to document observations through voice notes, digital annotations on screenshots, or physical modeling with objects. These methods support visual and physical access.
- Encourage collaborative observation roles. For example, one student watches and verbalizes what they see, while another records.
- Provide predrawn tank outlines where students can place arrows or labels instead of drawing. This supports visual and physical access.

UDL Principle: Multiple Means of Engagement

- Invite students to predict outcomes using multiple modalities (e.g., spoken, physical, or symbolic).
- Use repeated viewings or reenactments to support understanding.
- Encourage curiosity by framing the model as imperfect but useful, and validate multiple interpretations.

ADAPTATIONS FOR STEP 3:

UDL Principle: Multiple Means of Representation

- Provide 3D or tactile modeling materials (e.g., foam wedges, layered fabrics, raised arrows, textured “clouds”)..
- Provide written group discussion prompts along with checklists outlining required model components and guiding questions.
- Encourage groups to document their thinking in writing or symbols as they discuss, creating a shared visual record.
- Include options for non-visual models (e.g., physical movement, sound cues, or tactile sequencing cards).

UDL Principle: Multiple Means of Action and Expression

- Allow students to create their model using a variety of options, such as physical or tactile models, digital diagrams, oral explanations with visual supports, or sequenced symbol cards.
- Support participation through role-based group work (e.g., explainer, builder, labeler, connector).
- Provide sentence starters to support consensus-building (e.g., "We agree that…," "Our model shows…").

UDL Principle: Multiple Means of Engagement

- Emphasize collaborative sensemaking rather than individual performance.
- Connect the model back to observable weather events to reinforce relevance and meaning.
- Normalize multiple representation types, such as physical, digital, verbal, and symbolic, as equally valid scientific models.
- Encourage students to critique the model's strengths and limitations to support authentic scientific reasoning.

ADAPTED MATERIALS:

Lesson 9, Step 1: Printable symbol pictures for magnets

Lesson 9, Step 2: Still-frame images of tank demo

Arrow printable - print and cut out several arrows to label the diagrams

IMPLEMENTATION NOTES:

This lesson relies heavily on visual representation and observation to access core ideas. Students are expected to draw weather conditions, interpret color-coded diagrams (red vs. blue water), observe rapid fluid motion in the density tank, and translate those observations into cross-sectional sketches and models. Be aware of physical positioning (i.e., the view of the tank) to ensure access for students with mobility challenges. These barriers can prevent students from fully documenting observations and participating in modeling, even when conceptual understanding is intact. Understanding in this lesson depends significantly on spoken explanation, whole-class discussion, and oral sensemaking, so it is helpful to add alternative ways for students to demonstrate their understanding. Additionally, students sometimes struggle with interpreting transitions between map views, cross sections, and abstract models, which are not explicitly scaffolded for non-visual learners.

MY STUDENTS' UNIQUE NEEDS:

I have many students who have been identified as being on the Autism spectrum and/or ADHD, with challenges in executive functioning, emotional regulation, speech language and social skills, sensory processing skills, and writing/reading. Whether a student has physical or intellectual disabilities, they need multiple, flexible ways to perceive the phenomena being modeled, access key explanations and sensemaking without relying solely on hearing or vision, and the ability to express their understanding using methods that do not depend on fine-motor drawing, rapid observation, or physical stamina.