**Resource K**

**Structured Science Inquiry**

**Sixth Grade**

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**Student:** Nate Pittman (please see the summary of assessment data, goals, and objectives to identify the supports Nate will need to be successful: **Resource I**)

**Scenario:** Teacher candidate supporting Nate Pittman in an inclusive sixth-grade science classroom. Nate receives pull-out and push-in support from his special education teacher and/ or paraprofessionals. This scenario can also be used in professional development with teachers.

**Standard:**

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| **Sample State Science: Earth & Space Science for Sixth Grade** |
| S6E2. Obtain, evaluate, and communicate information about the effects of the relative positions of the sun, Earth, and moon. |
| c. Analyze and interpret data to relate the tilt of the Earth to the distribution of sunlight throughout the year and its effect on seasons. |

**Candidate Behaviors Needed for Inquiry-Based Learning Lesson:**

Candidates will need to demonstrate skill in performing the following skills/behaviors to teach the entire unit:

* Using a structured/supported inquiry approach
* Using active engagement strategies, including student questioning related to content of the unit, wait time, and prompting for student responses (HLP #18)
* Using academic and behavior constructive feedback, which should include ample specific praise (HLP #8 and HLP #22)
* Using multimodal content for presentation, progress monitoring, and assessment
* Using explicit instruction in graphic organizers (HLP #16)
* Using explicit instruction in vocabulary and completing a science notebook (HLP #16)
* OPTIONAL: Using any of the following supplemental techniques:
	+ Mnemonics
	+ Technology

**Lesson Unit:** The sixth-grade science candidate uses the Web-Based Inquiry Science Environment (WISE: <https://wise.berkeley.edu/> ) to teach students how the Earth's axis, latitude, and time of year affect average temperatures. Candidates are expected to demonstrate using explicit instruction and active engagement in teaching two components of the unit. WISE's open-inquiry investigation is used to teach the concept addressed in this unit: Tilt and Temperature Patterns (<https://wise.berkeley.edu/preview/unit/30191/node19>). The lesson plan provides little direct explanation and instead has sixth-grade students explore these concepts using the online module and flexible grouping (HLP #17; i.e., individual, pairs, and small/large groups). The candidates provide explicit instruction for two mini-lessons in the unit where students will need more explicit support. When finished with the module, students discuss what they discovered. The lesson ends with an open-ended writing activity in which students are asked to share what they learned using the appropriate supports.

**Structured Inquiry Support Model for Candidates:**



**Pre-Teaching:**

**Identify Big Ideas:** The science candidate and special education candidate work together to identify the core vocabulary concepts that students need to learn prior to participating in the inquiry lesson. They will center support around these concepts and their students' current knowledge of these topics (e.g., seasons of the year could be the core focus for students with little to no background in this area of inquiry). The overall big idea for this unit is the following: ***Many factors influence the temperature of the Earth at any given time of the year.***

**For students with limited background knowledge:** The candidate will focus on the concepts/vocabulary related to this big idea. Specifically:

* Earth tilt
* Northern Hemisphere
* Southern Hemisphere

**Informal Pre-test:** Before the formal inquiry lesson, the candidate will informally assess Nate and other targeted students’ understanding of the core concepts connected to the big idea. Potential ways to informally assess students can include:

* Developing student-directed concept maps (can be completed individually, in small groups, or via whole-class discussion)
* Using guided questions that lead to concepts or vocabulary
* Using any other appropriate pre-test assessment of students' prior/current knowledge of science concepts or the big idea

**Pre-Teaching** (Mursion Activity 1): Through the pre-testing, the candidate identifies that Nate and a few of his peers seem to understand the concept of seasons, but they have little to no background on the following core concepts that affect the Earth's temperature: Earth's tilt and Northern and Southern Hemisphere. She decides to pre-teach how these concepts affect the temperature on Earth using explicit instruction (HLP #16) and active engagement (HLP #17) before the whole-class investigation.

Design a lesson that actively engages students using what we know about explicit instruction of vocabulary. To prepare for this lesson, consider how to help students connect new vocabulary to what they already know about the seasons. Use images and concrete demonstrations to improve students’ understanding of the core vocabulary as it relates to the Earth’s temperature in different parts of the world. You can also provide student-friendly definitions and have students predict what might happen to the temperature if the Earth is titled in a certain way and the specified cities are either in the Northern or Southern Hemisphere. Be sure to use active engagement strategies to engage students cognitively and behaviorally.

Your mini-lesson should not be more than 15 to 20 minutes, and you can use the following resources and strategies contained within them to plan your lesson.

The following resources are from <https://vimeo.com/mjk>:

* Effective vocabulary instruction: Student-friendly definitions (<https://vimeo.com/444031616>)
* Effective vocabulary instruction: Provide demonstrations (<https://vimeo.com/448730569>)

Other resources to consider:

* The University of Texas at Austin/The Meadows Center for Preventing Educational Risk (2020). [*Evidence-based practices for vocabulary instruction.*](https://meadowscenter.org/wp-content/uploads/2022/04/STRIVE_vocab-Brief31.pdf)

**In-Class Inquiry Module Lesson:** The candidate will create and provide Nate with an inquiry scaffold checklist derived from the Student Inquiry Cycle to use during the open inquiry lesson.



The candidate will develop a checklist based on the above Student Inquiry graphic for use with the WISE Simulator (<https://wise.berkeley.edu/preview/unit/30191/node19>). We have provided a template that the candidate can expand on. This checklist will help to guide Nate through the inquiry process so he can answer the core investigative question for the lesson: How does the Earth's tilt affect average high temperatures? The candidate may need to provide some question prompts to help Nate and some of his peers who also need support to determine the type of data they will collect to answer their questions.

Using the WISE model, students are asked to predict the average monthly high temperatures for Washington, D.C., and Canberra, Australia, two locations on the Earth that are almost directly opposite each other latitude wise (D.C. 39 degrees N; Canberra 35 degrees S), which means when temperatures are at their highest in D.C., they are at their lowest in Canberra and vice-versa, as shown in the appendix.

To assist Nate, the special education candidate provided him with a data-collection sheet that includes the seasons as an extra scaffold (see data collection sheet in Mursion Activity 2). This data-collection sheet is based on the simulation <https://wise.berkeley.edu/preview/unit/30191/node19>

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| Template for student-inquiry process checklist |
| Ask questions | **1) How does Earth's tilt affect a city's temperature at different times during the year?**2) How does tilting the Northern Hemisphere away from the sun affect its temperature?  |
| Collect data | 1. What resources/materials will you need to collect data?
2. Describe the data you collected here or attach it.
 |
| Interpret and explain your data | 1. What patterns did you notice in the data?
2. How can you explain those patterns?
 |
| Discuss your data with other peers | 1. What are the different interpretations you had?
2. Which interpretations seem the most logical based on the data?
3. How would you explain your interpretations using the data?
 |
| Publish your findings | 1. How do you want to present your findings? (Candidate will likely need to teach the student some format for completing this step.)
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**Re-Teaching, Questioning, and Formative Feedback** (Mursion Activity 2): When the general and special education candidates circulate around the classroom during the inquiry lesson, they discover that Nate and three other students are not always predicting the high monthly temperatures for locations correctly. Using re-teaching via explicit instruction, questioning, and specific feedback, work with Nate and his peers in a small group to help them correct their predictions for Canberra. Focus your feedback on the tilt of the Earth and the seasons.

**Writing Activity:** The candidate will provide Nate and several of his peers with a writing template (see below) that prompts them to include all core ideas in their answers. The amount of writing required and depth of understanding will depend on the students’ writing ability and the big ideas targeted for that particular student. If necessary, the candidate may use writing prompts such as, *"Why is it cold in the winter?"*



**Reading Activity (if applicable):** The candidate will provide Nate and his peers who need more support with a fiction and/or non-fiction text related to the content (e.g., seasons, Earth's rotation, weather/climate). The candidate will create keyword mnemonics to support his/her vocabulary learning and connections to the science content/concepts. The following resources show how to teach mnemonics:

* The [mnemonic checklist](https://www.dropbox.com/s/bfr6k5z4auag092/Mnemonic%20checklist.pdf?dl=0) provides specific information about how to use keyword mnemonics
* Scruggs, T., Mastropieri, M., Berkeley, S., & Marshak, L. (2010). Mnemonic strategies: Evidence-based practices and practice-based evidence. *Intervention in School and Clinic, 46*(2), 79-86. DOI: 10.1177/1053451210374985

**Evaluation and Assessment:** The candidate will conduct an informal assessment of Nate's understanding of the targeted core concepts. The candidate will ask him to share the investigation with his parents and send a note home encouraging them to redo the module with Nate. The candidate will also work to modify the unit assessment for Nate so that he is assessed on the core vocabulary targeted.

**Additional Resources:**

* Arctic Lights, Arctic Nights by Debbie S. Miller
* Why do we have seasons? <https://florida.pbslearningmedia.org/resource/npls13.sci.ess.seasons/why-seasons/>
* Seasons Interactive from SEPUP; students can see daylight hours, temperature, etc. throughout the year and can manipulate tilt
<http://store.lab-aids.com/middle-school-curriculum/simulations/sepup_seasons5.html>
* Crash Course Kids: Earth's Rotation & Revolution: Crash Course Kids 8.1
<https://www.youtube.com/watch?v=l64YwNl1wr0>
* What Is a Season? by DKFindOut provides information about what causes seasons and facts about each season
<http://www.dkfindout.com/uk/earth/seasons/>
* Uncovering Student Ideas by Page Keely
<https://www.uncoveringstudentideas.org/resources/bundles/middle>
* What Causes the Seasons? from NASA; explores misconceptions and has good graphics
<https://spaceplace.nasa.gov/seasons/en/>
* University of Illinois Extension: Treehouse Weather Kids: What causes the weather?
<https://web.extension.illinois.edu/treehouse/seasons.cfm?Slide=1>
* Patterns: Investigating Weather and Climate from the American Museum of Natural History
<https://www.amnh.org/learn-teach/resources-for-learning>

**Mursion Activity 1**

**Pre-Teaching Mini-Lesson 1**

Based on Nate's concept map in relation to the big idea of the lesson (*Many factors influence the temperature of the Earth at any given time of the year*) are several misconceptions and unknown vocabulary words that Nate will need to learn (Earth's tilt, Northern and Southern Hemisphere).

Using the steps for pre-teaching:

1. Introduce the word and its definition (I do).
2. Model using the word in context or provide a demonstration of the word (I do).
3. Provide guided practice using the word by applying it. For example, “If I tilt the earth in this direction, will the Northern or Southern Hemisphere receive the most sun?” (We do).
4. Provide opportunities for independent practice (You do).

Provide Nate with a visual support aide (i.e., graphic organizer) to complete and connect the vocabulary term with appropriate science concepts after teaching the word as part of independent practice. This graphic organizer can also be provided prior to pre-teaching the vocabulary as an informal assessment of student knowledge. The middle circle with “Many factors influence ...” can be provided to students, and then they fill in the map according to their understandings.



This graphic organizer can also be used as a pre-assessment or during guided/independent practice. If used during guided practice, students might be directed to complete it as the teacher demonstrates the vocabulary to be pre-taught.



**Mursion Activity # 2**

**In-Class Graphing Assignment: Mini-Lesson 2**

Nate is completing an in-class graphing assignment with two peers using the WISE investigation. The core investigative question is: How does the earth's tilt affect average high temperatures?

Using the WISE model, students are asked to predict the average monthly high and low temperatures for Washington, D.C., and Canberra, Australia, two locations of the Earth that are almost directly opposite each other latitude wise (D.C. 39 degrees N; Canberra 35 degrees S), which means that when the temperatures are at their highest in D.C., they are their lowest in Canberra, and vice-versa. To assist Nate, you have provided him with a data-collection sheet that includes the seasons as an extra scaffold. Nate and two peers work independently for 20 minutes, predicting the high temperatures for these locations. When you check Nate's progress, he shows you the following data-collection sheet. Use re-teaching via explicit instruction, questioning, and formative feedback to help Nate correct his predictions for Canberra. Focus your feedback on the tilt of the Earth and the seasons.

**NAME:** Nate P.

**Washington, D.C.**

**Monthly high average prediction**

|  |  |  |
| --- | --- | --- |
| **Month** | **Predicted high temp** | **Season** |
| **January** | 40 | Winter |
| **February** | 43 | Winter |
| **March** | 50 | Winter/Spring |
| **April** | 55 | Spring |
| **May** | 60 | Spring |
| **June** | 65 | Spring/Summer |
| **July** | 80 | Summer |
| **August** | 82 | Summer |
| **September** | 75 | Summer/Fall |
| **October** | 65 | Fall |
| **November** | 60 | Fall |
| **December** | 50 | Fall/Winter |

**Canberra, Australia**

**Monthly high average prediction**

|  |  |  |
| --- | --- | --- |
| **Month** | **Predicted high temp** | **Season** |
| **January** | 35 | Winter |
| **February** | 37 | Winter |
| **March** | 42 | Winter/Spring |
| **April** |  | Spring |
| **May** |  | Spring |
| **June** |  | Spring/Summer |
| **July** |  | Summer |
| **August** |  | Summer |
| **September** |  | Summer/Fall |
| **October** |  | Fall |
| **November** |  | Fall |
| **December** |  | Fall/ inter |

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**References**

You may find these additional readings useful. Starred papers indicate practitioner-focused journal articles that provide additional strategies and approaches to be incorporated into science instruction.

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