Primary Type: Lesson Plan

Winter Ecologists Explore Effects of Climate Change

In this lesson, students will analyze an informational text that addresses the consequences of climate change on living organisms in snow ecosystems, particularly those who live in the subnivium beneath the snow's surface. The text describes a new field of researchers called winter ecologists and their findings that show how climate change is causing lighter snows in some areas, diminishing the amount of insulation in the subnivium that many living organisms need to survive the winter. This lesson is designed to support reading in the content area. The lesson plan includes a note-taking guide, text-dependent questions, a writing prompt, answer keys, and a writing rubric.

General Information

Subject(s): Science, English Language Arts
Grade Level(s): 9, 10
Intended Audience: Educators

Suggested Technology: Document Camera, Computer for Presenter, Computers for Students, Internet Connection, LCD Projector, Speakers/Headphones

Instructional Time: 2 Hour(s)

Resource supports reading in content area: Yes

Keywords: climate change, global warming, winter ecology, snow ecosystem, subnivium, informational text, text complexity
Instructional Component Type(s): **Lesson Plan,** Worksheet, Assessment, Video/Audio/Animation, Text Resource, Formative Assessment
Resource Collection: FCR-STEMLearn Literacy in STEM 2017

Attachment

Article_Snow.pdf
Final_Recommendation_Placement_Snow.pdf
Qualitative_Rubric_Snow.pdf
RubricforWritingPrompt_Snow.docx
Text_Dependent_Questions_Snow.docx
NoteTakingGuide_Snow.docx
Key_NoteTakingGuide_Snow.docx

Lesson Content

Lesson Plan Template: General Lesson Plan

Learning Objectives: What should students know and be able to do as a result of this lesson?

- Identify the environmental impacts of climate change on snow ecosystems.
- Cite specific and relevant textual evidence to support analysis of a text.
- Determine the meaning of unknown academic and domain-specific words in a text.
- Determine the central ideas of a text.
- Construct a written argument that clearly establishes the claim, contains relevant textual evidence to support the claim, utilizes transitions to maintain flow, effectively uses domain-specific vocabulary, and provides an appropriate conclusion.

Prior Knowledge: What prior knowledge should students have for this lesson?

In regards to **science:**

- Basic knowledge on ecology would be beneficial to students, including knowledge of ecosystems, food chains, food webs, biomes, and habitats.
  - If students need a quick refresher on ecosystems, this **website** provides a great summary, and it even comes with a few practice quiz questions.
  - This four-minute **video** ("What is an Ecosystem?") does a good job reviewing ecosystems and biomes.
  - If students need a refresher with a little more detail on ecosystems, **Crash Course** ("Ecosystem Ecology: Links in the Chain - Crash Course Ecology #7") offers a helpful review. The video is approximately ten minutes in length.
- Students should also have a general knowledge on climate change.
  - **NASA** provides a site that explains climate change and its causes.
  - If teachers prefer a review on climate change in a video format, this 10-minute **video** ("A Way Forward: Facing Climate Change") from National Geographic explains causes, consequences and recommendations for the future.
  - Bill Nye also has a helpful 5-minute **video** ("Climate Change 101 with Bill Nye the Science Guy") that teaches about climate change as well as demonstrates a simple lab teachers can conduct in class to show students how climate change works.
- General familiarity with water chemistry will facilitate the students' understanding of the article. Snow provides a great insulating layer, just as ice does on top of a lake. The fact that the solid form of water is less dense than the liquid form is key to the preservation of life.
  - This **website** by the University of Arizona's Biology Project provides the basics on water chemistry, its properties and its emergent properties.
  - Topics like cohesion, adhesion, capillary action, precipitation, and many other topics on water are described in the USGS Water Science School **website**.
  - This Mindset Learn **video** (16-minutes in length), "Special Properties of Water," explains and illustrates the properties of water. At the conclusion of the video, it suggests a lab experience that students can conduct in class or at home.

In regards to **literacy skills**:

- Students should have prior experience utilizing various vocabulary strategies to determine the meaning of unknown words in a text, including use of context clues and dictionary skills.
- Students should understand the term "central idea" and be able to distinguish central ideas from key details.
  - "Central idea" means the same thing as "main idea." The central idea is the author's main point about the topic or topics in a text. The central ideas are the dominant, most important, or chief ideas that emerge from all the ideas presented in a text. Students should be aware that the author can have several main points he or she wants to make about the topic or topics in a piece of writing, and as a result, there can be multiple central ideas in a text, especially in longer more complex pieces.
  - Key, or in other words, important, details in a text help an author support and develop his or her central ideas.
- Students should be aware of text features that can help them locate and learn information when reading a text. The text features in the National Science Foundation's winter snows article include: title, subtitle, headings, photographs, and captions.
- Based on the rubric provided with the lesson, students should be able to respond to a writing prompt in a clear, organized manner that includes use of an introduction to establish the main point(s), a body paragraph(s) that support the main point(s) and includes relevant and specific textual evidence, and a conclusion that supports the main point(s).
- Students should have some awareness that use of transition words or phrases can help a piece of writing flow smoothly from one point or idea to the next. Teachers might wish to provide students with a sheet of transitions to help them. This **site** provides transitions teachers might provide.

Guiding Questions: What are the guiding questions for this lesson?

1. What is climate change?

   Climate change is a change in the global climate patterns. In reference to current climate change, it is a change in global climate patterns that has occurred in mid to late 20th century and beyond that is largely attributed to the increased levels of greenhouse gases, especially carbon dioxide produced by the use of fossil fuels. Currently, the overall temperature of the Earth is increasing, which is known as global warming. Global warming, however, does not mean that every area is always warmer.

2. How are species in winter ecosystems able to survive the cold weather by being in the subnivium?

   The subnivium is insulated by the snowpack. The snow, if thick enough, creates a thick layer and acts like an igloo that protects the living organisms below it.

3. What research are scientists conducting to determine the effects of climate change on winter ecosystems?

   To assess climate change effects on sensitive subnivian habitats, researchers from UW-Madison built micro-greenhouses at sites in Washington, Minnesota, and Michigan to mimic climate conditions predicted for the Great Lakes region by 2050.

4. Explain the winter ecologists' findings in regards to the environmental impacts of climate change on snow ecosystems.

   According to the text, the subnivium is showing more temperature variability and decreased--not increased-- temperatures. In certain areas, less snow is falling, and without snow cover and its protective insulation, the inhabitants of the subnivium are being exposed to the winter cold. Climate change could have considerable effects on the refuge quality of the subnivium. In a warmer world with less snow, winter soils will be colder and this could have negative consequences for farmers planting crops in spring, as well as many mammals, microbes, and insects that overwinter in snow. These changes will have important implications for species that need the subnivium to survive and will lead to large-scale shifts in their ranges.

Teaching Phase: How will the teacher present the concept or skill to students?

1. Begin the lesson by grouping the students in groups of 2 or 4. Each group should use a piece of paper (paper size can be determined by the teacher) to write down all of the words that come to mind when they think of global warming. Give students 3-5 minutes to write down their thoughts.

2. After the time limit, teachers should give the students a few minutes to share their answers.

   Students answers will vary. Students will most likely mention anything from dying polar bears and flooding, to the idea that global warming is not real. Teachers should not tell students that their ideas are wrong at this point, just encourage discussion and allow students to feel comfortable with what they know, or think they know, at this point. This discussion will allow teachers to listen for misconceptions and prepare to address them throughout the lesson.

3. Show students a short NASA **video** ("NASA's Earth Minute: Gas Problem") on climate change.

4. After watching the video, ask students to add or change anything they want to on their pre-write paper. Allow a few minutes for them to make changes and then ask them to share what they may have changed.

5. End the discussion by informing students that snow ecosystems are being affected by climate change in ways that they might not have thought of. Tell students that they will be reading an article that addresses how climate change is affecting snow ecosystems.

Guided Practice: What activities or exercises will the students complete with teacher guidance?

1. Provide each student with a copy of the **article** "Peering into the Secret World of Life Beneath Winter Snows." For class discussions that will follow, it might be helpful to have students number each paragraph within each section. They can also number the sections. (Section 1 follows the subtitle, section 2- "Nature's igloo," section 3- "No two snowflakes, nor snows, alike," section 4- "Species need snow," section 5- "Snow research in a greenhouse.")

2. Provide each student with a **note-taking guide**.

3. Before students begin reading, direct them to pay attention to the text features of the article to help them learn and locate information:

- Title: Peering into the Secret World of Life Beneath Winter Snows
- Subtitle: Snow Sustains Species from Frogs to Birds to Mammals in Winter and Beyond
- Headings: Nature's igloo; No two snowflakes, nor snows, alike; Species need snow; Snow research in a greenhouse
- Captions: Located under each photograph

4. Have students fill out the note-taking guide as they read the text. This can be done individually, in pairs, or in a small group. Students should define any words they place in column one. Students should have access to print or online dictionaries. The teacher should monitor students as they work and provide support and guidance as needed.

Formative Assessment (How will teachers check for student understanding?)

1. Teachers can check students' understanding by collecting students'completed note-taking guide, checking their work, providing written feedback, or grading the assignment. Or, teachers can have students share out their responses and the teacher can provide verbal corrective feedback, allowing students to make corrections to their work during the discussion.

2. Teachers can use this **sample answer key** to help them assess students' answers.

Common errors/misconceptions to anticipate and how to respond:

- Students may find it hard to comprehend that an animal or any living organism can survive under a layer of snow. Students may need to be reminded that the snowpack creates a layer of insulation, just like our houses create a layer of insulation between us and the outdoor weather.
- Students may need to be reminded about the cycles that occur. Some students may find it hard to understand why an animal wouldn't want it to be warmer. Refer back to the example in the text about the fungus being most active in the winter and how that activity provides nourishment for the summer wildflowers.

Independent Practice: What activities or exercises will students complete to reinforce the concepts and skills developed in the lesson?

Provide each student with a copy of the **text-dependent questions** to complete. Students should be reminded to continually refer back to the text and to use relevant and specific evidence from the text to support their answers.

Formative Assessment (How will teachers check for understanding?):

1. Teachers can check students' understanding by collecting students' answers to the text-dependent questions, checking their work, providing written feedback, and maybe grading the assignment. Or, teachers can have students share out their responses and the teacher can provide verbal corrective feedback, allowing students to make corrections to their work during the discussion.

2. Teachers can use the sample answer key at the end of the text-dependent questions document to help them assess students' answers.

Common errors/misconceptions to anticipate and how to respond: Please see the text-dependent questions sample answer key.

Closure: How will the teacher assist students in organizing the knowledge gained in the lesson?

1. Before students complete the writing prompt be sure to review responses to the text-dependent questions as a class, including covering the misconceptions and key points described in the sample answer key.

2. After students' written responses for the summative assessment have been graded and returned with feedback, teachers might wish to use the provided sample response with the class. Students who are struggling writers can benefit greatly from seeing a well-organized, detailed written response. The teacher could show the sample response on an overhead or with an LCD projector and discuss:

- Point out the author's claim (the main point of the argument) in paragraph one.
- Ask students to identify use of textual evidence from the article throughout the written response that supports the author's claim.
- Have students identify accurate and effective use of domain-specific vocabulary in the response (e.g., *climate change, winter ecologists, snow ecosystem, atmosphere, organisms, environment, subnivium, insulated, microbes, micro-greenhouse*).

3. To pull this lesson to a close, have the students complete an exit ticket. For example, ask the students to sketch (in 5 minutes or less) what they think winter ecosystems will look like in 2075. Ask them to label their drawing or provide a caption to explain their visual image.

Summative Assessment

1. Students will individually respond to the writing prompt. They should be directed to respond with a multi-paragraph response, with a clear introduction, body section, and conclusion. They can refer back to the text as they construct their response.

2. Provide students with a copy of the **rubric** and go over the rubric with them so they will know how their written response will be assessed.

3. Go over the writing prompt with students and make sure students understand what the prompt is asking them to address.

The prompt: As you scroll through Facebook you see that one of your friends posted that climate change is not real and that there is no evidence to support it. Using evidence from the article, craft an argument that climate change is affecting the Earth's ecosystems, even in cold areas.

4. Teachers will use the rubric to assess students' written responses.

Formative Assessment

Specific suggestions for conducting the Formative Assessment can be found in the Guided Practice and Independent Practice phases of the lesson.

Feedback to Students

Specific suggestions for providing Feedback to Students can be found in the Guided Practice and Independent Practice phases of the lesson where it says, "Common errors/misconceptions to anticipate and how to respond."

Accommodations & Recommendations

Accommodations:

1. The following **video**, "Between Soil and Snow--Explaining the Subnivium," (approximately 6 minutes in length) offers a great introduction to winter ecosystems. The video is actually produced by the two researchers in the article used in this lesson. To support struggling learners, this video could be shown before students read the article "Peering into the Secret World of Life Beneath Winter Snows."

2. For struggling readers-- on the note-taking guide:

- Teachers might want to fill in some answers in some of the boxes, leaving students to fill in a few of the blank boxes in between provided answers.

3. For struggling readers: It might benefit students to break the text into chunks. Have students independently read section one, and then have several strong readers read section one aloud.

- Then, have students highlight vocabulary they don't know for this section of the article. Work with students to model ways to define a few of the academic or domain-specific vocabulary words to get them started. The teacher can think aloud as he or she decides which vocabulary strategy or strategies to use to define a word. The teacher can also conduct a think aloud while deciding which meaning from a dictionary entry with multiple meanings would be the best fit for how a word is used in context of the article.
- Then, have students complete the note-taking guide for the first section. When students are ready, have them share out their answers and the teacher can provide corrective feedback as needed, allowing students to make corrections to their work. If needed, this process could be repeated for the other sections of the text.

4. For struggling writers: It might help struggling writers to provide them with an outline to help them structure their response for the summative assessment. The outline might include places for them to record:

Introduction paragraph:

- Ideas on how to introduce the topic
- A few specifics from the text they might want to use to support or explain the topic
- A place to write down their main point(s)

Body paragraphs:

- Topic sentence (the first sentence of each body paragraph that will reveal the point of the paragraph and will connect to the paper's overall main point)
- Specific evidence from the text for support in each body paragraph
- Ideas for transition words
- Ideas for use of selected vocabulary

Conclusion:

- Ideas on how to wrap up their piece and connect back to the main point(s)

Extensions:

Students could conduct research on animals or plants that live in snow ecosystems. Students could work alone or in pairs to conduct this research. This could be assigned as homework or as an in-class project.

- Some animals might include: mice, moles, shrews, lemmings, foxes, owls, ermine (stoats), ringed seals, ruffled grouse, or polar bears
- Some plants might include: crowberry and apline azalea, lingonberry shrubs or alpine buttercups

Teachers can make the guidelines as simple or as complex as time permits. Topics to cover could include habitat range, predators, prey, types of food eaten, symbiotic relationships, breeding or mating behaviors, diurnal or nocturnal, and amount of offspring produced in one year.

Suggested Technology: Document Camera, Computer for Presenter, Computers for Students, Internet Connection, LCD Projector, Speakers/Headphones

Further Recommendations:

For teachers who would like more support in understanding and implementing Reading Standards for Literacy in Science and Technical Subjects into their science curriculum, please see the teacher tutorials featured in the section of this lesson's CPALMS resource page labeled "Attached Resources."

Additional Information/Instructions

By Author/Submitter

The text's grade band recommendation reflects the shifts inherent in the Florida Standards and is based on a text complexity analysis of a quantitative measure, qualitative rubric, and reader and task considerations.

Source and Access Information

Contributed by: Jennifer Storer
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District/Organization of Contributor(s): Brevard
Access Privileges: Public
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Aligned Standards

Name	Description
LAFS.910.RST.1.1:	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
LAFS.910.RST.1.2:	Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
LAFS.910.RST.2.4:	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
LAFS.910.RST.4.10:	By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.
LAFS.910.WHST.1.1:	Write arguments focused on *discipline-specific content.* a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns. c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Provide a concluding statement or section that follows from or supports the argument presented.
LAFS.910.WHST.3.9:	Draw evidence from informational texts to support analysis, reflection, and research.
SC.912.L.17.8:	Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, non-native species.

Related Resources

Tutorials

Name	Description
Infectious Evidence:	**Click "View Site" to open a full-screen version.** This tutorial is designed to help secondary science teachers learn how to integrate literacy skills within their science curriculum. This tutorial focuses on using specific textual evidence to support students' responses as they analyze science texts. The focus on literacy across content areas is designed to help students independently build knowledge in different disciplines through reading and writing.
Sparks Fly: Discovering Central Ideas:	**Click "View Site" to open a full-screen version.** This tutorial is designed to help secondary science teachers learn how to integrate literacy skills within their science curriculum. The focus on literacy across content areas is designed to help students independently build knowledge in different disciplines through reading and writing. This tutorial will demonstrate a series of steps that teachers can use with students to help them determine the central ideas of a science text. It will also demonstrate how students can trace a text's explanation or depiction of a complex process. Finally, it will explain what an effective summary contains.
Words in the Wild: Vocabulary Strategies:	**Click "View Site" to open a full-screen version.** This tutorial is designed to help secondary science teachers learn how to integrate literacy skills into their science curriculum. This tutorial will demonstrate a number of strategies teachers can impart to students to help them use context clues to determine the meaning of unfamiliar words within science texts. It will also help them teach students how to select the appropriate definition from reference materials. The focus on literacy across content areas is intended to help foster students' reading, writing, and thinking skills in multiple disciplines.