

## Connecting to the *Next Generation Science Standards* (NGSS Lead States 2013)

| <b>Standard</b><br>HS-ESS2 Earth's Systems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                           |                                                                                                                                                                     |
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| <b>Performance Expectation</b><br>The chart below makes one set of connections between the instruction outlined in this article and the <i>NGSS</i> . Other valid connections are likely; however, space restrictions prevent us from listing all possibilities. The materials, lessons, and activities outlined in the article are just one step toward reaching the performance expectations listed below.<br><br>HS-ESS2-2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. |                                                                                                                                                                                                                                                                           |                                                                                                                                                                     |
| Dimension                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Name and <i>NGSS</i> code/citation                                                                                                                                                                                                                                        | Classroom Connection                                                                                                                                                |
| <b>Science and Engineering Practice</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Developing and Using Models <ul style="list-style-type: none"> <li>Develop a model based on evidence to illustrate the relationships between systems or between components of a system</li> </ul>                                                                         | Students construct descriptive models to answer the driving question. The models get revised throughout the unit as new evidence is gathered through lessons.       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Analyzing and Interpreting Data <ul style="list-style-type: none"> <li>Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution</li> </ul> | Students graph and analyze authentic Arctic data sets (shortwave/longwave radiation, sea ice extent, albedo, temperature) to test their ideas about the phenomenon. |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Constructing Explanations <ul style="list-style-type: none"> <li>Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review).</li> </ul>        | Students use evidence gathered throughout the unit to develop final models and explanations that address the unit driving question.                                 |
| <b>Disciplinary Core Ideas</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ESS2.A: Earth Materials and Systems <ul style="list-style-type: none"> <li>Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes</li> </ul>                                                           | Students learn how melting Arctic sea ice (in response to an enhanced greenhouse effect) causes further melting of sea ice, a positive                              |

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|                             | <p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> <li>The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.</li> </ul> | <p>feedback loop called the ice-albedo feedback.</p> <p>Students learn that sea ice has a high albedo and thus reflects much of the incoming shortwave energy from the sun. As sea ice declines, much of the shortwave energy that was previously reflected is now absorbed by the exposed dark ocean.</p> |
| <b>Crosscutting Concept</b> | <p>Stability and Change</p> <ul style="list-style-type: none"> <li>Feedback (negative or positive) can stabilize or destabilize a system.</li> </ul>                                                                                                                                                                                               | <p>Students learn that the ice-albedo feedback is contributing to the amplified warming in the Arctic.</p>                                                                                                                                                                                                 |