

Where does Climate Change fit with NGSS?

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What is NGSS?

- ▶ Next Generation Science Standards
- ▶ Three Dimensions:
 - ▶ Science and Engineering Practices
 - ▶ Crosscutting Concepts
 - ▶ Disciplinary Core Ideas
- ▶ All Students, All Standards
- ▶ Build scientifically literate students

Three Dimensional Learning

Students engage in **Science and Engineering Practices** to discover or explore phenomena (**Disciplinary Core Ideas**) while developing a scientific mindset (**Crosscutting Concepts**)

Science and Engineering Practices (Doing)

- ▶ 1- Asking Questions and Defining Problems
- ▶ 2- Planning and Carrying Out Investigations
- ▶ 3- Analyzing and Interpreting Data
- ▶ 4- Developing and Using Models
- ▶ 5- Constructing Explanations and Designing Solutions
- ▶ 6- Engaging in Argument from Evidence
- ▶ 7- Using Mathematics and Computational Thinking
- ▶ 8- Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts (Thinking)

- ▶ 1- Patterns
- ▶ 2- Cause and Effect
- ▶ 3- Scale, Proportion, and Quantity
- ▶ 4- Systems and System Models
- ▶ 5- Energy and Matter
- ▶ 6 - Structure and Function
- ▶ 7- Stability and Change

Disciplinary Core Ideas (Content)

- ▶ Physical Science (PS)
- ▶ Life Science (LS)
- ▶ Earth and Space Science (ESS)
- ▶ Engineering, Technology and the Application of Science (ETS)

Why is Climate Change Science in NGSS?

Table S7. Formal class hours devoted to recent global warming

| | Teachers devoting one or more class lessons to RGW (%) | Number of hours devoted to recent global warming (among those with one or more class lessons) | |
|--------------------------------|--|--|---------------|
| | | <i>Mean</i> | <i>Median</i> |
| Middle School (<i>n</i> =568) | 70.2 | 4.4 | 1.5 |
| Earth Science (<i>n</i> =285) | 95.5 | 6.0 | 4.0 |
| Biology (<i>n</i> =308) | 86.6 | 4.1 | 1.5 |
| Chemistry (<i>n</i> =183) | 53.5 | 3.5 | 1.5 |
| Physics (<i>n</i> =156) | 48.6 | 4.1 | 1.5 |
| Total (<i>n</i> =1500) | 74.3 | 4.7 | 1.5 |

Climate confusion among U.S. teachers, Plutzer et al, SCIENCE, Feb 2016,
<http://science.sciencemag.org/content/351/6274/664>

Climate Change in the Three Dimensions

- ▶ **Science and Engineering Practices**
 - ▶ Analyze Data, Construct Explanations, Construct Models
- ▶ **Disciplinary Core Ideas**
 - ▶ Earth and Space Science
- ▶ **Crosscutting Concepts**
 - ▶ Stability and Change, Cause and Effect, Scale

Weather and Climate

Earth's Systems

Grades K, 3, 6, HS Earth Science

| | K-2 | 3-5 | 6-8 | 9-12 |
|----------------------------------|---|--|--|---|
| ESS2.D Weather and Climate | Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time. ESS2.D | Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed. ESS2.D | <p>Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.</p> <p>Complex interactions determine local weather patterns and influence climate, including the role of the ocean. ESS2.D</p> | The role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Global climate models are used to predict future changes, including changes influenced by human behavior and natural factors. ESS2.D |

Human impacts on Earth's systems

Earth and Human Activity

K, 5, 6, 8, HS Earth Science

| | K-2 | 3-5 | 6-8 | 9-12 |
|--|--|---|--|--|
| ESS3.C Human Impacts on Earth Systems | Things people do can affect the environment but they can make choices to reduce their impacts. ESS3.C | Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Students describe things society does to protect Earth's resources and environments. ESS3.C | Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth. ESS3.C | Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies and regulations. ESS3.C |

Global Climate Change Earth and Human Activity 5, 6, HS Earth Science

| | K-2 | 3-5 | 6-8 | 9-12 |
|---------------------------------|-------------|--|---|---|
| ESS3.D Global Climate Change | N/A. ESS3.D | Humans and other organisms will be affected in many different ways if Earth's global mean temperature continues to rise. ESS3.D | Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics. ESS3.D | Global climate models used to predict changes continue to be improved, although discoveries about the global climate system are ongoing and continually needed. ESS3.D |

Let's Try An NGSS Activity!

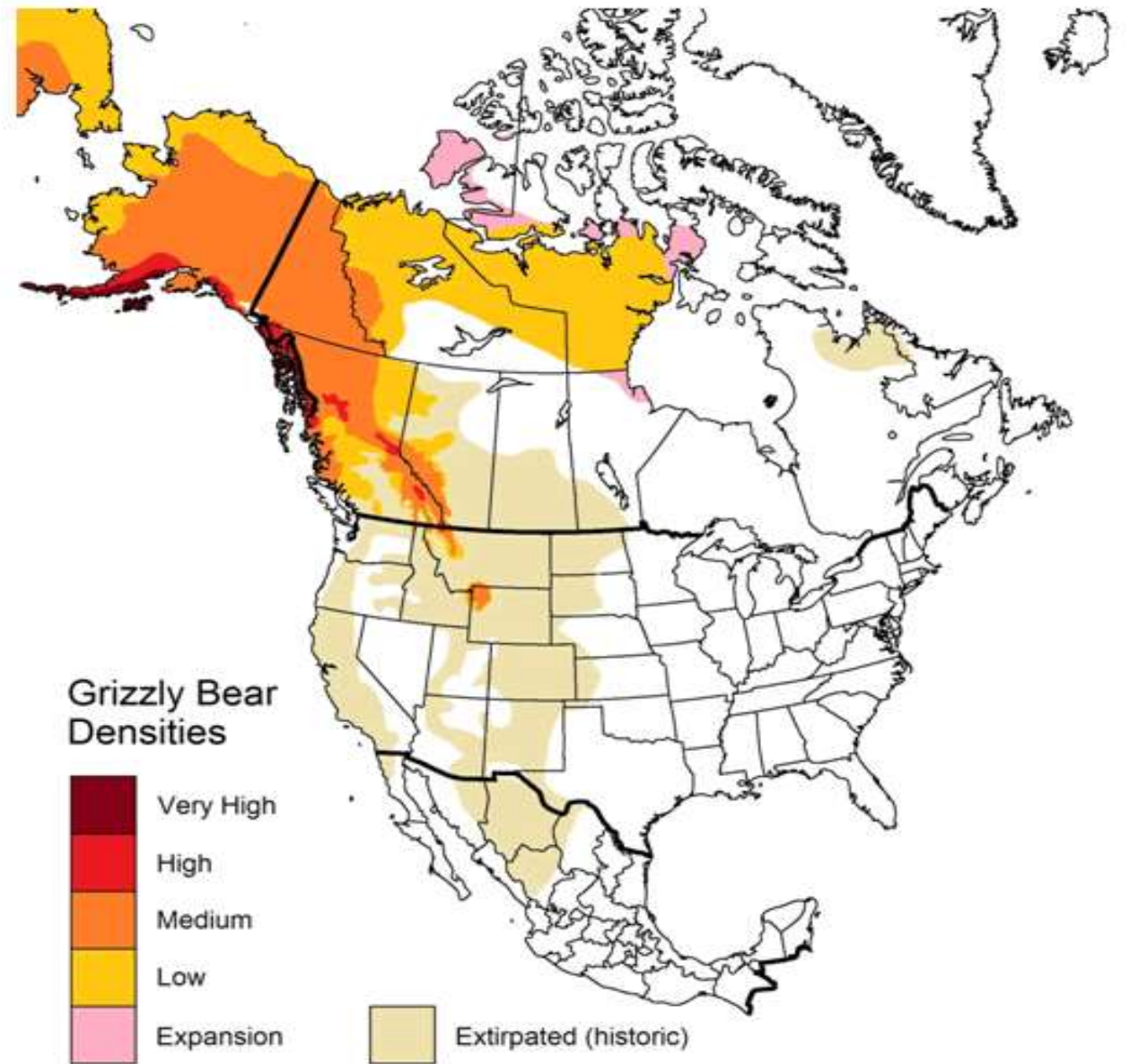
- ▶ Phenomenon
 - ▶ The Grolar Bear - a hybrid of Polar Bears and Grizzly Bears has begun to be observed more often in the wild.
- ▶ What might be causing the Grolar Bear to be seen more often?
 - ▶ Claim-Evidence-Reasoning

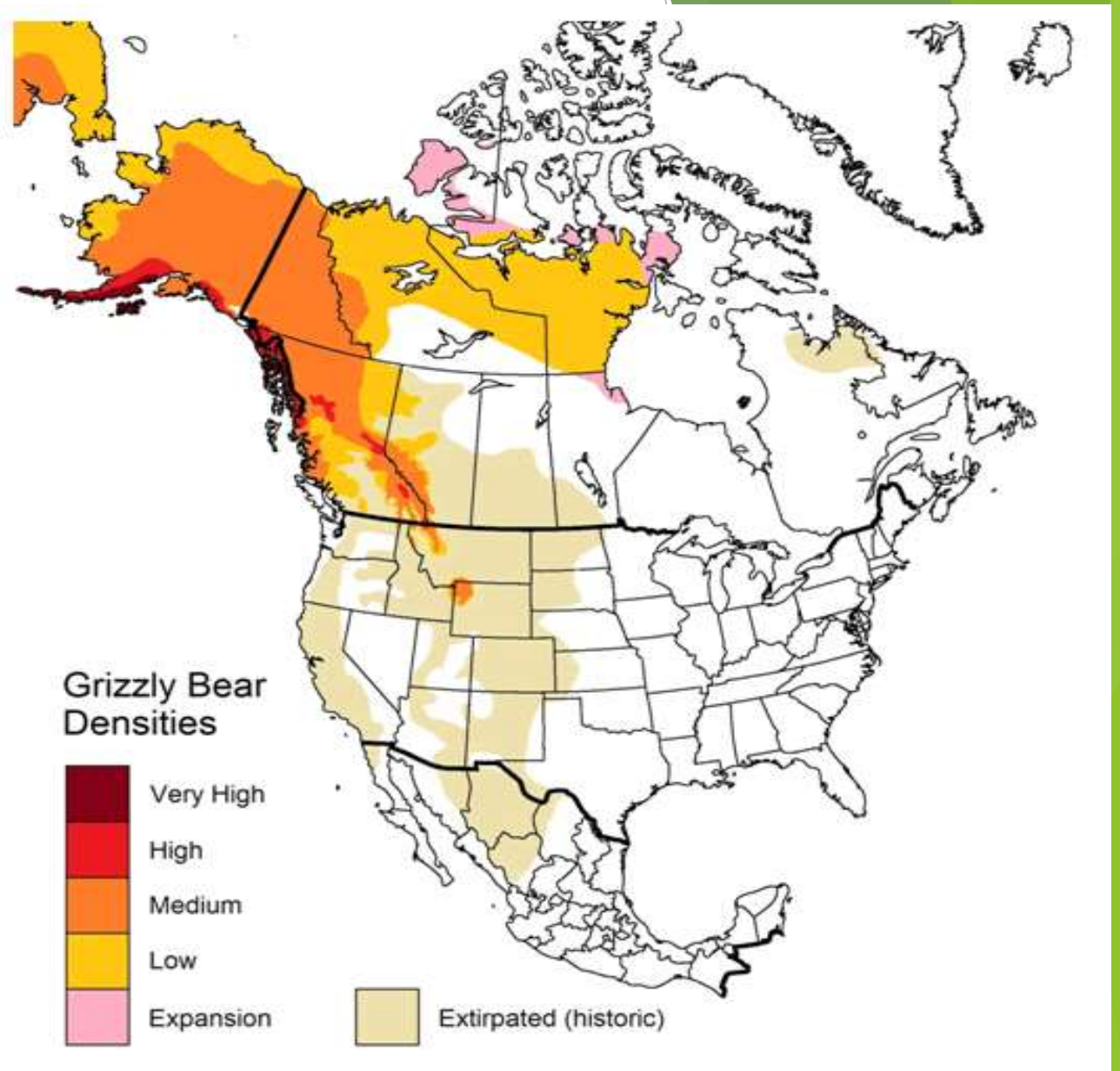


Bear Ranges



Effects of Climate change on ranges





Update your Explanation

- ▶ What might be causing the Grolar Bear to be seen more often?
 - ▶ Claim-Evidence-Reasoning

Questions?



Resources

San Diego Children and Nature

- ▶ sdchildrenandnature.org/wp/teachers/climate-change/

Climate.gov

- ▶ www.climate.gov/teaching/national-climate-assessment-and-next-generation-science-standards

NSTA

- ▶ ngss.nsta.org

CSTA

- ▶ cascience.org

California Regional Environmental Education Community

- ▶ creec.org