Learning Progressions: It's All About Fused Knowledge

(Content + Practices + Crosscutting Concepts)

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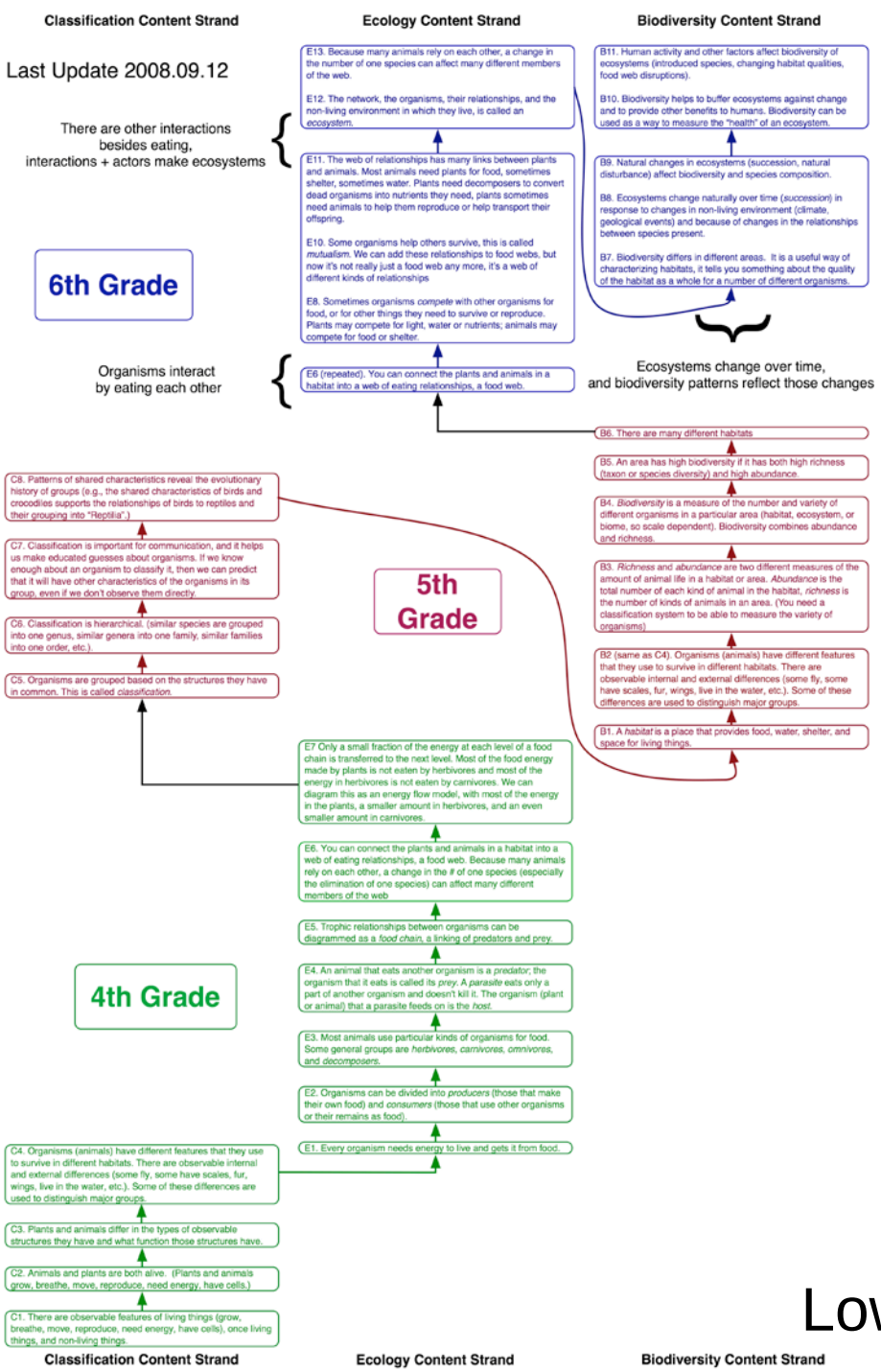
NGSS and Fused Knowledge

"The standards are written as student performance expectations...These statements each incorporate a practice, a disciplinary core idea, and a crosscutting concept. The performance expectations are the assessable components of the NGSS architecture." (Achieve draft, May 2012)

How Do We Use Learning Progressions?

- 1. Framing scientific knowledge and goals
  - e.g., Identify what knowledge is important



Upper Anchor

2008: Three Year Content Learning Progression in Ecology and Biodiversity

Lower Anchor

Focal Knowledge We Care About = Knowledge That Fuses Content + Practices

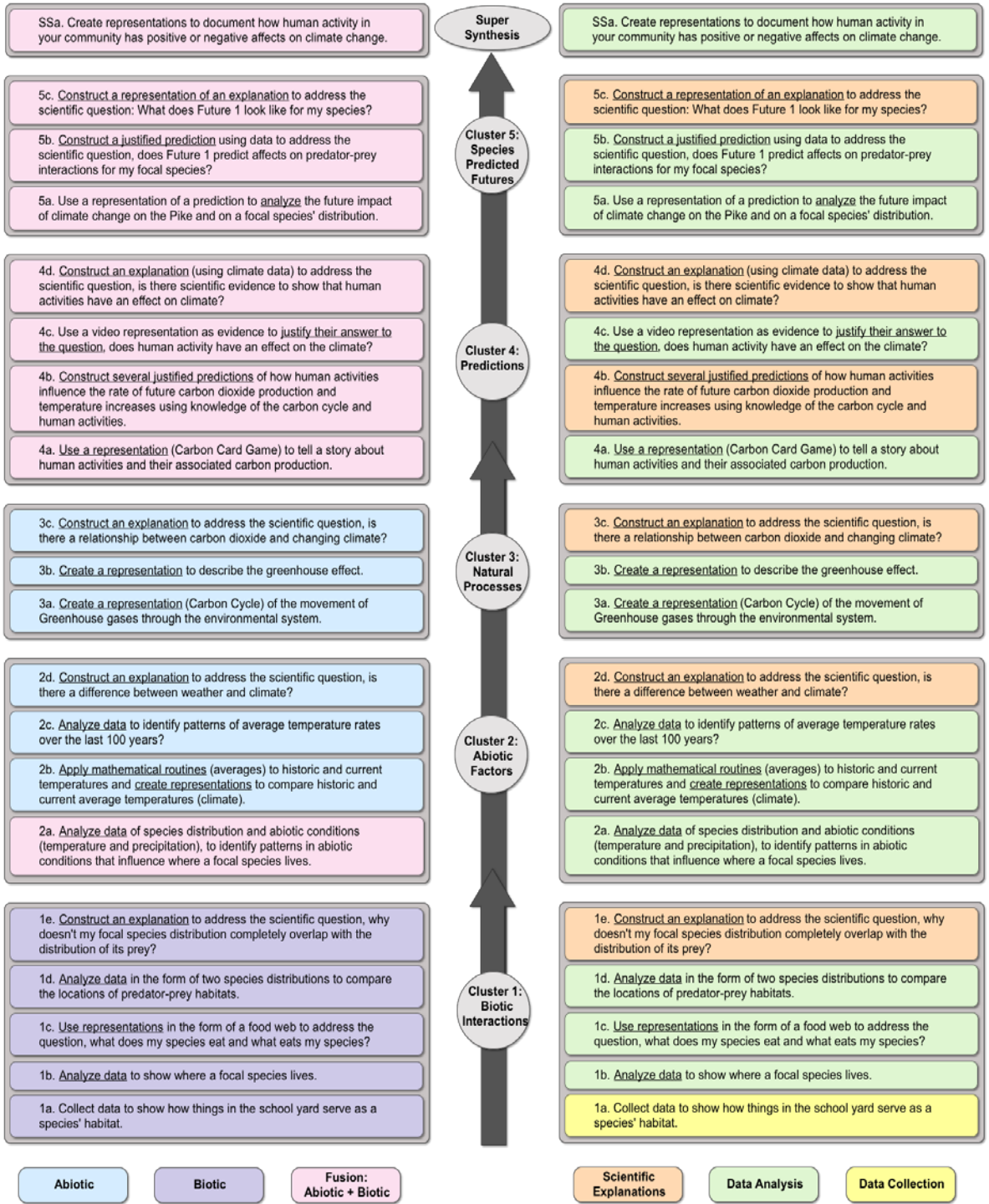
- **Content***:* Because many animals rely on each other, a change in the number of one species can affect different members of the web.
- **Science Practice** ***Explanations***: Students build a complete scientific explanation consisting of a claim, two pieces of evidence and reasoning

- **Fused C+P CC**: Students construct scientific explanations to address the question, How have recent changes in the Detroit River affected yellow perch populations?

Learning Progression, Climate Change Impacts

Content Highlighted

Practices Highlighted



Learning Goals Highlighted by Content

3c. Construct an explanation to address the scientific question, is there a relationship between carbon dioxide and changing climate?

3b. Create a representation to describe the greenhouse effect.

3a. Create a representation (Carbon Cycle) of the movement of Greenhouse gases through the environmental system.

Abiotic

Biotic

Fusion: Abiotic + Biotic

Learning Goals Highlighted by Science Practices

3c. Construct an explanation to address the scientific question, is there a relationship between carbon dioxide and changing climate?

3b. Create a representation to describe the greenhouse effect.

3a. Create a representation (Carbon Cycle) of the movement of Greenhouse gases through the environmental system.

Scientific Explanations

Data Analysis

Data Collection

How Do We Use Learning Progressions?

- 2. Formative and summative assessment
  - e.g., Identify what knowledge to assess

Assessment Emphasizing Fused Knowledge

Beth wrote this explanation below to answer the scientific question, **Is there evidence that climate change will affect where plants and animals can live in the future?**

A. Is there anything you would change about Beth's explanation?

"Yes."

B. If you would change something, what would you write instead?

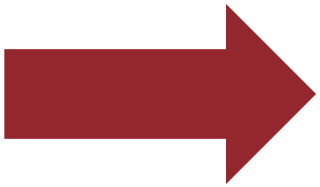
" Instead of talking about what she saw on the maps I would use real life evidence. Like the example about polar bears and ice caps."

"Her reasoning and evidence isn't legit. It only states the warmth which isn't enough to say climate change will affect where plants and animals can live."

How Do We Use Learning Progressions?

- 3. Scaffolding students' practices fused to core science content
  - e.g., Provide guidance on how to guide learning through "the messy middle" towards upper anchor

LP Section: Impact of Climate Change on Species



5c. Construct a representation of an explanation to address the scientific question, "what does Future 1 look like for my species?"

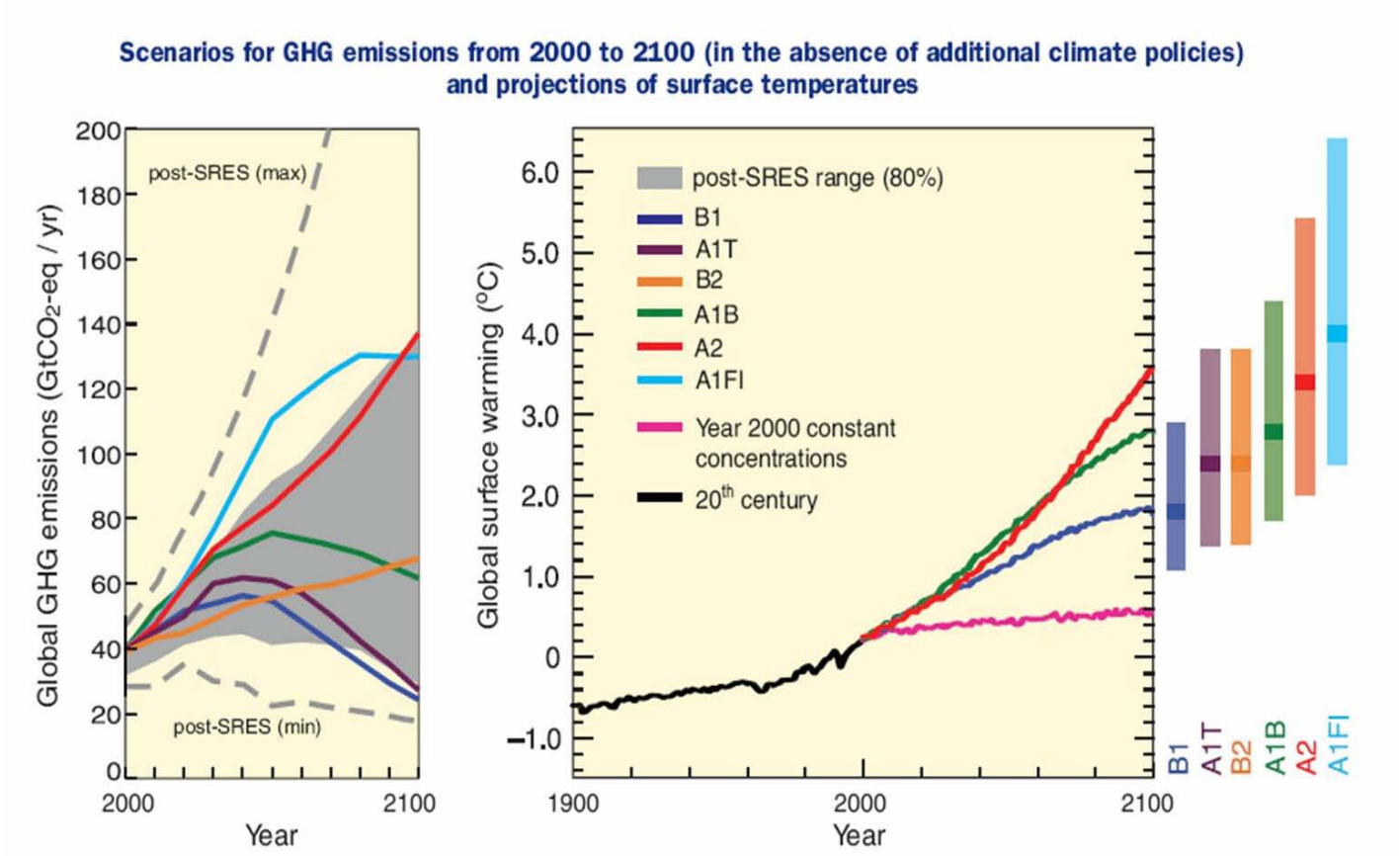
5b. Construct a justified prediction using data to address the scientific question, "does Future 1 predict effects on predator-prey interactions for my focal species?"

5a. Use a representation of a prediction to analyze the future impact of climate change on the northern pike (the fish species) and on a focal species' distribution.

Future Scenarios from (IPCC) = COMPLEX

Future **climate change** depends on future greenhouse gas emissions

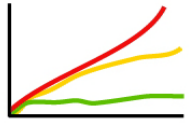
Future **greenhouse gas emissions** depend on socio-economic choices



Prediction-Making using Models of Simplified Climate Change Scenarios for Middle/High Schoolers

Future **climate change** depends on future greenhouse gas emissions

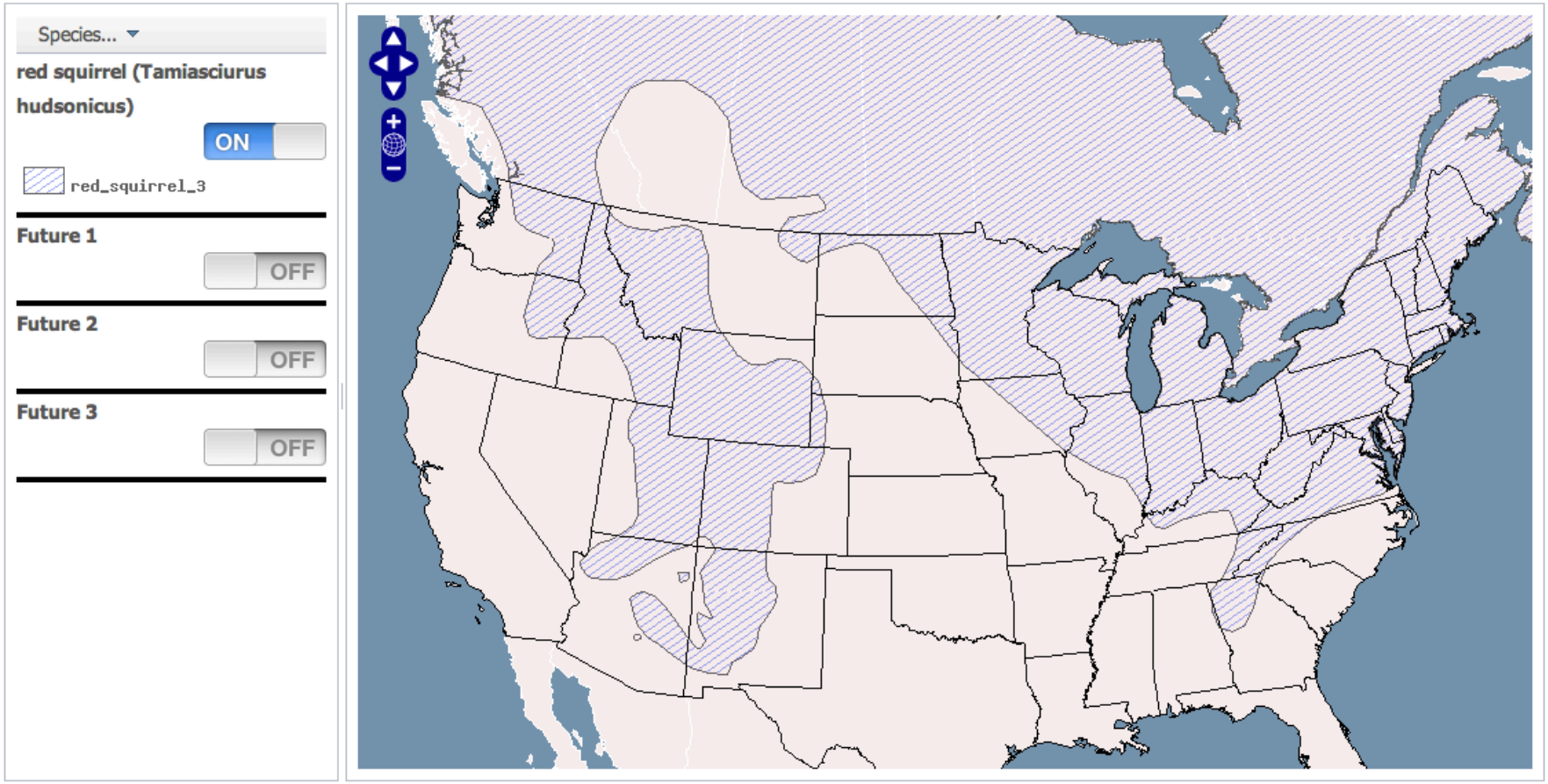
Future **greenhouse gas emissions** depend on socio-economic choices

	Population growth rate	Energy use per person	Proportion clean energy	Total CO_2 emissions by 2100 (gigatons)
				
Future 1	Fast	Low	Low	1862
Future 2	Slow	High	High	1499
Future 3	Slow	Low	High	983

Simplified Modeled Predictions

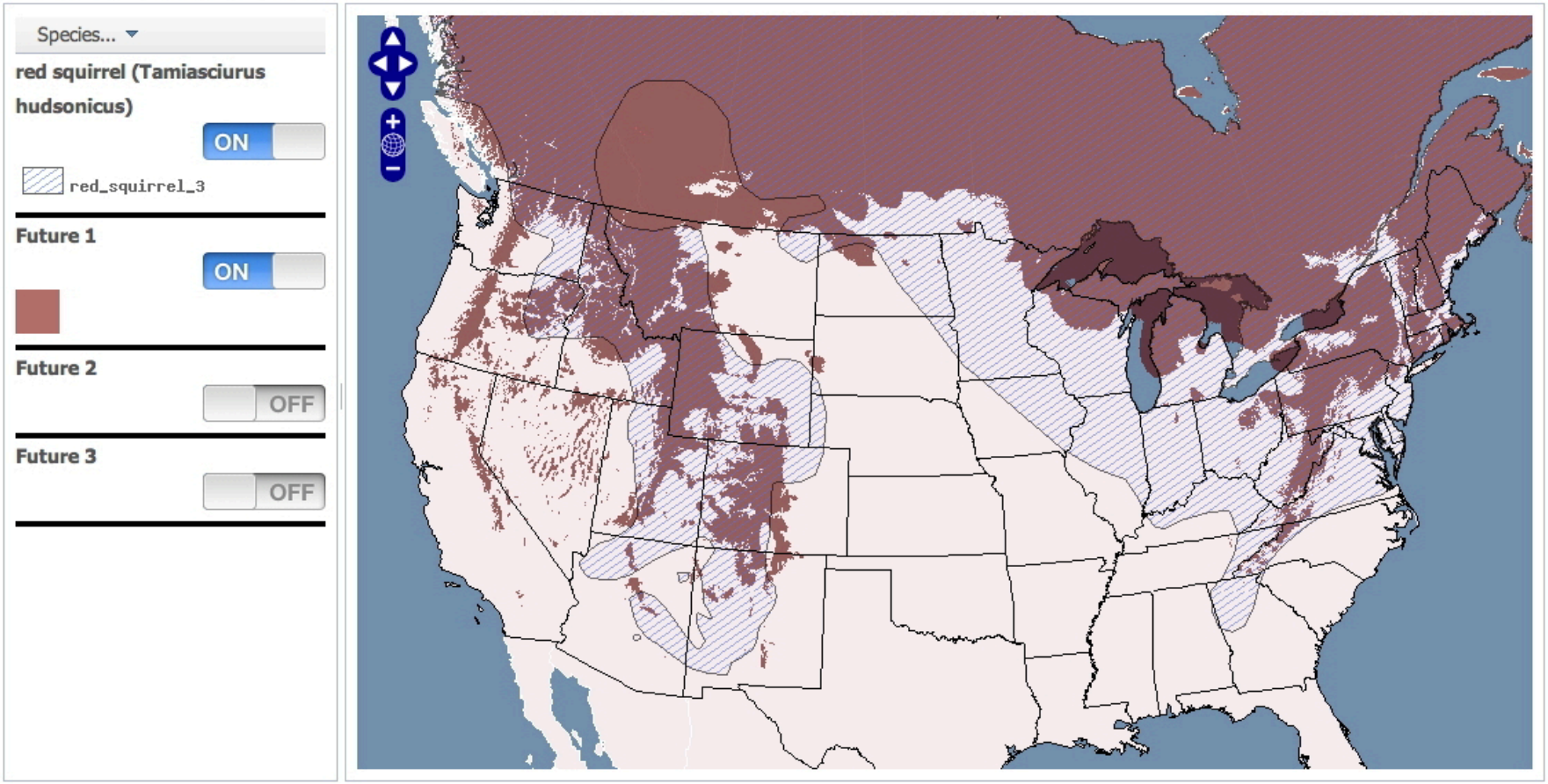
Is there evidence that climate change will impact the distribution of my species, Red Squirrel?

Focal Species Current and Future Distributions

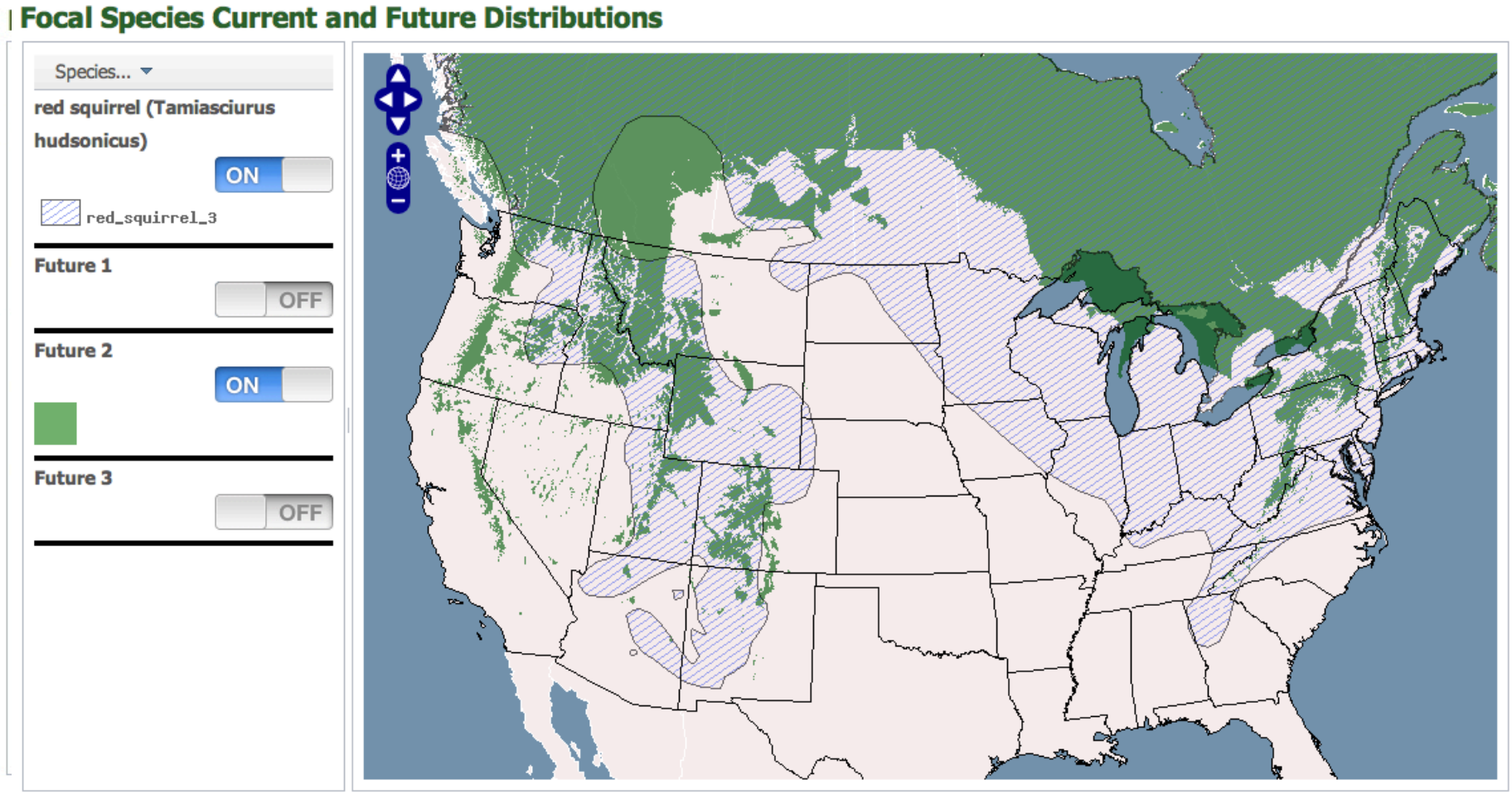


Red Squirrel: Future 1

Focal Species Current and Future Distributions

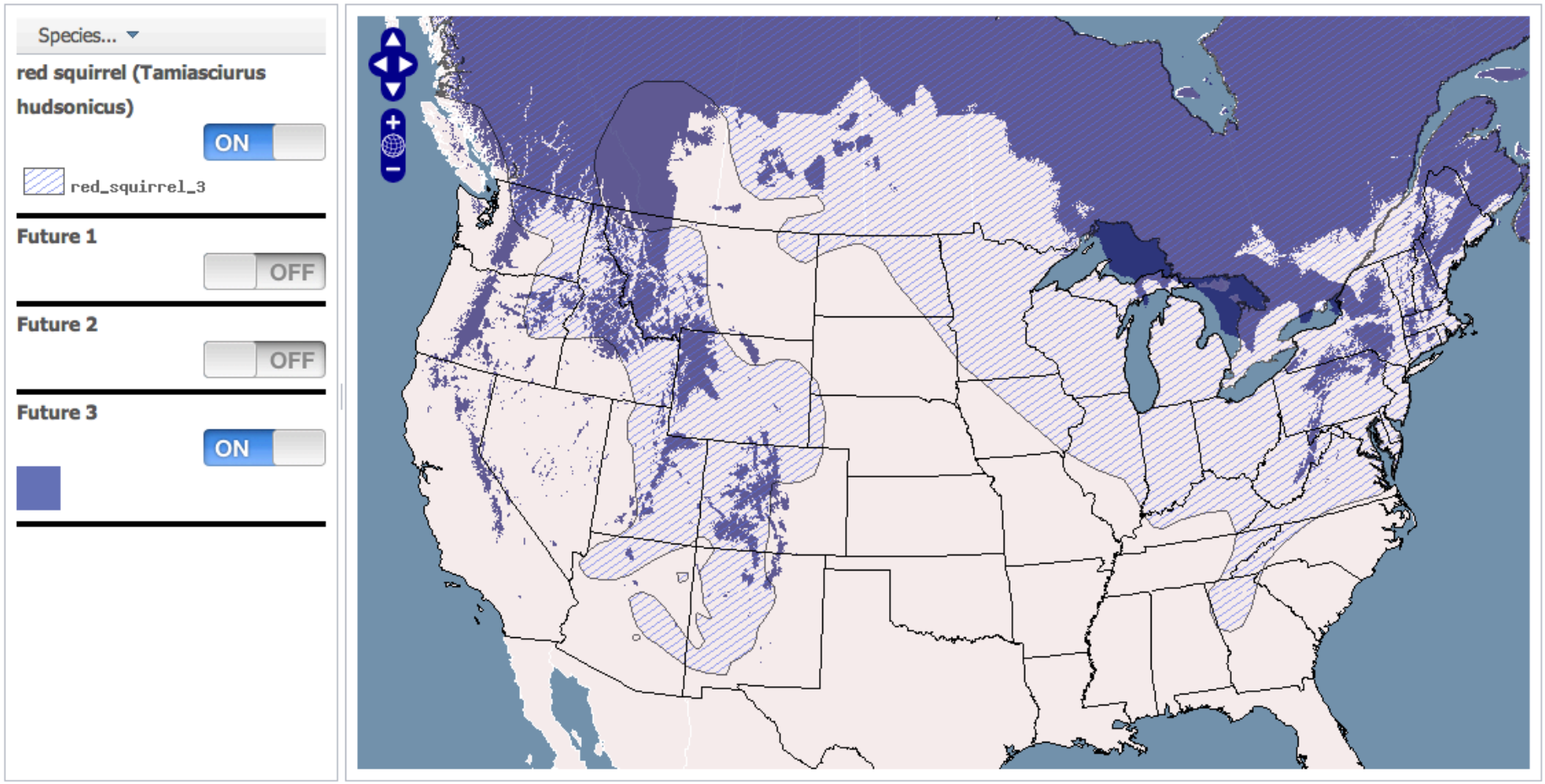


Red Squirrel: Future 2

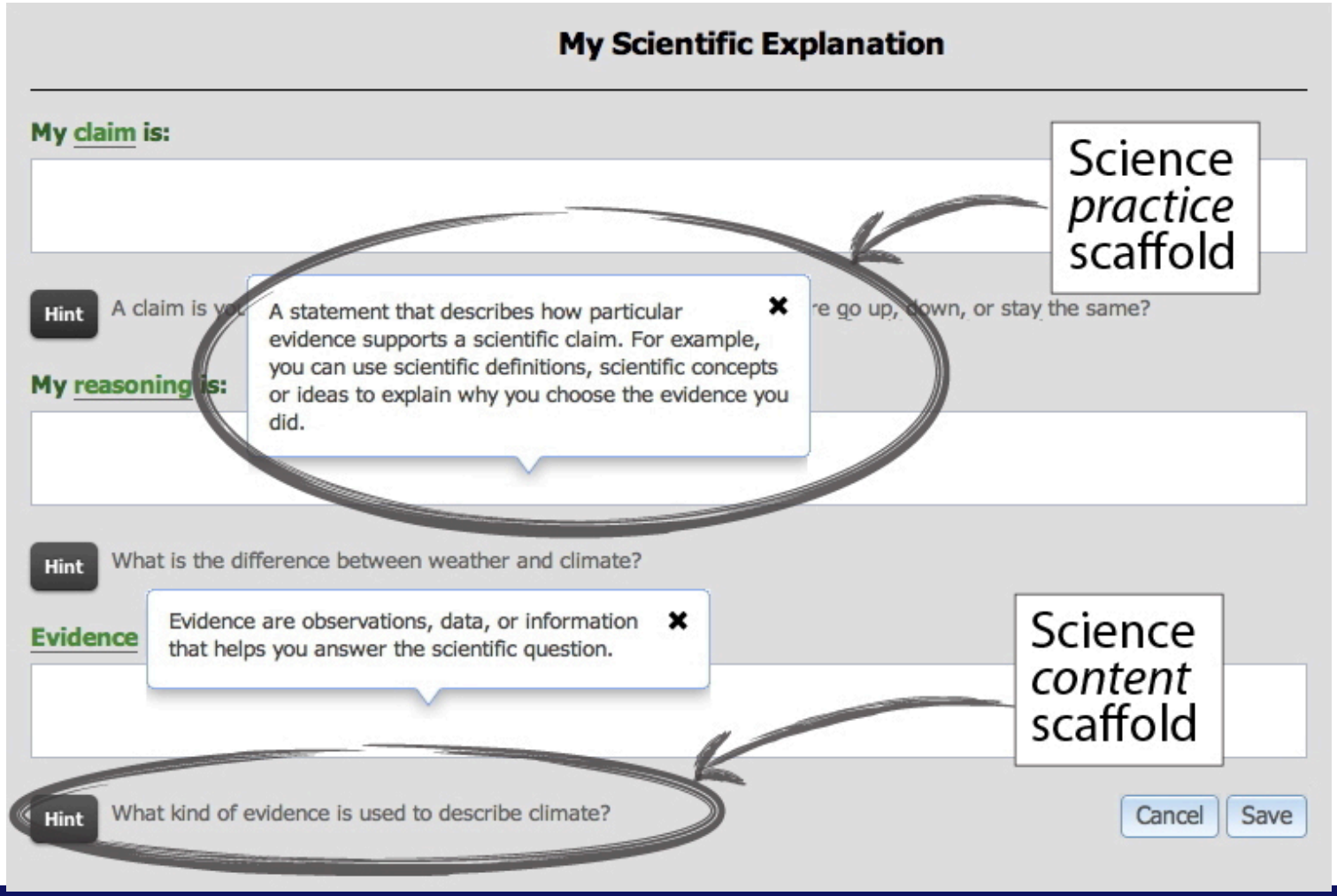


Red Squirrel: Future 3

Focal Species Current and Future Distributions



Guided Reflection in Constructing Explanations to address question, Is there evidence that climate change will impact the distribution of my focal species?



Conclusions

- Largest gap in current research on learning progressions is in the area of assessment design and assessment evaluation
- Second priority: Discussions about use of LPs and representing the knowledge we (and NGSS) care about :
- Fused content+practices+crosscutting concepts