

# Assessing Science Knowledge that Inextricably Links Core Disciplinary Ideas and Practices

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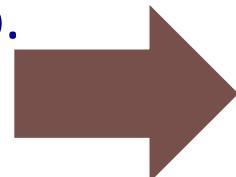
The University of Michigan

# Example of Tri-Dimensional Fused (Inextricably Linked ) Knowledge

## Core Disciplinary /Crosscutting

Because many animals rely on each other, a change in the number of one species can affect different members of the web.

**Practice** Students build a complete scientific explanation consisting of a claim, two pieces of evidence and reasoning



## Fused Knowledge

Students construct scientific explanations to address the question, How have recent changes in the Detroit River affected yellow perch populations?

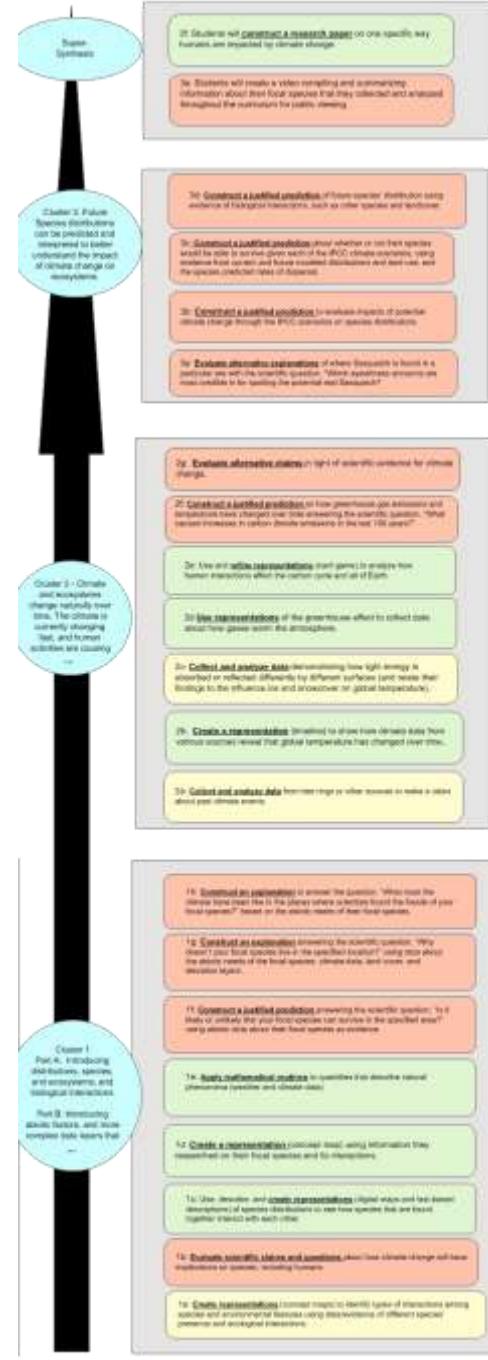
## Two Samples of Fused Knowledge from a Learning Progression Focused on Climate Change

Students *construct a scientific explanation* based on evidence about how greenhouse gas emissions and temperature have changed over time.



Students *construct a explanation* to address the question, Is there evidence that climate change will impact the distribution of the Red Squirrel?

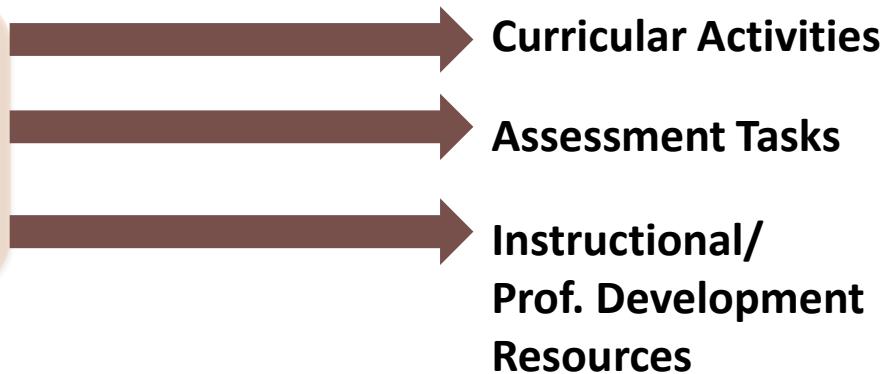
# Tri-Dimensional Fused Knowledge Learning Progression



# Fused Knowledge Learning Goals are the Template for Curricular Units, Assessment, and Instruction

## Fused Knowledge 3b. From Learning Progression

3b. Students *construct a explanation* to address the question, Is there evidence that climate change will impact the distribution of the Red Squirrel?



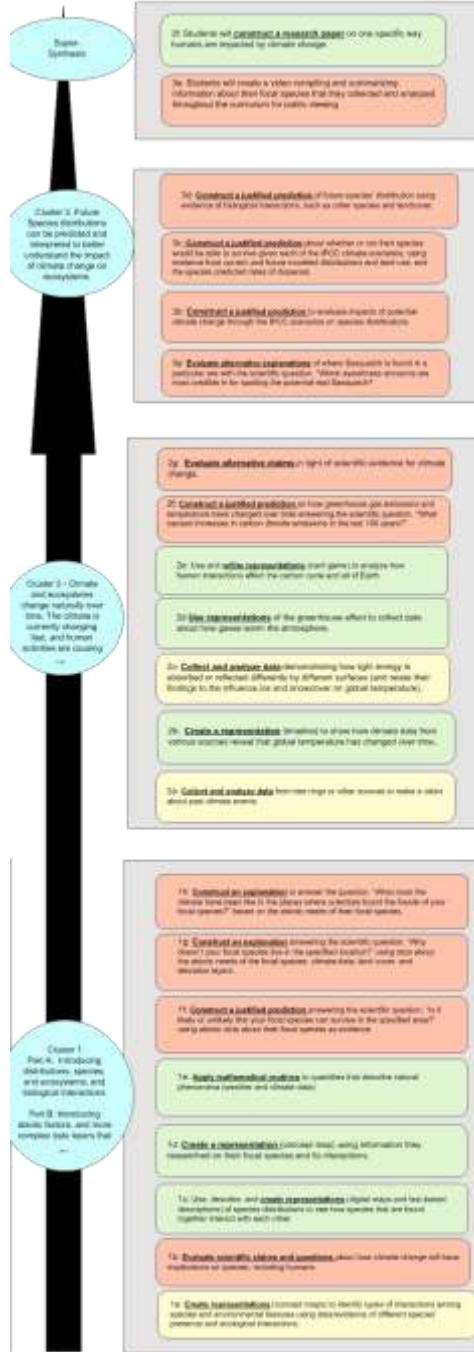
# How Do We Design Assessment Tasks Focused on Fused Knowledge ?

Students *construct a explanation* to address the question, Is there evidence that climate change will impact the distribution of the Red Squirrel?



Assessment Task

## Summative Assessment >

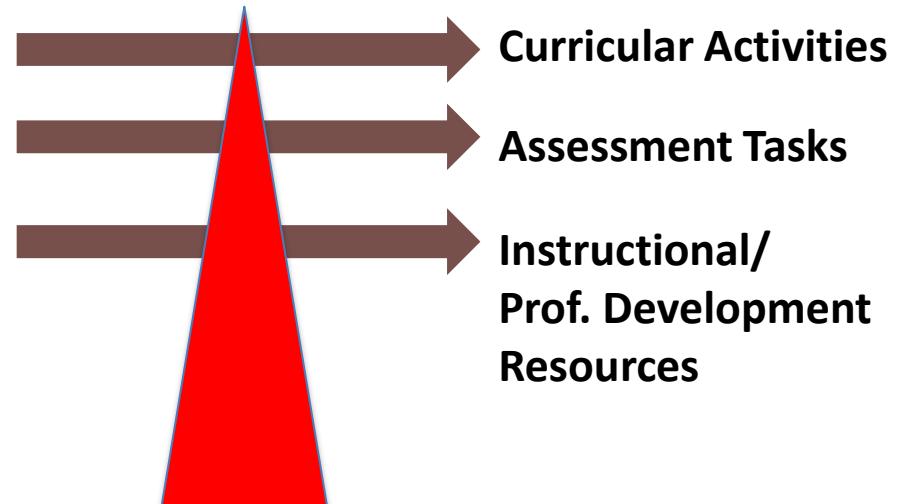


## Embedded Assessment >

### Practices Highlighted

# Step One: Cognitive Analysis and Strategic Simplification

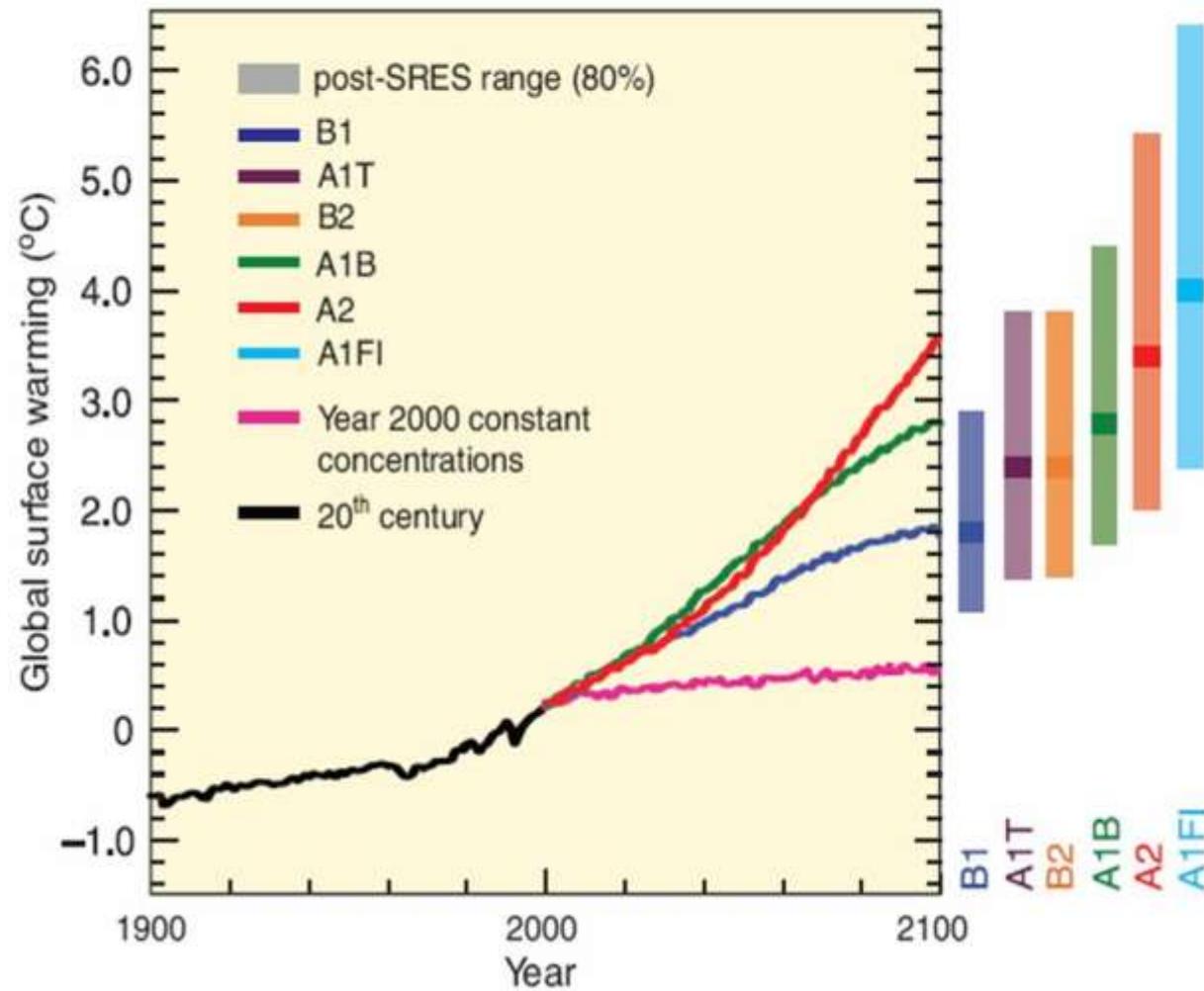
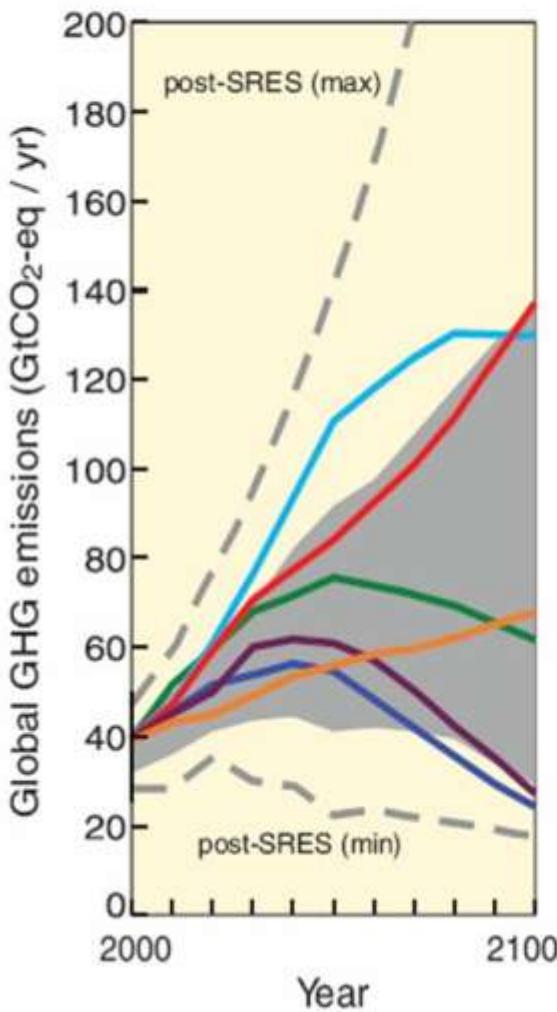
Students *construct a explanation* to address the question, Is there evidence that climate change will impact the distribution of the Red Squirrel?



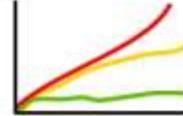
## 1. Strategic Simplification

# Example: Intergovernmental Panel on Climate Change (IPCC) Future Scenarios

Scenarios for GHG emissions from 2000 to 2100 (in the absence of additional climate policies)  
and projections of surface temperatures



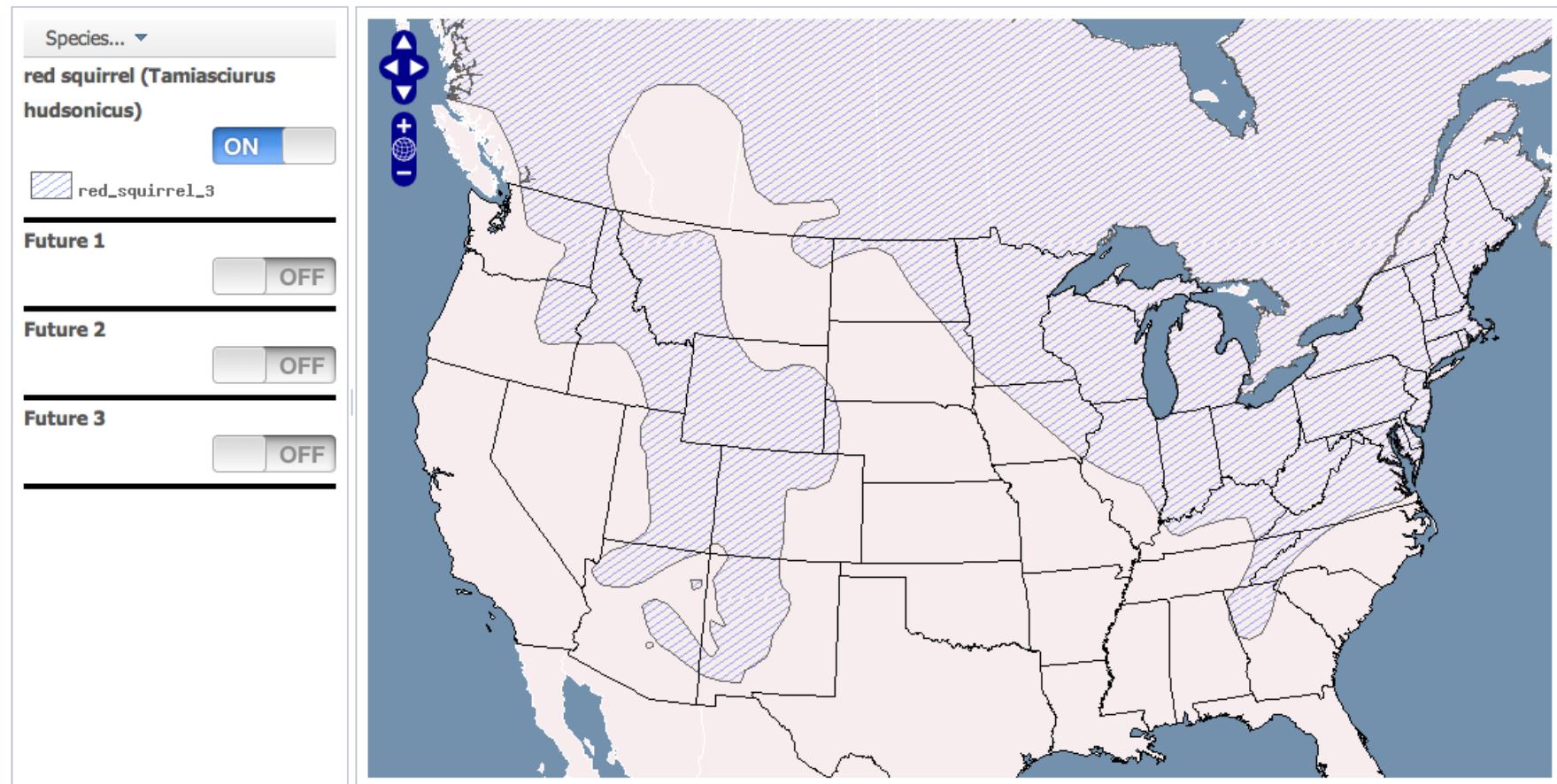
# Strategic Simplification of Aspects of (Content) Necessary to Support Students' Ability to Construct Explanation or Prediction

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

## Step 2: Create Stimulus Materials

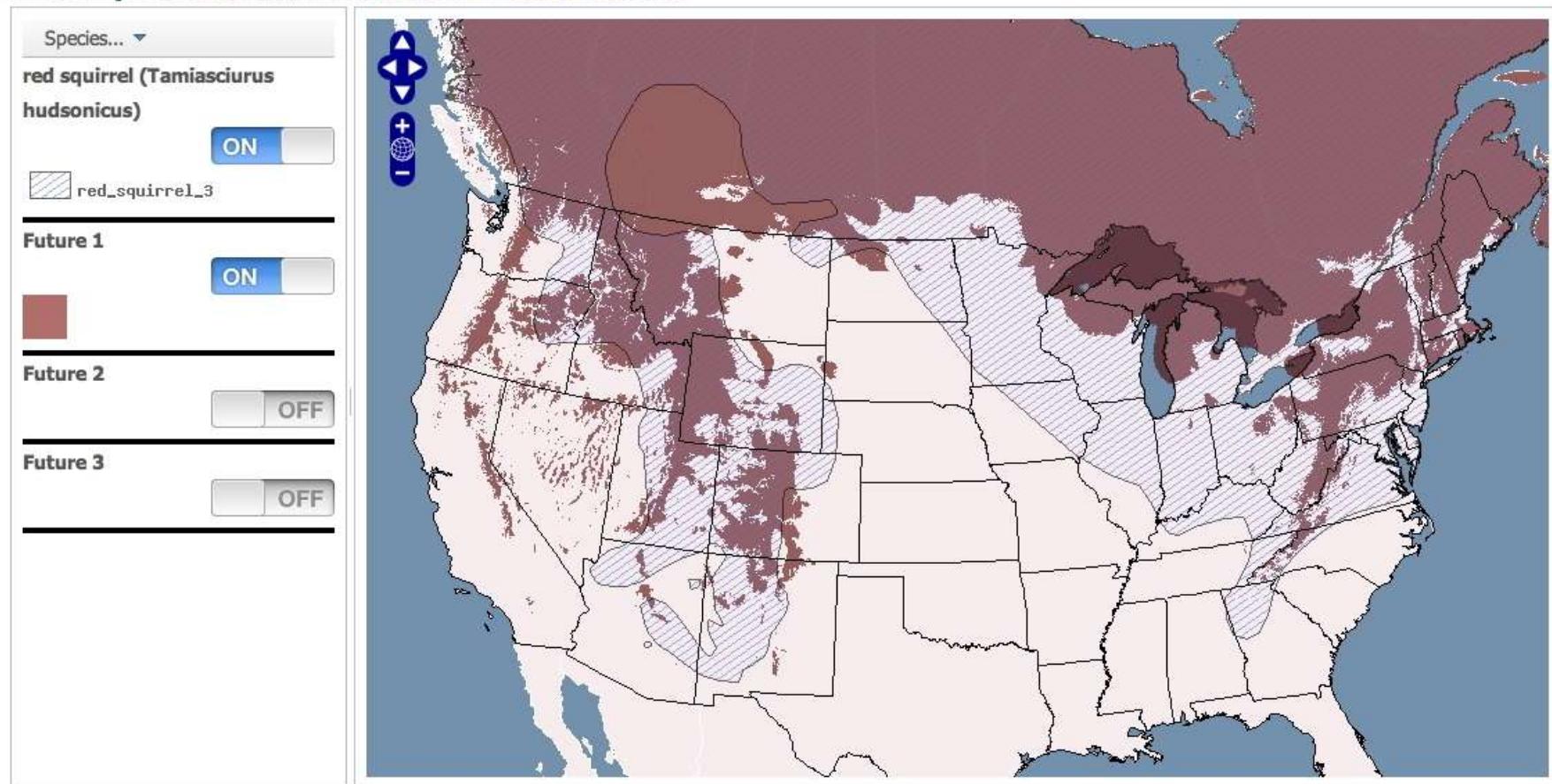
### Current Distribution of the Red Squirrel (real data)

#### Focal Species Current and Future Distributions



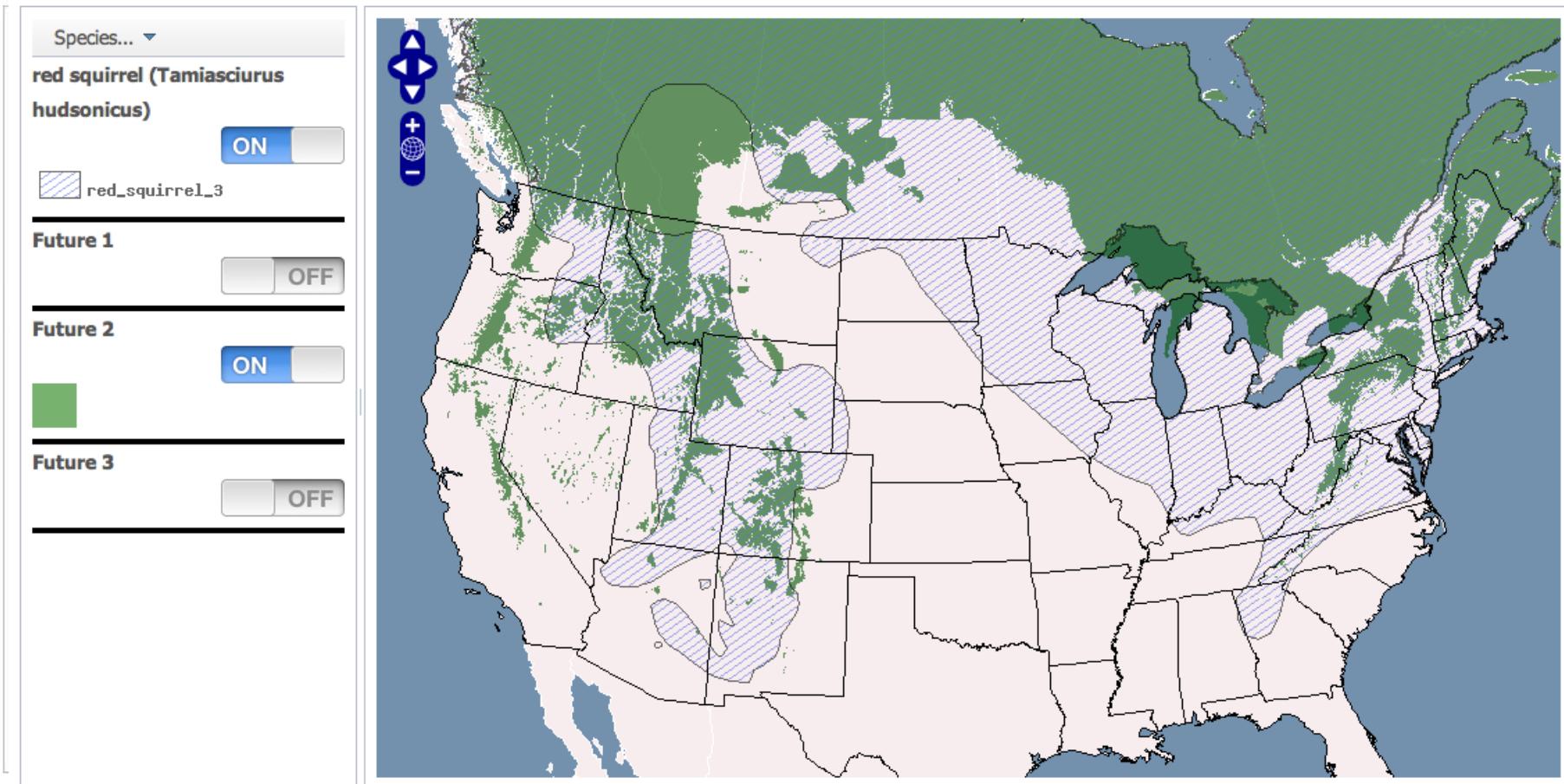
# Red Squirrel Distribution Under IPCC Scenario Future 1 (modeled data)

## Focal Species Current and Future Distributions



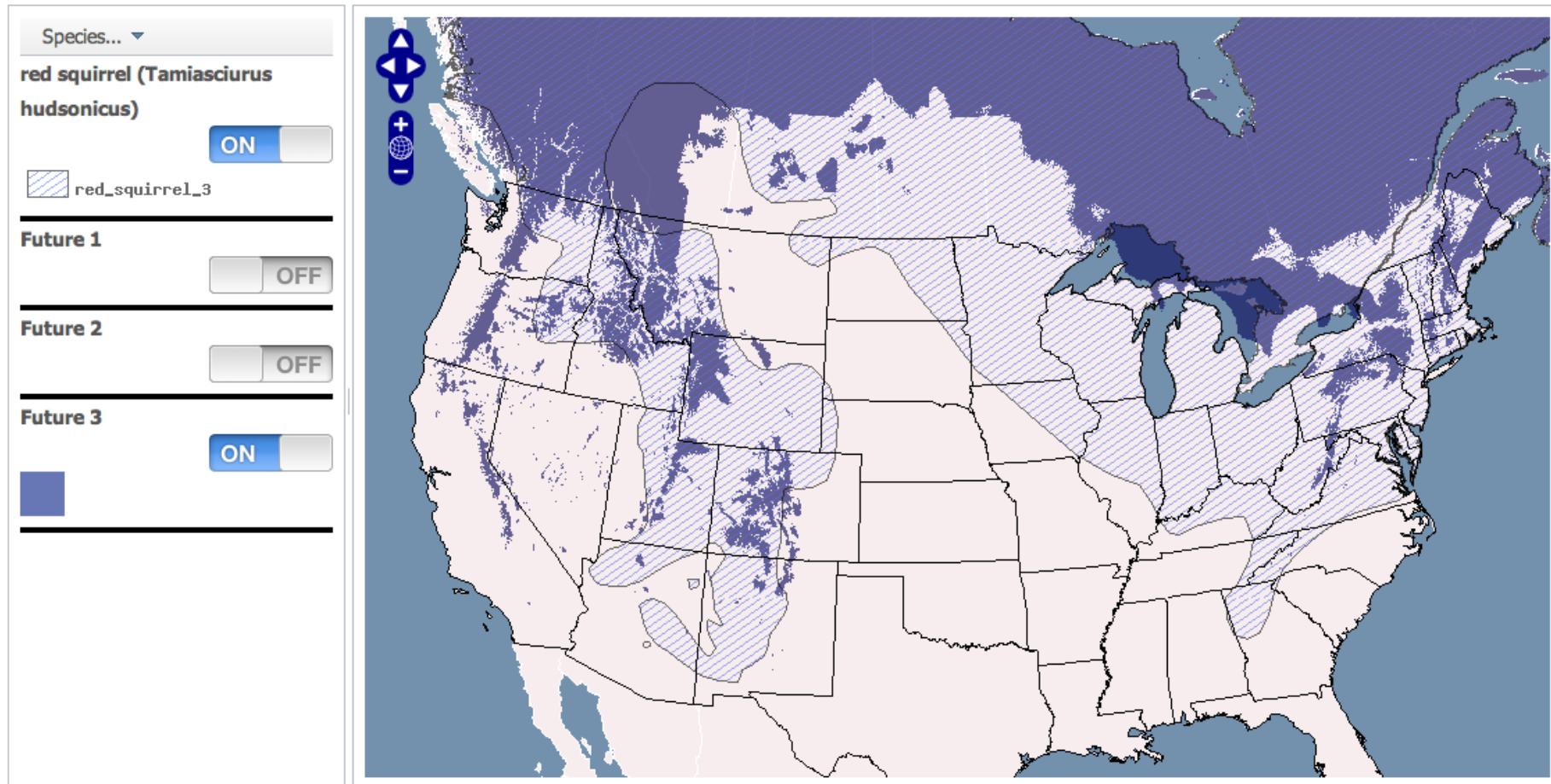
# Red Squirrel Distribution Under IPCC Scenario Future 2

## Focal Species Current and Future Distributions



# Red Squirrel Distribution Under IPCC Scenario Future 3

## Focal Species Current and Future Distributions



# Is there evidence that climate change will impact the distribution of the Red Squirrel?

## My Scientific Explanation

**My claim is:**

**Hint** A claim is what you say is true about the world.

**My reasoning is:**

**Hint** A statement that describes how particular evidence supports a scientific claim. For example, you can use scientific definitions, scientific concepts or ideas to explain why you choose the evidence you did.

**Evidence**

**Hint** Evidence are observations, data, or information that helps you answer the scientific question.

**Hint** What kind of evidence is used to describe climate?

**Science practice scaffold**

Science content scaffold

Cancel Save

# Online Assessment Information Available for Teachers and Students in Real or Near Time

The image shows two side-by-side computer screenshots. The left screenshot displays a 'SPECIES' interface for 'Columbia Prep - Bess' with a list of items and their counts. The right screenshot shows a 'SPECIES' interface for 'Honey Creek 2 :: Lesson 2 :: Variables' with a list of student responses and their timestamps.

**SPECIES | Columbia Prep - Bess**

Climate Change Biology - High School Spring 2012	0
Welcome to SPECIES!	0
Learning Set 1	0
Lesson 1 - What is climate change?	0
Lesson 1 - Teacher Information Part 1	1
Lesson 1 - Teacher Information Part 2	1
Lesson 1 - Part 1	10
Lesson 1 - Part 2	4
Lesson 1 - Part 3	1
Lesson 1 - Homework	1
Lesson 2 - How are weather and climate different?	0
Lesson 2 - Teacher Information Part 1	1
Lesson 2 - Teacher Information 2	1
Lesson 2 - Teacher Information Part 3	1
Lesson 2 - Introduction	2
Lesson 2 - Part 1	7
Lesson 2 - Part 2	8
Lesson 2 - Part 3	7
Lesson 3 - How does climate limit where your focal species lives?	0
Lesson 3 Teacher Notes	1
Lesson 3 - Part 1	4
Lesson 3 - Part 2	6
Lesson 3 - Part 3	9
Learning Set 2	0
Lesson 4 - How do we know that ecosystems change over time?	0
Lesson 4 - Teacher Notes, Part 1	1

**SPECIES | Honey Creek 2 :: Lesson 2 :: Variables**

project: Center for Essential Sci...	animaldiversity.ummz.umich.edu/changethinking/species/manager/workbook/report	SPECIES   Honey Creek 2 :: Less...	animaldiversity.ummz.umich.edu/changethinking, Goo
JillianB	[274] 1b_article_main2	2012-04-09 11:45:27	Weather is talking about current weather, like saying what the temperature is like right now, but climate is talking about weather, but in a certain area, over a long period of time. In this case, we were looking at climate for three different decades.
JonathanS	[276] 2a_pollen_y_axis	2012-04-09 11:23:05	Weather is daily temp that goes on climate is an average temp recorded over a period of time
KateM	[277] 2a_pollen_x_axis	2012-04-09 11:30:32	The difference between weather is change. Weather always changes and is a day to day thing. Climate is the average temperature for an area and is a year round thing.
KeeganP	[278] 2a_how_many_plants	2012-04-09 11:33:33	-
KristineM	[279] 2a_spruce_most_abundant	2012-04-09 11:42:19	Weather is what is happening in the near future or the present. Climate is what is expected to happen.
MayaK	[280] 2a_annual_herbs_most_abundant	2012-04-09 11:32:21	Long period of time for climate and what's happening NOW for weather
NatalieK	[288] L9_Prediction about sasquatch reports	2012-04-12 14:59:08	Weather is what is happening now. It is what is going on in the sky. Climate is the change of the earth over time. It is how the earth changes.
NyahS	[289] L10 If FS and Prey do not overlap in Future 3	2012-04-09 11:38:30	Weather is what is going on right now, but climate is what usually happens in that specific area.
RitaH	[290] L10 Barriers around focal species	2012-04-09 11:38:30	Weather is what is happening at one instant. Climate is the overall average temperature of a specific area.
	[291] L10_predict_clim_change_impact_on_F		
	[292] 1f_a		
	[293] 1f_bio		
	[294] 1f_abiotic_definition		
	[295] 1f_type_of_habitat		
	[296] 1f_predators		
	[297] 1f_prey		
	[298] 1f_interesting_info		
	[299] 1f_total_temp_range		
	[300] 1f_low_temp_average		
	[301] 1f_high_temp_average		
	[302] 1f_total_precip_range		

# Summary Ideas

1. Our learning progressions are a series of fused knowledge statements organized into one of several possible sequences
1. Our assessment constructs are fused knowledge statements
1. Cognitive analysis leading to strategic simplification of some or all of the three dimensions of knowledge is necessary so that target audience can focus on generating fused knowledge
1. Our curricular activities and our assessment tasks always focus on fused knowledge even as they variously provide support and fading of support appropriate for target audience
1. Assessment items can be coded for either core disciplinary ideas, practices and/or fused knowledge (when appropriate)