

# Place, community, and biosphere: An overview of the TERC Life Science Initiative's climate education work

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TERC

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## ***Introduction***

- Practicing scientists in Ecology
- Ecological perspective
- Training and assumptions about ecosystems, systems thinking, complexity, etc.



## *Early work 1*

- **The Global Lab**

- The first network of schools using “telecommunication”
- Making and sharing environmental measurements
- Included a unit on measurements related to climate change



## *Early work 2*

- **Ecology: A systems approach**
  - Adopted a systems approach to studying ecosystems
  - Placed issue of carbon cycling and climate change in the broad context of ecology and evolution



# *Biocomplexity and the habitable planet*

- Year long capstone high school course
- Built around cases local-to-global, focused on land use, resource use and conservation
- Introduces new science

Biocomplexity and the habitable planet

Home Urban Biocomplexity Suburban Sprawl Amazonia Arctic

Home

Biocomplexity Resources

5



# Biocomplexity

## SOCIAL CONTEXT

### Ecosystem Services

- Ecosystem processes on which humans depend

## NATURAL SYSTEMS

### Landscapes

- Spatial context and its structure and patterns

### Coupled natural & human (CNH) systems

- Considering humans, their social institutions and behaviors as part of all ecosystems

# Experiencing research first hand...

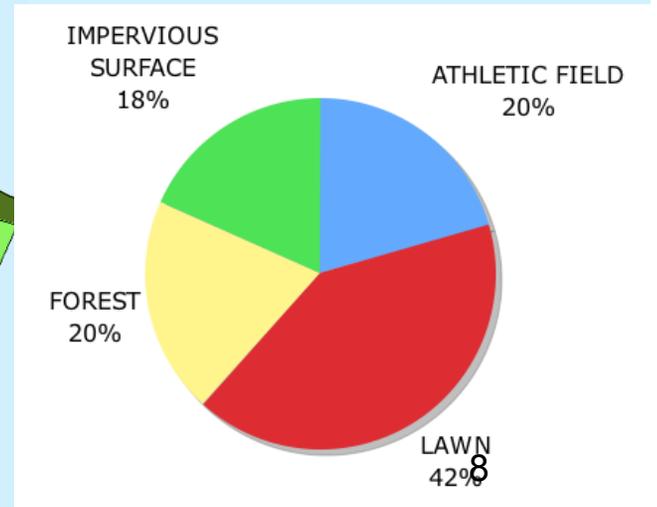
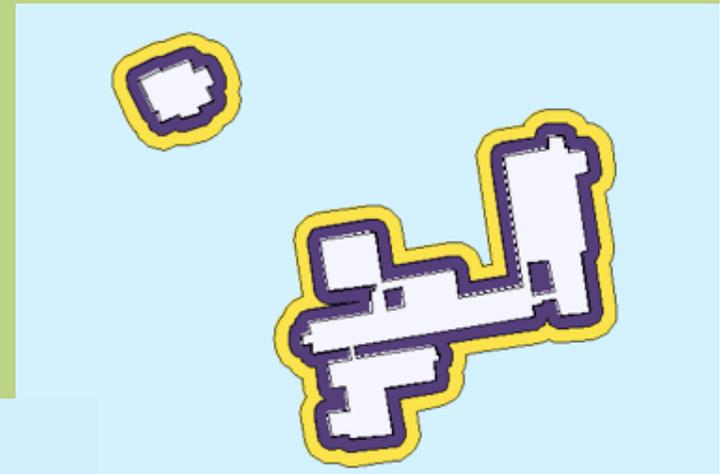
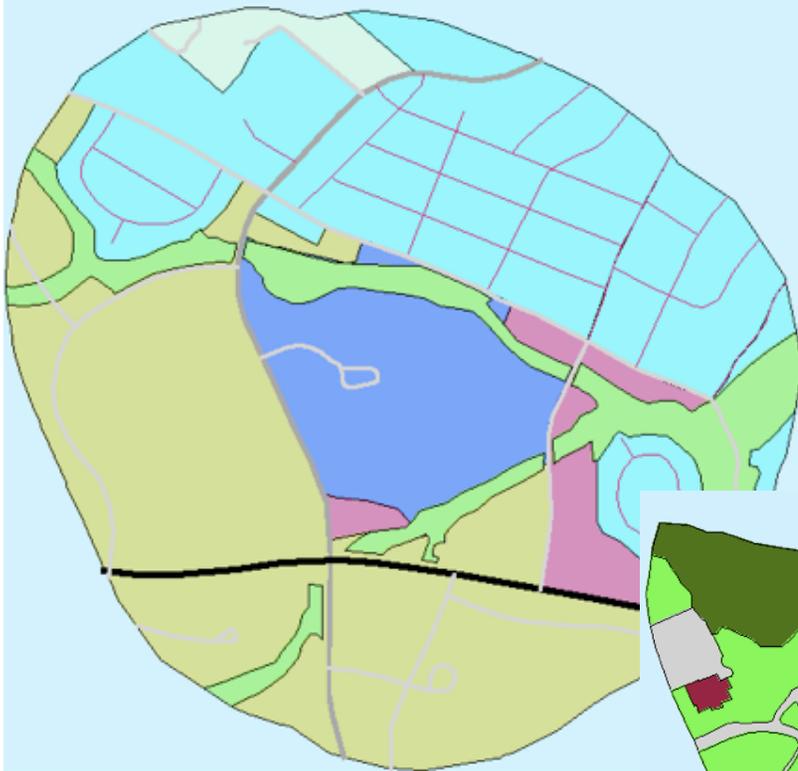


| BIRDS                       |  |  |
|-----------------------------|--|--|
| American crow               |  |  |
| American goldfinch          |  |  |
| American robin              |  |  |
| Barn swallow                |  |  |
| Blue jay                    |  |  |
| Canada goose                |  |  |
| Carolina chickadee          |  |  |
| Carolina wren               |  |  |
| Cedar waxwing               |  |  |
| Chipping sparrow            |  |  |
| Common grackle              |  |  |
| Downy woodpecker            |  |  |
| Eastern kingbird            |  |  |
| European starling           |  |  |
| Gray catbird                |  |  |
| Green heron                 |  |  |
| House sparrow               |  |  |
| Mourning dove               |  |  |
| Northern cardinal           |  |  |
| Northern flicker            |  |  |
| Ringed-bill gull            |  |  |
| Sharp-shinned hawk          |  |  |
| Song sparrow                |  |  |
| Tufted titmouse             |  |  |
| Turkey vulture              |  |  |
| White-breasted nuthatch     |  |  |
| Yellow-crowned night heron  |  |  |
| [Unidentified large raptor] |  |  |



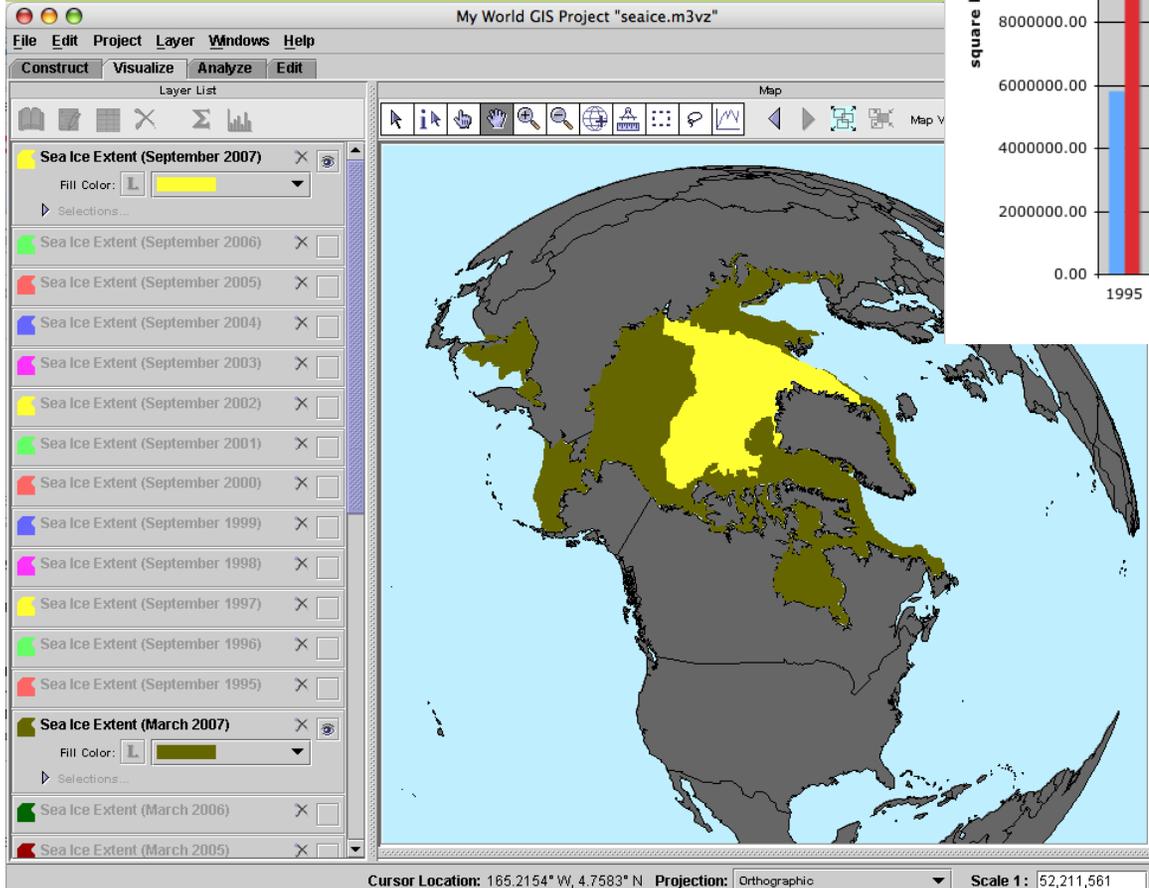
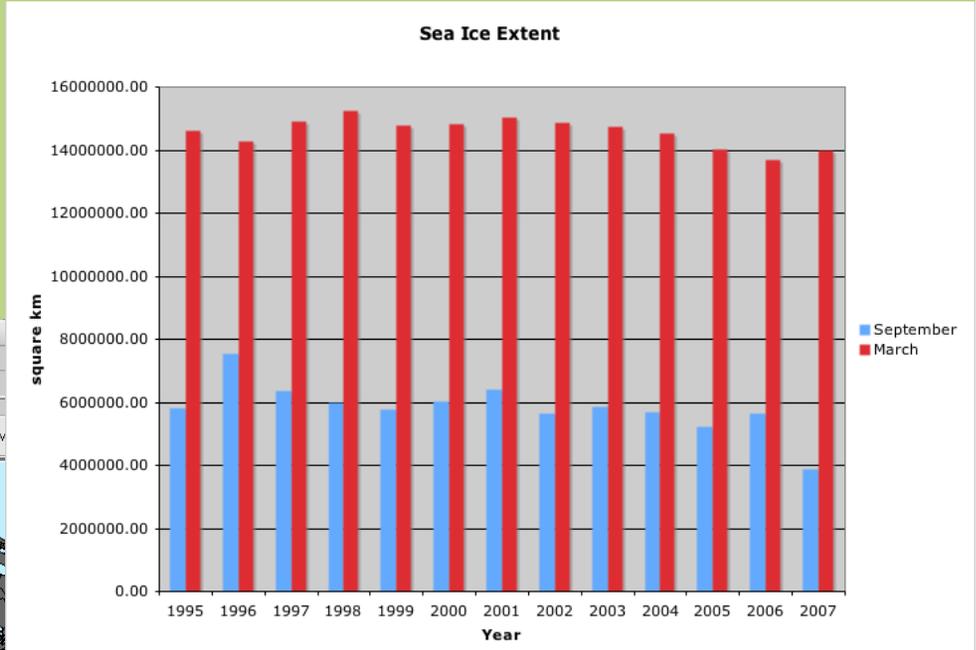
# Use Real Data as Evidence

## Existing Site vs. the 3 Scenarios



# Arctic

|    | A    | B          | C           |
|----|------|------------|-------------|
| 1  | Year | September  | March       |
| 2  | 1995 | 5804653.50 | 14612152.63 |
| 3  | 1996 | 7529641.00 | 14287196.94 |
| 4  | 1997 | 6350118.50 | 14911608.44 |
| 5  | 1998 | 5992598.00 | 15224399.00 |
| 6  | 1999 | 5764920.00 | 14791946.63 |
| 7  | 2000 | 6016656.50 | 14810169.50 |
| 8  | 2001 | 6411767.00 | 15015106.88 |
| 9  | 2002 | 5657139.50 | 14855622.63 |
| 10 | 2003 | 5862068.00 | 14734680.13 |
| 11 | 2004 | 5686248.00 | 14532936.56 |
| 12 | 2005 | 5207504.50 | 14004288.25 |
| 13 | 2006 | 5645656.50 | 13696842.44 |
| 14 | 2007 | 3862648.75 | 13989895.25 |
| 15 |      |            |             |



GIS Analysis of Arctic Sea Ice Extent over Time



Polar bear

Bowhead



Little Auk



Red  
Knot



Caribou



## ***New approaches? The problem***

- Science of climate change is complex
- Learning about it is difficult
  - Results from Yale study group
  - Research findings from the classroom
  - Public discourse about climate change



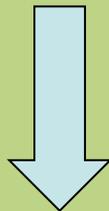
## ***New approach? A conjecture***

- Learning about climate change is difficult because:
  - Science is abstract
  - Complex, diffuse and probabilistic causality (Grotzer)
  - Effects seem distant in space and time (Leiserowitz)
  - Science practices are unfamiliar (Osborne, Krajcik)
  - Learning is also influenced by emotional dimension (Saunders, Moser)
- Therefore, we conjecture that a place-based approach can counter these difficulties



## ***New approaches?***

- Stories
- Local (New England) examples



- The importance of Place



# Biosphere and Climate

Understanding Climate Change in New England



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## Latest Updates:

New species added to the Peer Reviewed Changes list

## Curriculum Sample



Title: Your Town in Past, Present, and Future

Grade Level: 3-5

Source: National Geographic

[Other curriculum studies](#)

## Collaborating to Teach the Ecology of Climate Change in New England



### Mammalian responses to climate change

Abe Drayton posted on Jul 08, 2014

In our last post, we reported on a study of how lungless salamanders are responding to climate change. This week, we're reading a literature review of mammal studies in North America.



Christy McCain and Sarah King examined 1050 papers that took a look at the ways in which human-caused climate change is affecting mammals in North America. They took pains to include only works that could exclude other factors that might be causing changes, such as habitat destruction

The first thing to note about this study is that the authors sought, and found no publication bias. Science deniers often claim that there is a bias toward "popular" results, that is, studies that seem tilted to support mainstream opinion.. McCain

## Case Studies



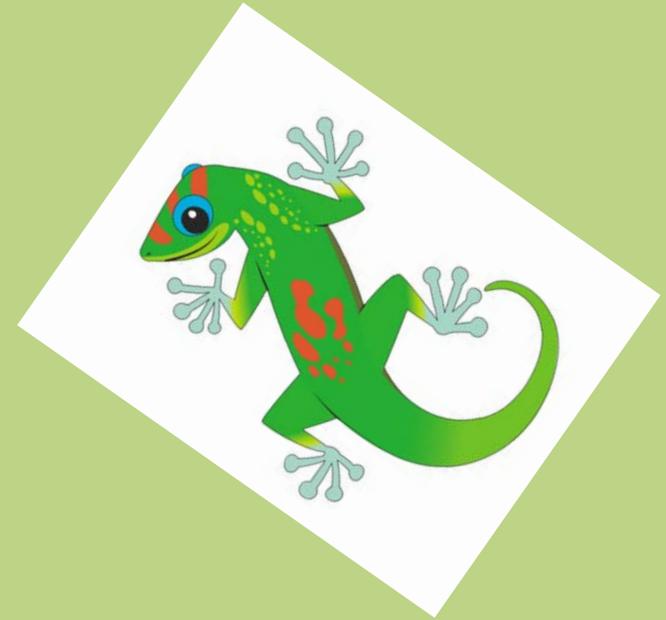
Northern Shrimp (*Pandalus borealis*)



Atlantis Fritillary (*Speyeria atlantis*)

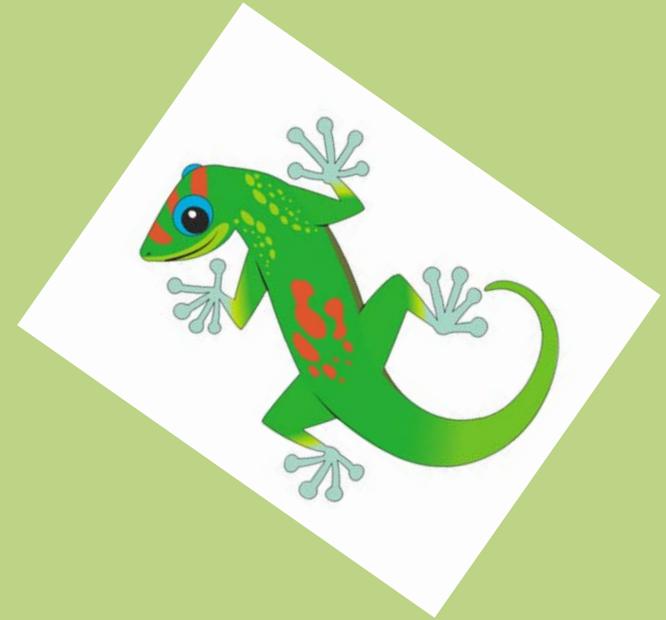


# GECCo





**GECCo**

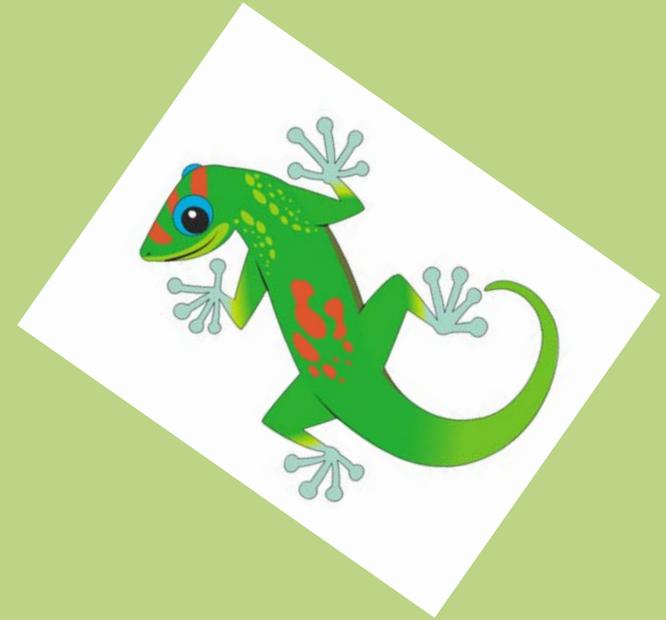


## Girls

- Learn about energy conservation
- Learn about climate change and their own connection to it
- Take action by saving energy
- “Tell the world” about why conservation is important



**GECCo**



Theoretical framework:

- Social norms
- Conservation psychology
- Theories of behavior change



## ***Current projects***

- **Place identity** – A component of personal identity, a process by which, through interaction with places, people describe themselves in terms of belonging to a specific place.
- **Environmental identity** – A sense of identity that transcends the individual and encompasses one's place in an ecosystem



## ***Climate Conversations***

- **Communities as the agents of climate change education**



- **Coordinated vision of climate change**
- **Skills and insights of each sector**



## ***Climate Conversations***

- Cross-sector Climate Conversations
- Work with communities with nature centers as “anchors” or “trusted messengers”
  - Build knowledge of climate change
  - Build educational capacity
  - Build social capital for community action
- Conduct research on mechanisms and effectiveness via a focus on the microgenesis of ideas



## ***The Climate Lab***

<https://www.manomet.org/climatelab>

The screenshot displays the Manomet Center for Conservation Sciences website. At the top left is the Manomet logo, a stylized globe with blue and white waves. To its right, the text reads "MANOMET Center for Conservation Sciences". Below this is a dark teal navigation bar with white text for "ABOUT", "PROGRAMS", "PUBLICATIONS", and "PRESS". The main content area features a large photograph of a man in a white shirt and glasses, likely a scientist or educator, interacting with a group of students in a forest. One student is holding a red clipboard. Below the photo is the heading "Climate Lab" and a breadcrumb trail: "Home » Programs » Connecting to Nature » Climate Lab". To the left of a smaller inset photo is a text block: "The impacts of climate change are already becoming apparent, and part of our response must be to prepare our children—the next generation of decision makers—to understand and deal with this altered landscape. Manomet Center for Conservation Sciences has partnered with curriculum experts at TERC to address this need through Climate Lab, a program through which students collect data on biological indicators of climate change." The inset photo shows a person's hands using a specialized tool to measure a plant stem.



## *Innovate to Mitigate*

[http://  
innovatetomitigate  
.org](http://innovatetomitigate.org)

# Innovate to Mitigate



## Climate Change Challenge

**Innovate to Mitigate invites students to come up with ideas to reduce greenhouse gases.**

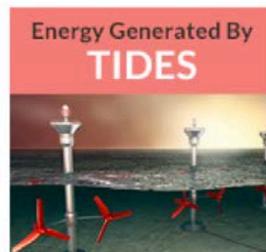
In this competition, students send in a brief statement describing one or more ideas (up to 250 words for each idea) for mitigating climate change. **The deadline for the first round is MONDAY MARCH 9.**

The most promising ideas qualify for a second round. Round 2 participants expand on how and why their idea(s) will work in a 2-minute video and a paper (max 1200 words). Prizes for Round 2 finalists: 1<sup>st</sup> prize \$4,000. 2<sup>nd</sup> prize \$2,500. Public choice award \$500.

Check it out at <http://innovatetomitigate.org>

Please [forward](#) this to anyone you know who might be interested, like us on [Facebook](#) and follow us on [Twitter](#). (If you click on the [social media toolkit](#) link on the website, you'll find samples to post on Twitter or your own Facebook page.)

## What's Your Idea?





# Innovate to Mitigate



VIDEO & POSTER COMPETITION

HOME

PRESENTATIONS

PRESENTERS

JUDGES

ABOUT

## FILTER:

### BY KEYWORD

- biofuel
- phytoplankton
- green roof
- carbon sink
- sequestration
- soil enrichment
- cell phone charger
- crank generator

### BY INSTITUTION



### NAME/TEXT SEARCH



## SHOWING ALL 5 PRESENTATIONS



### Colored Lights and Algae to Generate Biofuels

The Dry Ice Cubes



### Renewable Energy Using Crank Generators

F=I3



### Phytoplankton Behavior Through The Meticulous Introduction o

Intelligent Life Forms



### Biochar For Soil Enrichment and Carbon Sequestration

FOCIS



### Carbon Sequestration Using the Green Roof

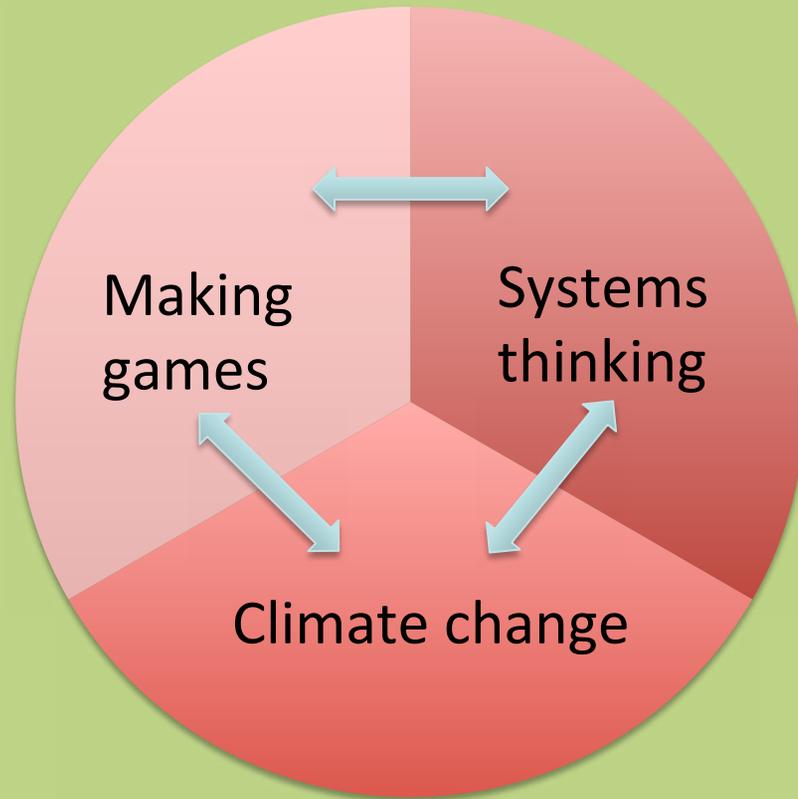
The Carboneers



## ***Building systems from Scratch***

- **Affordances of student game design to learn about climate change**
- **Early evidence: Students are**
  - **Motivated**
  - **Persistent**
  - **Learn about aspects of climate change**

# ***Building systems from Scratch***



## Results:

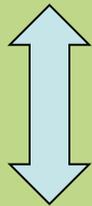
- Young people (YP) pick up programming quickly
- YP focus on subsystems in their game designs
- YP articulate tacit knowledge about larger Earth systems when asked





## ***Conclusion***

| <b>Project</b>        | <b>Audience</b>                 | <b>Setting</b>      | <b>Features</b>  |
|-----------------------|---------------------------------|---------------------|--|
| Biocomplexity         | High school students            | In school           | Climate change from “biocomplexity” perspective        |
| Biosphere and Climate | Broad community spectrum        | Formal and informal | Biotic impacts of climate change as driver of learning |
| GECCo                 | Elem and Middle school girls    | Informal            | Energy conservation and personal action                |
| The Climate Lab       | Middle school students          | In school           | Biotic impacts of climate change as driver of learning |
| Climate Conversations | Broad community spectrum        | Formal and informal | place-identity, community as agent of education        |
| Innovate to Mitigate  | Middle and High school students | Formal and informal | Climate mitigation as driver of learning               |
| Scratch               | Middle school students          | Informal            | Drawing on participatory pedagogy                      |



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