Formal Education Programs in the CACCE Partnership

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University of South Florida and Hillsborough County Public Schools

CACCE Conference-Workshop on Impacts of Climate Change in Caribbean Countries

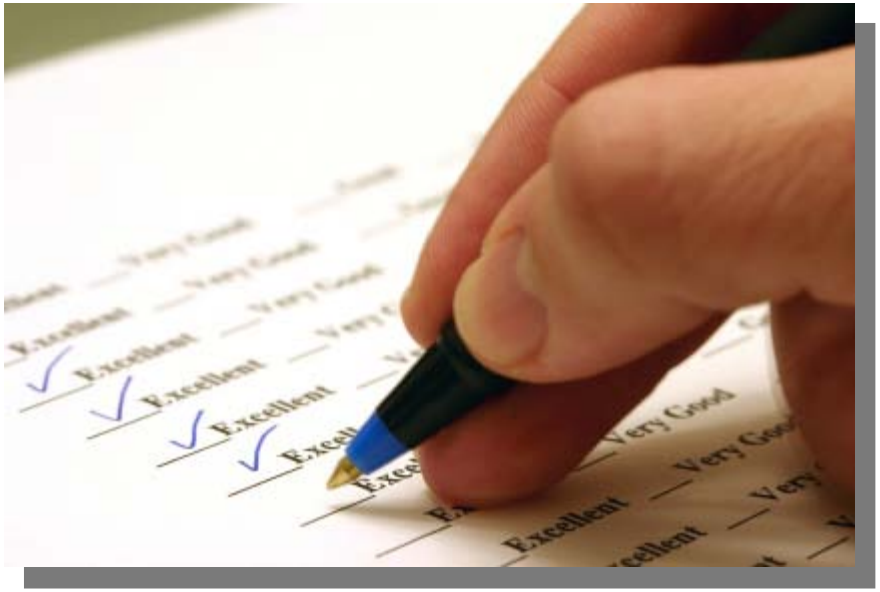
February 1-3, 2012

Holiday Inn Hotel, Mayagüez, Puerto Rico

Outline of presentation

- Findings from survey administered to teachers and students in FL and PR
- Multiple Outcome Interdisciplinary Research and Learning (MOIRL) Projects
- Overview of the primary and secondary education system in Florida
- Draft CACCE plan for climate change education in secondary schools

TEACHER AND STUDENT SURVEYS



Teacher Survey

- Developed teacher survey based on previous research (Bord et al., 1998; Rutledge & Warden, 1999)
  - Understanding of climate change
  - Beliefs about climate change science
  - Climate change teaching practices
- Distributed surveys to Florida (N = 145) and Puerto Rico Science (N = 479) elementary and secondary science teachers.

Teacher Survey (Cont.)

- Florida and Puerto Rico secondary science teachers hold naïve views about CC and CC science.
- Examples:
  - 46 % FL teachers and 82 % PR teachers responded that the depletion of the ozone layer is a primary cause of CC.
  - 10 to 63 % of all teachers responded insecticides, aerosol sprays, and nuclear power generation were also primary causes of CC.

Teacher Survey (Cont.)

- Examples:
  - 31 to 48 % of all teachers erroneously thought that vehicle emissions and fossil fuel use by utility companies were at most secondary or minor causes of climate change.
  - ~50% of all teachers agreed that CC science needs to be based on controlled experiments in order to be valid.
  - 25 %FL teachers and 45 % PR teachers unsure if, or agreed that, climate change is not a valid science idea because most of the knowledge is based on modeling.

Teacher Survey (Cont.)

- Teachers' climate change instructional practices are largely inadequate.
- Examples:
  - 55% FL teachers and 51% PR teachers indicated they only mentioned climate change briefly in their classrooms.
  - ~45% of FL teachers and 49% of PR teachers indicated deep coverage of climate change or that climate change is a unifying theme of their courses.
  - ~56%of FL teachers and 49% of PR teachers devote two days or less to teaching about climate change over the span of a course.

Teacher Survey (Cont.)

- Examples:
  - >60% FL teachers provide at least some instruction about carbon cycle disruption, ocean level changes, and the development of evidence for climate change. Conversely, less PR teachers provide at least some instruction about the carbon cycle (22%), ocean level changes (54%), and the development of evidence for climate change (40%).
  - ≥50% provide little to no instruction about the prevalence of diseases, socio-political considerations, or how humans will need to mitigate or adapt in response to climate change.

Student Survey

- Surveys of students in FL (n=477)
- Developed student survey based on conceptual literature (Rudolph,1999)
  - Perceptions of the validity of climate change
  - Beliefs about the nature of climate change science
  - Climate change learning experiences
  - Willingness to mitigate or adapt to climate change

Student Survey (Cont.)

- Many Florida marine science students question the validity of CC and CC science.
- Examples:

➢ 63% to 30% consider scientists' claims about CC are valid.

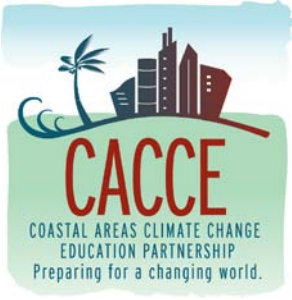
  ➢ 63% consider scientists' claim that the climate system is warming as valid. (no human-caused references)

  ➢ 41-49% consider statements referring to anthropogenic causes of CC as valid.

  ➢ Only 30% consider scientists' projections about sea level rise as valid.

Student Survey (Cont.)

- Many Florida marine science students possess naïve views about CC science.
  - ~45% agreed that CC science needs to be based on controlled experiments in order to be valid. *~30 % unsure*
  - ~50% think scientists must follow pre-set procedures to develop valid evidence & conclusions about CC. *~30% unsure*
  - ~35% consider CC research & accounts cannot represent reality because CC data is often not based on direct observations. *27% unsure*
  - ~45% think climate scientists' ideas about CC must perfectly reflect the data. *28% unsure*



MULTIPLE OUTCOME INTERDISCIPLINARY RESEARCH AND LEARNING (MOIRL)

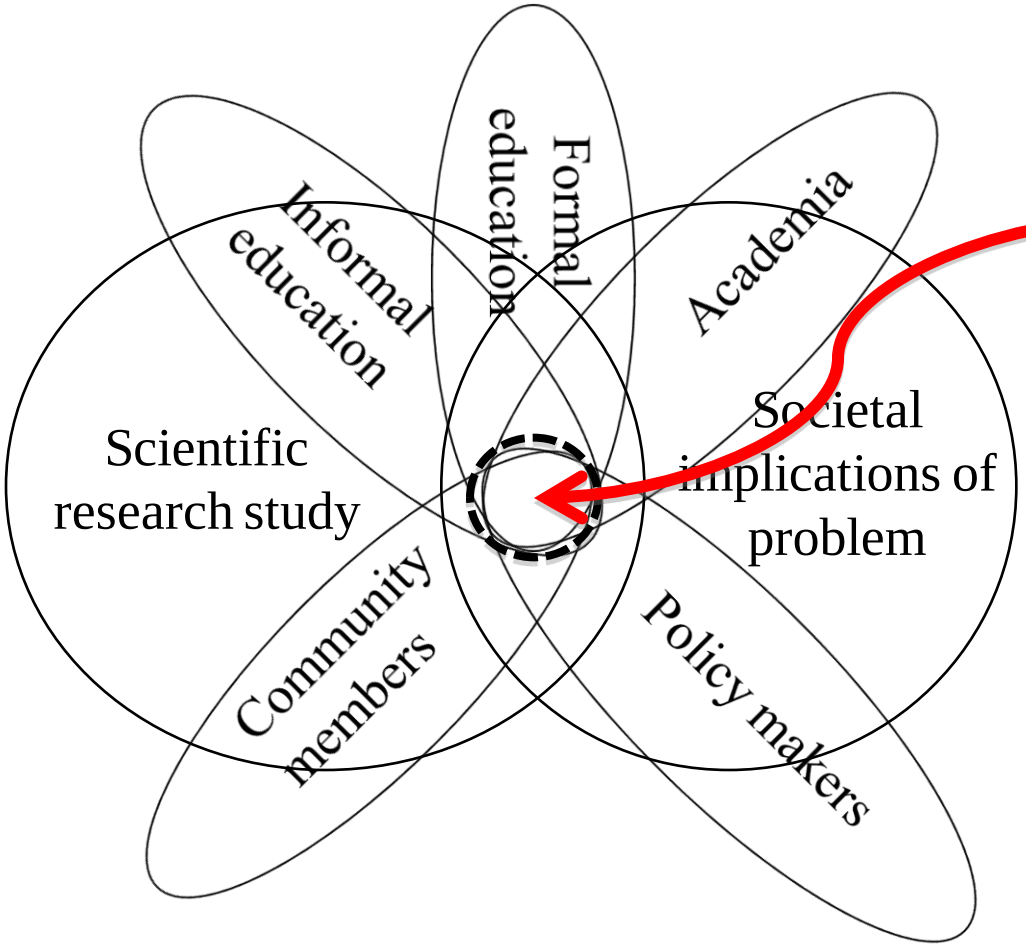
MOIRL

- Multiple Outcome: allows for people and organizations to work together without necessarily having the same immediate goals.
- Interdisciplinary: builds on expertise from more than one discipline
- Research and learning: assumes that people learn when engaged in research

MOIRL (Cont.)

- MOIRL is *transdisciplinary*: includes expertise inside and outside of the university:
  - students (K-16 and graduate);
  - teachers and educational researchers;
  - informal science educators;
  - scientists and engineers;
  - business and industry;
  - policy makers; and
  - community members

MOIRL (Cont.)


Informal education
Formal education
Academia
Scientific research study
Societal implications of problem
Community members
Policy makers
MOIRL

MOIRL (Cont.)

- Algal biofuels: Middleton HS
- Phenology: Stewart MS
- Perceptions Toward Storm Surge, Future Sea Level Rise, and Evacuation: Liberty MS
- Sea Level Change Effects on Tampa Bay and the Hillsborough River: Stewart MS
- Water Awareness Research & Education: Weather, CC and Adaptation: Franklin and Young MS
- Cave deposits & climate: Camuy Caves, PR

Algal biofuel production

Sarina Ergas and Trina Halfhide (USF Eng), Angela Chapman (USF COE); Patricia Dodson and Jessica Copeland (Middleton HS)

Overall anticipated goal: Students will gain an **understanding of biological and chemical principles influencing algal growth** through **this authentic research science experience** with USF.

Each group will be testing the **influence of a manipulated variable** on its influence on growth. Students will be responsible for individual tasks in their respective group. Responsibilities include: collecting samples, analytical chemistry, collating data, results, and report writing.

Students will initially learn the fundamental principles of algal growth, **design their experiments and subsequently execute experiments** over a 6-week period. Over this period, there will 2 experimental runs.

Algal biofuel production

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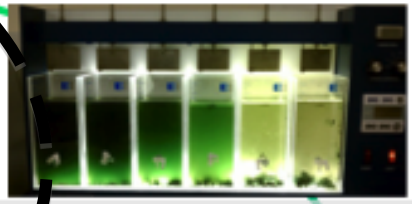
Growth Media
A mixture of wastewater streams are used to feed reactors.

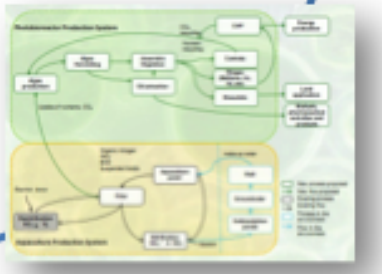
Algae Growth in Photobioreactors
Optimizing growth and biomass nutrient removal.



Harvesting Experiments
Determines optimal dose of coagulants to be used.

Gas CO_2 Exchange Experiments
Maximize efficiency in gas delivery.

Analytical Chemistry
Determines how efficient algae are at removing the nutrients



Overall Process Modeling
Examines the cost and energy inputs of all process.

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Algal biofuel production student bioreactor prototype

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Phenology and Climate Change

George Kish (USGS) and Meghan Lindsey (USF CAS), Lynn McDaniel and Pat McFarlin (Stewart MS)

"Phenology is the study of recurring plant and animal life cycle stages, especially their timing and relationships with weather and climate."

- Middle School students are observing phenology, temperature, and precipitation at two locations within the Hillsborough River Watershed; Crystal Springs Preserve and Stewart Middle School gardens and riverside restoration site.

Phenology and Climate Change
(Cont.)

- Up to 5 plants, 3 birds, and 3 pollinators (butterflies or bees) common to each location will be studied. Students will develop a portfolio of maps, plant and animal information, and data about their observations. Data will include different life-cycle events observed during the school year.
- Workshops on phenology and climate change for teachers about identifying the plants and animals and recording phenology observations, and using Nature's Notebook (at the USA-National Phenology Network web site) for learning about plants and animals and managing student data.

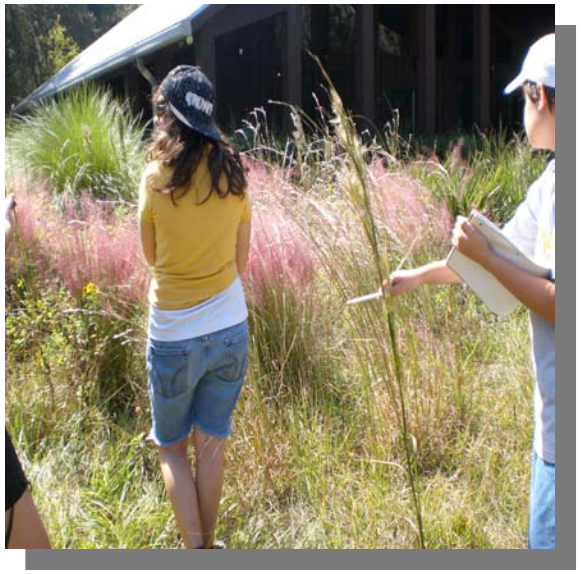
Phenology and Climate Change (Cont.)

- Expected outcomes:
  - Students will walk away from this project understanding that climate change affects the timing of life cycle events in plants and animals.
  - Students will be inspired to develop experiments about how satellite data could be used to document climate change impacts in the Southeast in the future.

Phenology and Climate Change
(Cont.)

The next steps:

- Buy plants that are found at Crystal Springs Preserve for the Stewart Middle School gardens to increase the number of plants common to both sites to observe.
- Plant and establish the plants
- Prepare a plant profile and phenophase image for each plant
- Assemble a workbook and web information and image repository
- Pre-label plant data sheets
- Begin observing plants, pollinators, and birds.



Perceptions Toward Storm Surge, Future Sea, Level Rise and Evacuation

Jennifer Collins (USF CAS), Nicolle Weis (USF CAS), Charles Paxton (US Weather Service), Brandon Zawicki and Andria Keene (HCPS)

- The purpose is to provide effective warning information to communities vulnerable to climate change to prevent large loss of human life in the future.
- High school students will survey and interview community members and then work with USF faculty and students to assess the community's knowledge about climate change with a focus on rising sea level, storm surge, and rainfall related hazards.
- The survey results will be evaluated by the NWS to provide call to action statements with more effective wording.

Sea Level Change Effects on Tampa Bay and the Hillsborough River

Frank Muller-Karger and Juan Carlos Millán (USF CMS), Lynn McDaniel and Pat McFarlin (Stewart MS)

- Local data from weather stations and tide gauges will help students understand both short-term processes (weather, tides) and what they mean in terms of long-term and global patterns (i.e. climate, sea level rise).
- Sea level rise is an important consequence of climate change, which affects coastal communities. Better understanding of this process will help develop strategies for adaptation.

Initial finding: The concept of sea level is not taught in US schools!

Cave deposits & climate: Camuy Caves, PR

Bogdan Onac (USF CAS) ,Vanessa Vernaza-Hernández (USF COE), Mora (Adela Rolón Fuentes, Toa Alta HS), Abigail Resto (Adolfina Irrizary de Puig, Toa Baja HS), and Janet Maldonado (Onofre Carballeira , Cataño MS)

- The purpose of the Camuy Cave Project is to help students to understand how cave deposits provide clues to climate change.
- The students learn how through the study of caves can provide information on how climate has changed over time, and how it can be used to predict future changes in climate and sea level.

Cave deposits & climate: Camuy Caves, PR (Cont.)

- The students made an educational visit to the Camuy Cave.
- Bogdan, Vanessa, and the teachers explained to the students different aspects about the formation, structure and characteristics of the caves, and how scientists can obtain information about climate change through the study of the caves

Cave deposits & climate: Camuy Caves, PR (Cont.)

- A set of data loggers were installed to automatically measure temperature and relative humidity (inside and outside the cave every hour for a year).

- Drip water and precipitation will be collected at 2 week periods for a year.

Cave deposits & climate: Camuy Caves, PR (Cont.)

- Students will analyze the data from the data loggers and water samples.
- With this information and data the students will develop a scientific poster which will be exhibited at the Park Visitor Center of the Camuy Cave so that the results can reach the wider community.
- A mixed-methods approach is used for this project. The data collection methods are: Students Survey, Pre-PostTest, and Observation.

Cave deposits & climate: Camuy Caves, PR (Cont.)

- Climate Change - Results

Item	Agree		Disagree		Unsure	
	Pre	Post	Pre	Post	Pre	Post
1. I can explain the difference between climate and weather.	39%	90%	12%	5%	47%	5%
2. Climate change is happening naturally.	78%	84%	13%	13%	7%	3%
3. Scientists have evidence that global climate is changing	83%	95%	1%	0%	14%	5%
4. Most scientists agree that global climate is changing.	72%	49%	6%	47%	21%	5%
5. Human activity affects the climate.	69%	98%	18%	2%	12%	0%
6. We don't have to worry about the rise in sea level caused by climate change because the sea rises and falls every day with the tides.	15%	7%	67%	94%	14%	0%
7. Only people who live near the coast would be affected by sea level rise.	33%	52%	52%	46%	12%	2%

Cave deposits & climate: Camuy Caves, PR (Cont.)

- Cave - Results

24. Which of the following options defines what science Karst is?

Pre	Post	
19%	3%	a. Set of rock formation as a result of the rock dissolution by water.
14%	3%	b. The study of volcanic rock found in caves.
31%	**92%**	c. The study of a particular landscape generated when water dissolves soluble rocks.
20%	2%	d. The scientific study of the formation of the springs inside the cave.
16%	0%	missing

Cave deposits & climate: Camuy Caves, PR (Cont.)

- Cave – Results (Cont.)

25. Which of the following factors are required to produce karstification? (Select all that apply)

	Pre	Post	
✓	52%	95%	a. Presence of water
✓	30%	92%	b. Appropriate structural and textural conditions.
✓	46%	92%	c. Soluble rocks
	33%	3%	d. Presence of salt.

Cave deposits & climate: Camuy Caves, PR (Cont.)

- Cave – Results (Cont.)

26. Which of the following factors allow the process that leads to the development of a cave?

Pre	Post	
21%	7%	a. Geological Factors, Climatic Factors and Architectural Factors.
36%	**75%**	b. Geological Factors, Climatic Factors and Biotic Factors.
19%	7%	c. Climatic Factors, Biotic Factors and Architectural Factors.
17%	11%	d. Geological Factors, Biotic Factors and Architectural Factors.
7%	0%	Missing value

Cave deposits & climate: Camuy Caves, PR (Cont.)

- Cave – Results (Cont.)

27. Once a soluble rock comes in contact with water, the cave forming processes are activated. Which are three common phases that allow the generation of a karst system?

Pre	Post	
21%	5%	a. Formation of soluble rocks, widening of conduits, and water evaporation.
21%	5%	b. Formation of conduits, creation of conduit of air, and drying the rock.
35%	8%	c. Formation of preferred drainage network, accumulation of groundwater, and formation of soluble rocks.
11%	**79%**	d. Formation of conduits, formation of preferred drainage network, and widening of conduits.
12%	3%	Missing value

Cave deposits & climate: Camuy Caves, PR (Cont.)

- Cave – Results (Cont.)

28. What does contain the water in the caves that allows the formation of stalactites and stalagmites?

Pre	Post	
67%	**93%**	a. Dissolved Mineral
12%	0%	b. Salt
7%	2%	c. Sand
7%	2%	d. Bacteria
7%	3%	Missing value

29. How cold periods are recognized in caves?

Pre	Post	
12%	5%	a. Large amounts of vegetation.
16%	**77%**	b. Large quantities of detrital sediment.
34%	10%	c. Carbonate deposits in crystalline form.
32%	7%	d. Formation of limestone rock.
6%	1%	Missing value

Cave deposits & climate: Camuy Caves, PR (Cont.)

- Cave – Results (Cont.)

30. How warm periods are reflected in cave deposits?

Pre	Post	
11%	2%	a. Large amounts of vegetation.
30%	8%	b. Large quantities of detrital sediment.
20%	**82%**	c. Carbonate deposits in crystalline form.
31%	5%	d. Formation of limestone rock
8%	3%	Missing value

31. How can scientists extract climate information from cave deposits?

Pre	Post	
26%	7%	a. Measuring the amount of accumulated water in the cave.
23%	**84%**	b. Through the study of stalagmites and stalactites.
18%	3%	c. Extracting soluble rocks from the caves.
27%	3%	d. Recording the temperature of ground water.
6%	3%	Missing value

Water Awareness Research & Education: Weather, CC and Adaption

Maya Trotz and Ryan Lociero (USF Eng), Angela Chapman (USF COE), Krysta Porteus (Young MS) and Bethany Tilson (Franklin MS)

- Storm water ponds are used as field sites to study the hydrologic cycle and the nature of science.
- Climate and weather distinctions will be explored through the use of a weather station to be installed at one of the ponds.
- Students will educate the community through a kiosk to be built at the pond. The kiosk will house a weather station and will include information about how stormwater ponds are related to current climate change.

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FLORIDA PUBLIC SCHOOLS

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Florida Public School Structure

67 school districts organized by county (municipality)

K-5, primary grades; 6-12, secondary grades

All grade levels are standards driven, but local communities determine curriculum (instructional materials, pacing, etc.) and instructional methodologies (literacy strategies, inquiry-based learning, etc.)

High-stakes assessments

Hillsborough County Public Schools

193,000 students

250 schools

17,000 teachers

8th largest school district in the United States (3rd largest in Florida)

Educational leader in innovative methods (Bill & Melinda Gates grant of $202 million in 2009)

Problems with K-12 Climate Change Education K-12 in Florida

- Little emphasis in state or local benchmarks on climate science and impacts
- Very few “officially” adopted resources
- Teacher content knowledge/belief systems

Benchmark	Descriptor	Grade Level	HS Courses
SC.5.E.7.6	Describe characteristics (temperature and precipitation) of different climate zones as they relate to latitude, elevation, and proximity to bodies of water.	5	N/A
SC.6.E.7.2	Investigate and apply how the cycling of water between the atmosphere and hydrosphere has an effect on weather patterns and climate.	6	N/A
SC.6.E.7.6	Differentiate between weather and climate.	6	N/A
SC.912.E.7.4	Summarize the conditions that contribute to the climate of a geographic area, including the relationships to lakes and oceans.	9-12	Marine Science
SC.912.E.7.7	Identify, analyze, and relate the internal (Earth system) and external (astronomical) conditions that contribute to global climate change.	9-12	Astronomy Earth/Space Science Marine Science
SC.912.E.7.9	Cite evidence that the ocean has had a significant influence on climate change by absorbing, storing, and moving heat, carbon, and water.	9-12	Earth/Space Science Marine Science
SC.912.L.17.4	Describe changes in ecosystems resulting from seasonal variations, climate change and succession.	9-12	Biology Marine Science
SC.912.L.17.8	Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, non-native species.	9-12	Biology Marine Science

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WORKING PLAN FOR CLIMATE CHANGE EDUCATION IN SECONDARY SCHOOLS

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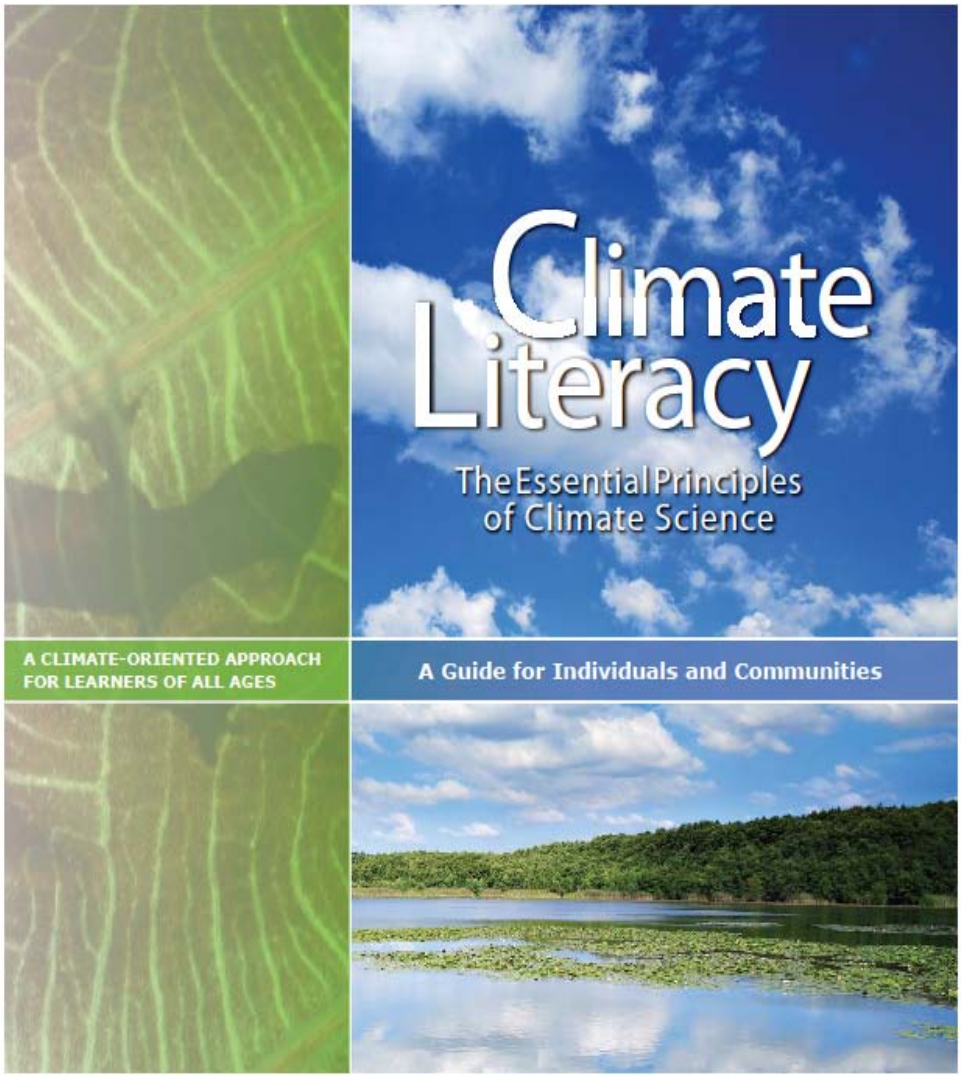

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CACCE Climate Change Education Plan Framework (5 objectives)

- CACCE's formal educational efforts will focus on helping educators and students:

1. Demonstrate a fundamental and working understanding of CC and CC science especially as it relates to the built environment.

2. Demonstrate a fundamental and working understanding of the interrelation among the natural environment, built environment, and social, economic and political aspects in the context of CC in coastal regions.

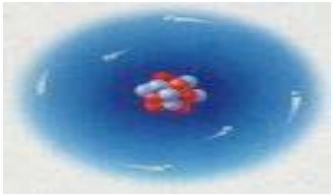
CACCE Climate Change Education Plan Framework (5 objectives)

- CACCE's formal educational efforts will focus on helping educators and students:

3. Critically analyze CC and CC science information and the sources of that information.
4. Effectively communicate about CC and CC science.
5. Engage in informed and responsible decision making related to CC.

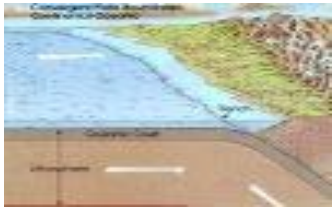
Aquariums

History & Technology

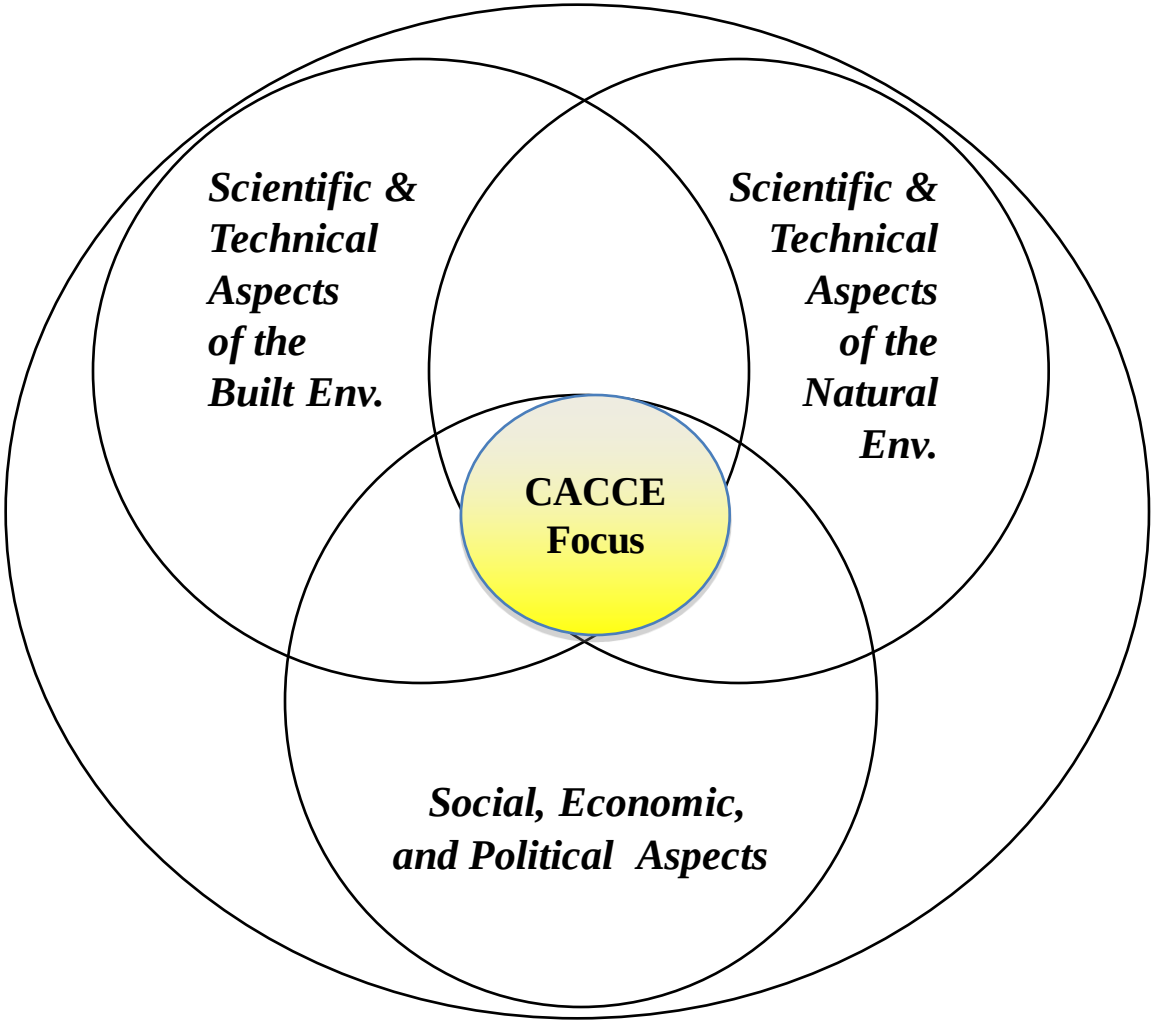


Chemistry

Physics



Geology



Climate Change in Coastal Regions

Ecology

Populations

Environment

Human Impacts

Formal Program Development

- Develop learning modules aligned with the marine science curriculum and based upon the following:
  - Narrative in nature (storyline)
  - Local, site-specific scenarios (place-based)
  - Real life data (used in simulations or other components)
  - Project/problem-based learning (design challenges or inquiry)

Formal Program Development

- Draft Timeline of Activities:

2012-13: Develop CC modules for Marine Science course

Professional development for teachers

2013-14: Full implementation of CC modules in HCPS

Revision of modules

Professional development of teachers

2014-17: Implementation of CC modules in partner districts

Professional development of teachers

Formal Program Development

- Still to be considered…
  - Specific focus of modules/narrative
  - Who will write the modules?
  - Who will provide professional development for teachers?
  - How will the formal education component align with other components of CACCE?

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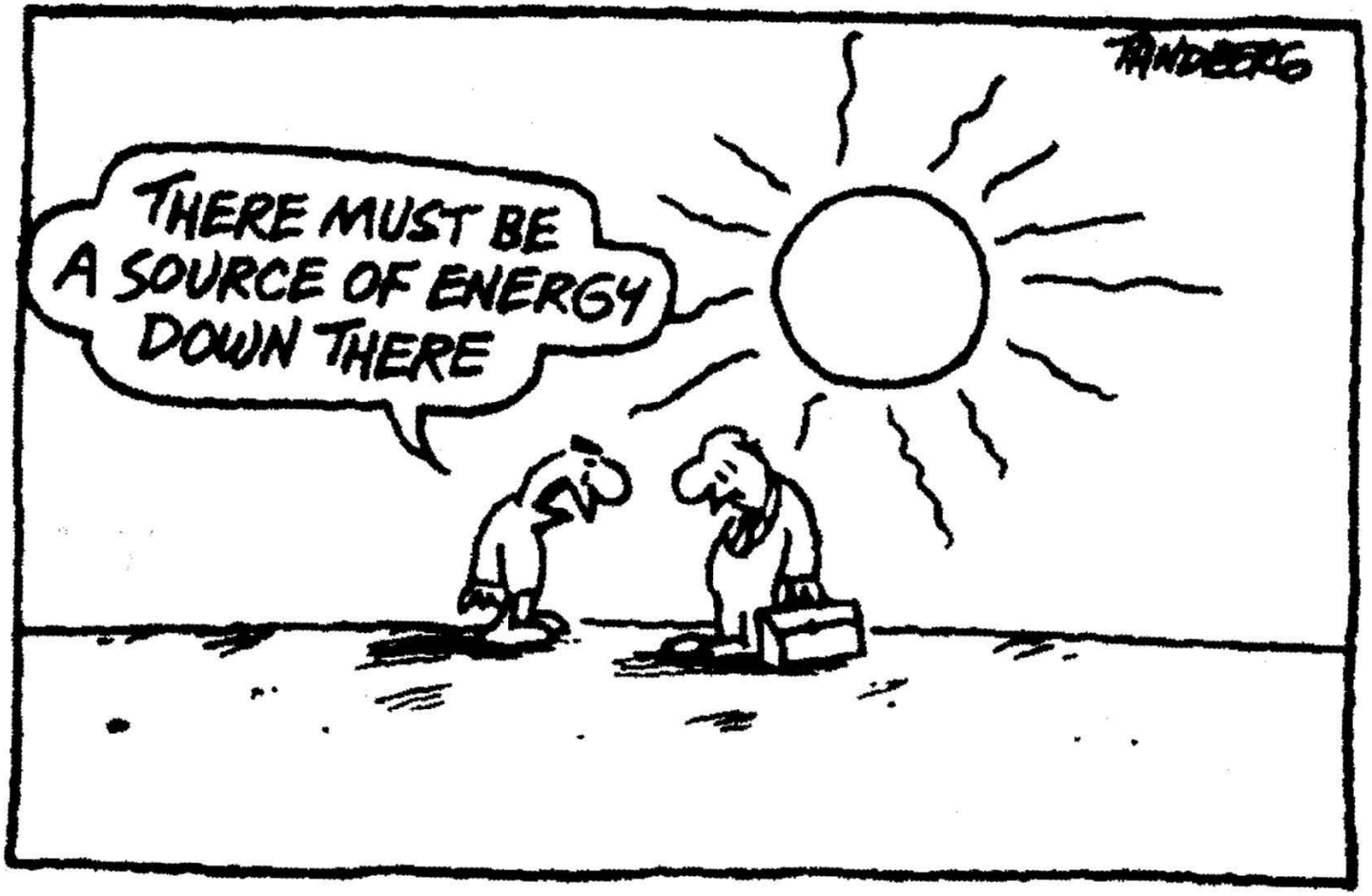

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QUESTIONS?

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Thank You