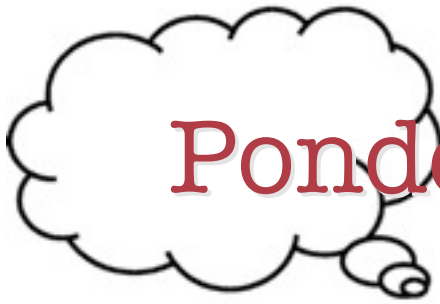

Ponder This

Contact a colleague in this webinar through the text box or talk to someone next to you & record ideas in the text box. Type your answers to these questions to each other.

1. Describe a moment when you thought you were at your best teaching – or you saw someone else doing it. What was especially effective about it?

2. What do you want your learners to learn when they participate in your programs?

Objectives for Today's Session:

- To share research and theory on learning and teaching science in informal environments.
- Discuss how educators can facilitate learners making meaning about science.
- Discuss how your practice helps learners build understanding and the knowledge, skills and tools your CYFAR project requires.

Today's Agenda

- Learning & Meaning-making
  - Role of informal science
  - How people learn, constructivism & prior knowledge
- Concepts, Content and Nature of Science
  - What is the Nature of Science?
  - Inquiry & subtle shifts
  - Ocean and Climate Literacy & Scope and sequence
- Curriculum components to meet your project goals

LHS

Role of informal environments in learning & doing science

- Contrary to the idea that schools are responsible for addressing the scientific knowledge needs of society, schools cannot act alone and individuals spend as little as 9% of their lives in schools.
- Science in school is often marginalized by emphases on math & literacy, and much of school science focuses on received knowledge & simplistic notions of scientific practice.
- Society needs to draw creatively on all available resources to improve science literacy & address serious societal issues, such as climate change. People of all ages need to understand science as they grapple with science-related issues in their everyday lives.
- Learning science in informal environments has the potential to bolster science education on a national scale.

LHS

Strands of Informal Science Learning

1. Developing interest in science
2. Understanding science knowledge
3. Engaging in scientific reasoning
4. Reflecting on science
5. Engaging in scientific practice
6. Identifying with the scientific enterprise

From *Surrounded by Science: Learning Science in Informal Environments*, National Research Council, 2009

Ponder This

Please write in this space your ideas about:

- In your practice, how do you allow for your learners to <u>make sense</u> of the science?

Ponder This

Please write in this space your ideas about:

- How & why do you access learners' prior knowledge and what do you do with it after you access it?
- What affect does learners' prior knowledge have on their learning experiences?

Key Ideas from Literature: *about learning & meaning-making*

- Knowledge is acquired through active construction & learners' prior knowledge & experiences are important.
- Learners "construct" their understanding of the world through an active process of engaging and manipulating objects, experiences & conversations, based on social interactions & motivation.
- Social & cultural interactions with peers & educators are necessary to construct knowledge - ideas are shared & meaning making is created & expanded by interaction with their environment.
- People learn by participating in social situations - language is used to familiarize ideas and concepts into complex networks of knowledge

LHS

From the Literature: *about Prior Knowledge*

— Learners need to draw on existing resources in their conceptual framework—the things they already understand in some context or that make sense to them, their prior knowledge. Drawing on and connecting to these resources is essential if the new understanding is going to be comprehensible to them.

— The knowledge system of learners consists of an unstructured collection of many simple elements (prior knowledge) that originate from everyday interpretations of the world. The process of building understanding is one of collecting and systemizing these pieces of simple elements into larger wholes.

LHS

More about prior knowledge

— Informal ideas are not simply personal views of the world, but reflect a shared view represented by a shared language. This shared view constitutes a socially-constructed "commonsense" way of describing and explaining the world.

— Learners' prior ideas, their common sense, and everyday thinking, are intelligent and useful. If those ideas are not engaged, learners often dismiss science teaching as irrelevant.

— Learners reveal their thinking—how they conceptualize the scientific concepts and ideas—through their comments, explanations, and responses in conversations, writing, observations, interactions, and illustrations.

LHS

Teaching Strategies based on constructivist theory

- Make connections **explicit** between new learnings and previously learned knowledge.
- Engage and motivate learner with interesting, culturally/socially relevant activities & experiences that allow learner to discover, infer, reflect & apply.
- Learners, peers, & educators engage in **meaningful conversations** about the experiences and content. The opportunity to explain to oneself & to others improves understanding.
- Learners engaged in reflective discussions with broad questions to encourage them to articulate thoughts & use language of science.
- Learners are engaged in metacognition (thought about thought) to help construct new representations of concepts.
- Learners offered opportunity to express their everyday views & then later see how these views relate to the science perspective.
- Part of learning science is learning to talk science - tools of talk e.g. questioning, explaining, predicting, reasoning may need to be learned

LHS

Connecting back to your prior knowledge

- What affect does learners' prior knowledge have on their learning experiences?
- What would you say is the take home message for YOU from this discussion?

Today's Agenda - take 2

- Learning & Meaning-making
  - Role of informal science
  - How people learn, constructivism & prior knowledge

- Concepts, Content and Nature of Science
  - What is the Nature of Science?
  - Inquiry & subtle shifts
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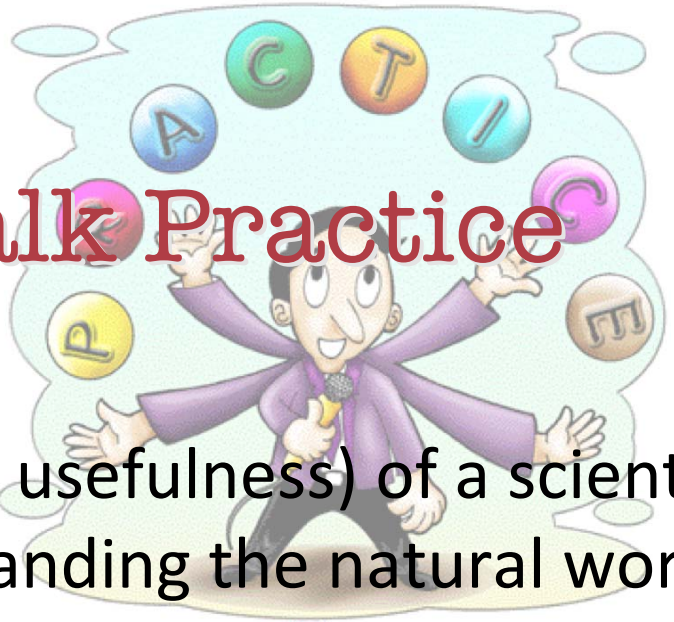
- Curriculum components to meet your project goals

LHS

What is Science?

http://www.synergizedsolutions.com/simpsons/pictures.shtml

Let's Talk Practice



- What is the value (or usefulness) of a scientific approach to understanding the natural world?
- How is a scientific view distinct from other ways of knowing?
- How is determining the "nature & practices of science" relevant to your practice?
  - *Hmmmm…what do you all think? Pick one of these questions and share/write down a few thoughts - to a colleague or to all of us on the white board or phone.*

Share a few ideas here or on the phone…

- What is the usefulness of a scientific approach to understanding the natural world?
- How is a scientific view distinct from other ways of knowing?
- How is determining the "nature & processes of science" relevant to your practice?

Ideas from the Literature: *About Science*

A. Science is evidence-based, consistent, durable, peer-reviewed, self-correcting & based on observations & hypotheses within a testable framework of ideas.

B. Science is a social enterprise and relies on cooperation and diversity of scientific thinking.

C. Science is a subculture & science education is a cultural enterprise. Science is a way of looking at the world that may be distinct from other worldviews based on culture & socioeconomics, including everyday ways of thinking & talking about the world.

D. Imagination & creativity often play a role in science. Evidence is collected, interpreted and influenced by current scientific perspectives and by the society, culture and even the scientists' personal subjectivity.

E. Scientific knowledge and explanations are accepted based on consistency and strength of argument.

Do opinion poll 1) which statements do you agree with/resonate with you & 2) which statements do you tend to disagree with or you have questions about?

LHS

Inquiry and the National Science Standards

- Learners are engaged by scientifically oriented questions.
- Learners give priority to evidence, which allows them to develop and evaluate explanations.
- Learners formulate explanations from evidence to address scientifically oriented questions.
- Learners connect their explanations to scientific knowledge.
- Learners communicate and justify their proposed explanations.

From *Inquiry and the National Science Education Standards*, Chap.2, pp. 24-27

Breakdown of Inquiry Emphasis

NSES	Out of School
Exploration	Exploration
Investigation	Investigation
Explanation	Explanation
Generalization	Generalization

Table 2.–6. Essential Features of Classroom Inquiry and Their Variations

Essential Feature	Variations			
1. Learner engages in scientifically oriented questions	Learner poses a question	Learner selects among questions, poses new questions	Learner sharpens or clarifies question provided by teacher, materials, or other source	Learner engages in question provided by teacher, materials, or other source
2. Learner gives priority to **evidence** in responding to questions	Learner determines what constitutes evidence and collects it	Learner directed to collect certain data	Learner given data and asked to analyze	Learner given data and told how to analyze
3. Learner formulates **explanations** from evidence	Learner formulates explanation after summarizing evidence	Learner guided in process of formulating explanations from evidence	Learner given possible ways to use evidence to formulate explanation	Learner provided with evidence
4. Learner connects explanations to science knowledge	Learner independently examines other resources and forms explanations	Learner directed towards sources of scientific knowledge	Learner given possible connections	
5. Learner communicates and justifies proposed explanations	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to use and sharpen communication	Learner given steps and procedures for communication

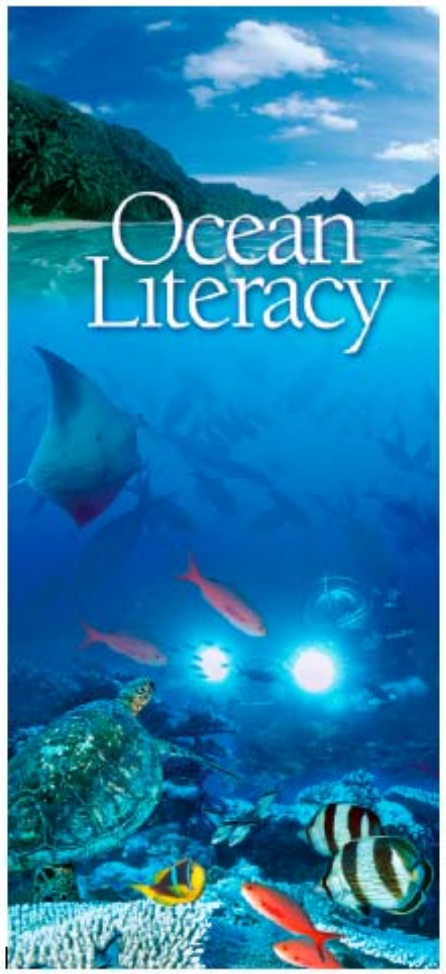
More----------Amount of Learner Self–Direction----------Less

Less----------Amount of Direction from Teacher or Material----------More

Ocean Literacy

The 7 Essential Principles

- *Earth has one big ocean with many features*
- *The ocean and life in the ocean shape the features of the earth*
- *The ocean is a major influence on weather & climate*
- *The ocean makes Earth habitable*
- *The ocean supports a great diversity of life and ecosystems*
- *The ocean and humans are inextricably interconnected*
- *The ocean is largely unexplored*



3 The ocean is a major influence on weather and climate.

a The ocean controls weather and climate by dominating the Earth's energy, water and carbon systems.

b The ocean absorbs much of the solar radiation reaching Earth. The ocean loses heat by evaporation. This heat loss drives atmospheric circulation when, after it is released into the atmosphere as water vapor, it condenses and forms rain. Condensation of water evaporated from warm seas provides the energy for hurricanes and cyclones.

c The El Niño Southern Oscillation causes important changes in global weather patterns because it changes the way heat is released to the atmosphere in the Pacific.

d Most rain that falls on land originally evaporated from the tropical ocean.

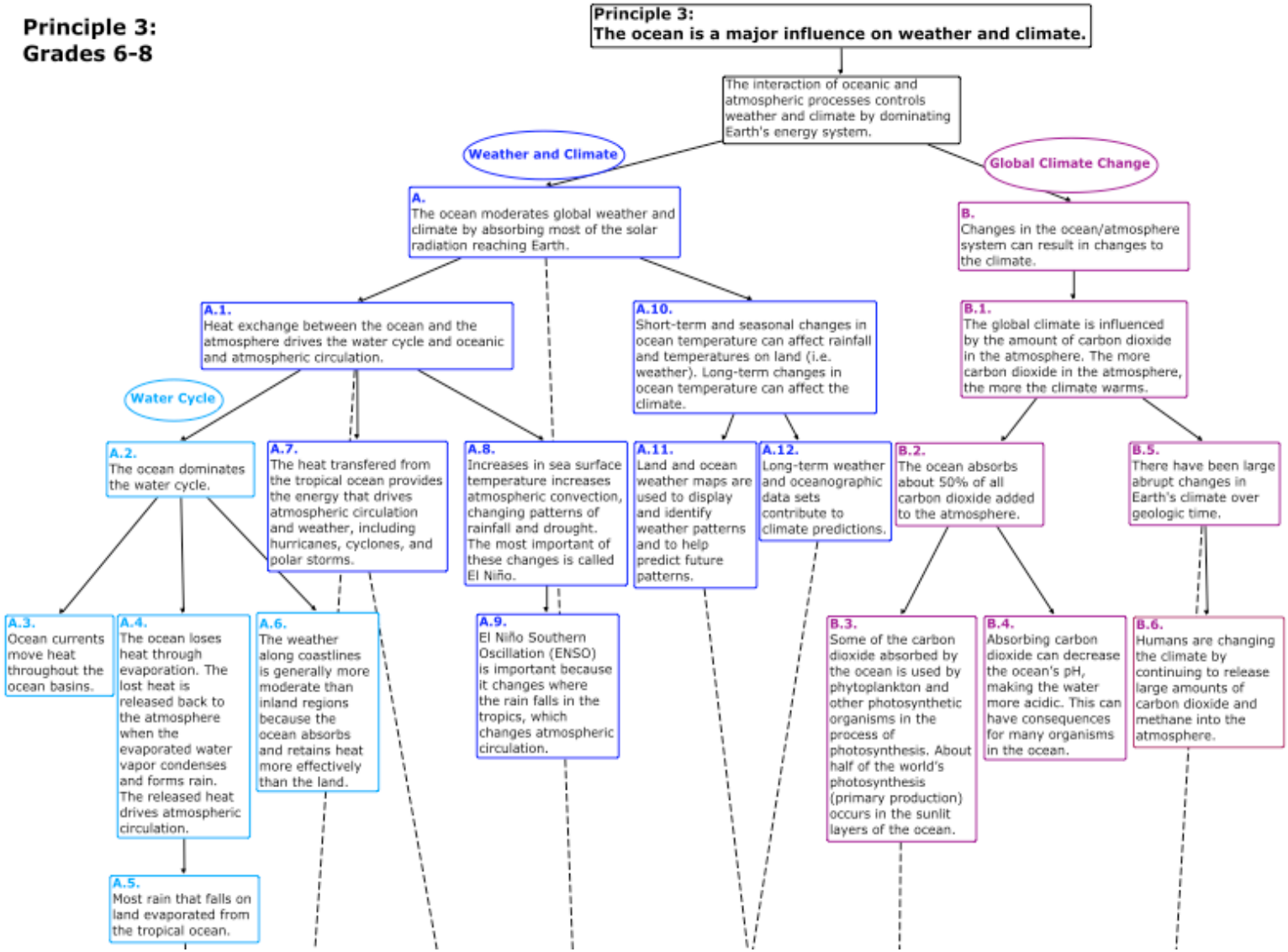
e The ocean dominates the Earth's carbon cycle. Half the primary productivity on Earth takes place in the sunlit layers of the ocean and the ocean absorbs roughly half of all carbon dioxide added to the atmosphere.

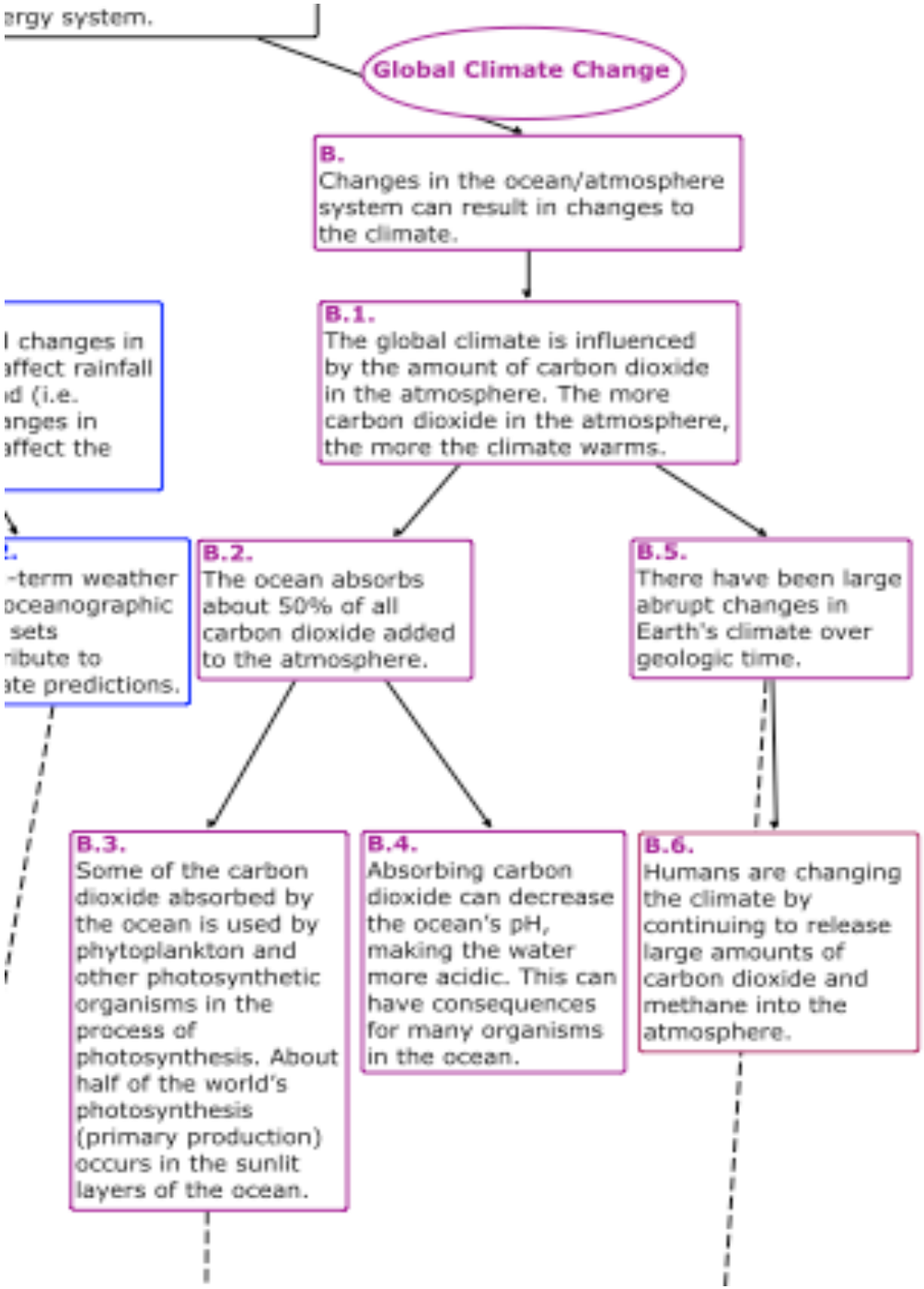
f The ocean has had, and will continue to have, a significant influence on climate change by absorbing, storing, and moving heat, carbon and water.

g Changes in the ocean's circulation have produced large, abrupt changes in climate during the last 50,000 years.

NATURAL PHENOMENON. A rotating column of air (similar to a tornado) creates this water spout in the Gulf of Mexico near an offshore oil rig.

Principle 3:
Grades 6-8




ergy system.
Global Climate Change
B.
Changes in the ocean/atmosphere system can result in changes to the climate.
l changes in affect rainfall d (i.e. anges in affect the
B.1.
The global climate is influenced by the amount of carbon dioxide in the atmosphere. The more carbon dioxide in the atmosphere, the more the climate warms.
-term weather oceanographic sets ribute to te predictions.
B.2.
The ocean absorbs about 50% of all carbon dioxide added to the atmosphere.
B.5.
There have been large abrupt changes in Earth's climate over geologic time.
B.3.
Some of the carbon dioxide absorbed by the ocean is used by phytoplankton and other photosynthetic organisms in the process of photosynthesis. About half of the world's photosynthesis (primary production) occurs in the sunlit layers of the ocean.
B.4.
Absorbing carbon dioxide can decrease the ocean's pH, making the water more acidic. This can have consequences for many organisms in the ocean.
B.6.
Humans are changing the climate by continuing to release large amounts of carbon dioxide and methane into the atmosphere.

Today's Agenda - take 3

- Learning & Meaning-making
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- **Curriculum components to meet your project goals**

Curriculum Components

- Based on how people learn and make-meaning
  - Constructing knowledge through experiences, prior knowledge, & social interactions
  - Learning cycle (invitation, exploration, concept invention, application and reflection)
- Relevance, Action & Impact
  - opportunity to engage effectively with problem/issue
  - service learning opportunities in community
- Collaboration & Communication
  - opportunity to share learnings & be accountable
  - opportunity to make sense with others (peers & experts)
- Focus on Key Science Concepts
- Identify with science enterprise
  - Opportunity to consider science careers

LHS

Self Reflection

- What did you find most interesting, thought-provoking, or applicable to your practice from today's session?

Thanks for all you do!