Nature & Practices of Science

What is Science and how is it done?

Sorting Statements about Science

- Read each statement out loud.
- Discuss which statements are

  Accurate or Inaccurate.
- Give reasons for your position on each statement as you sort.
- How does your discussion inform your ideas about what science is and isn't?

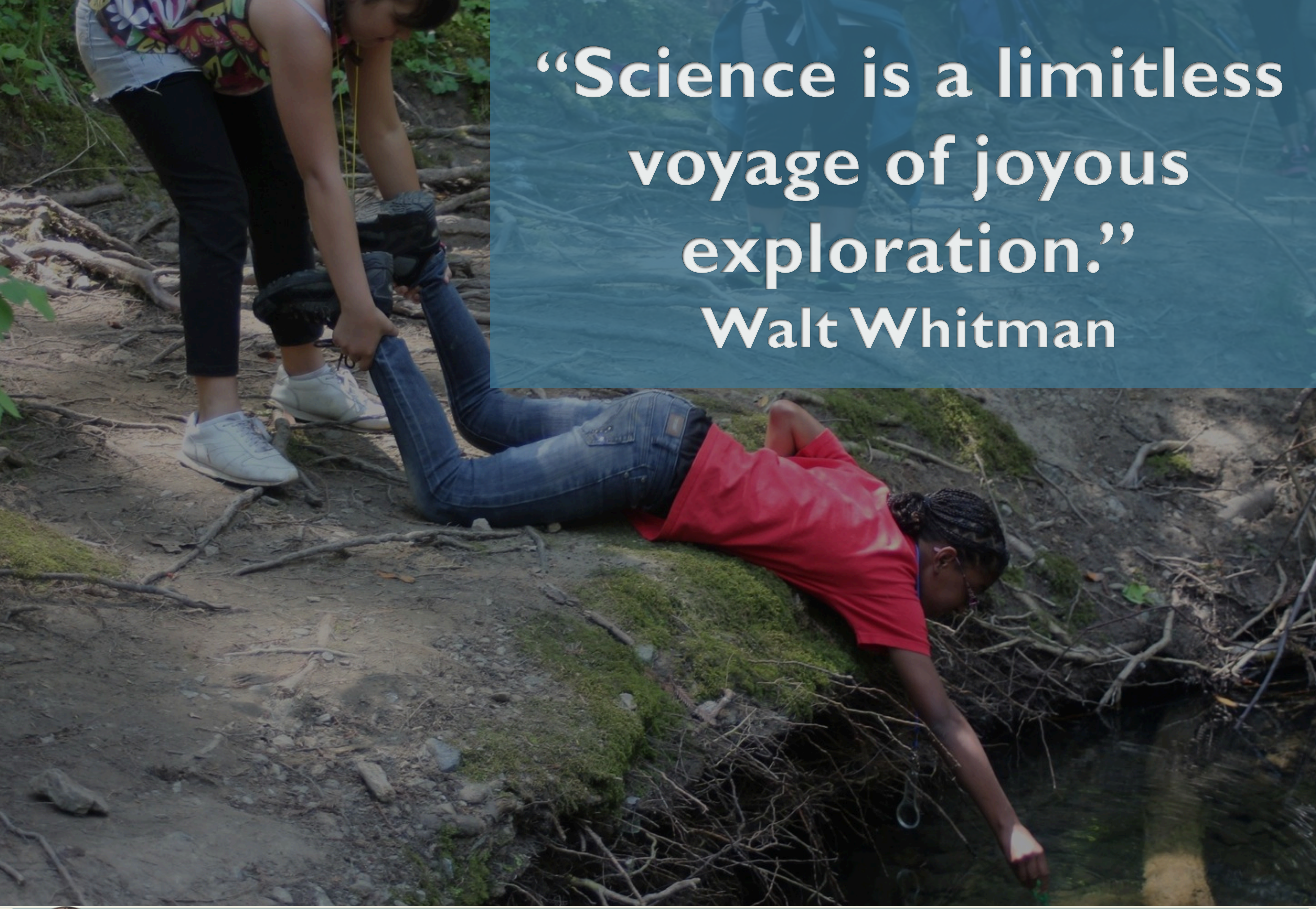
Understanding Science
how science *really* works

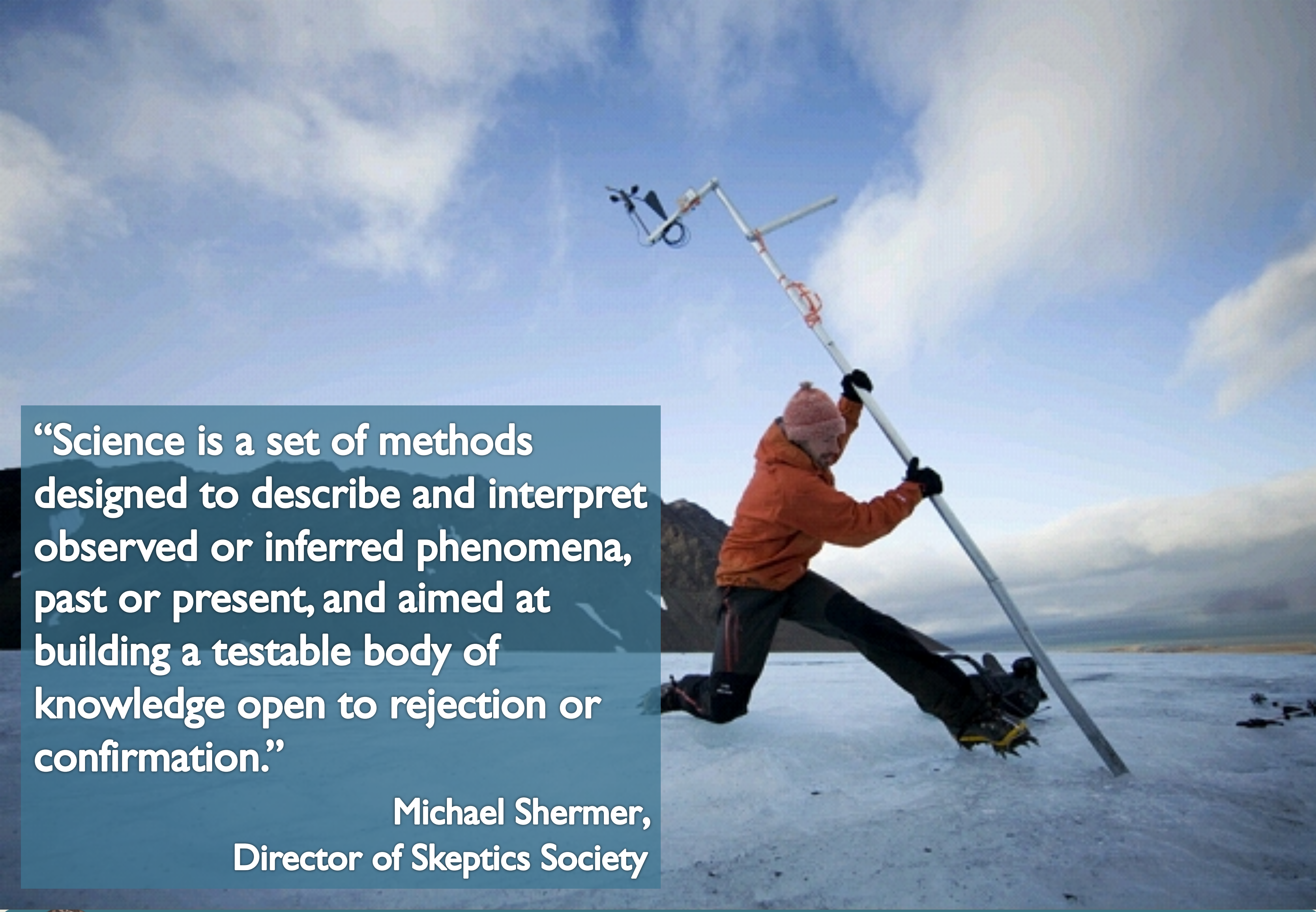
UCMP

(University of California Museum of Paleontology)

Understanding Science

http://undsci.berkeley.edu/


"Science is a limitless voyage of joyous exploration."
Walt Whitman



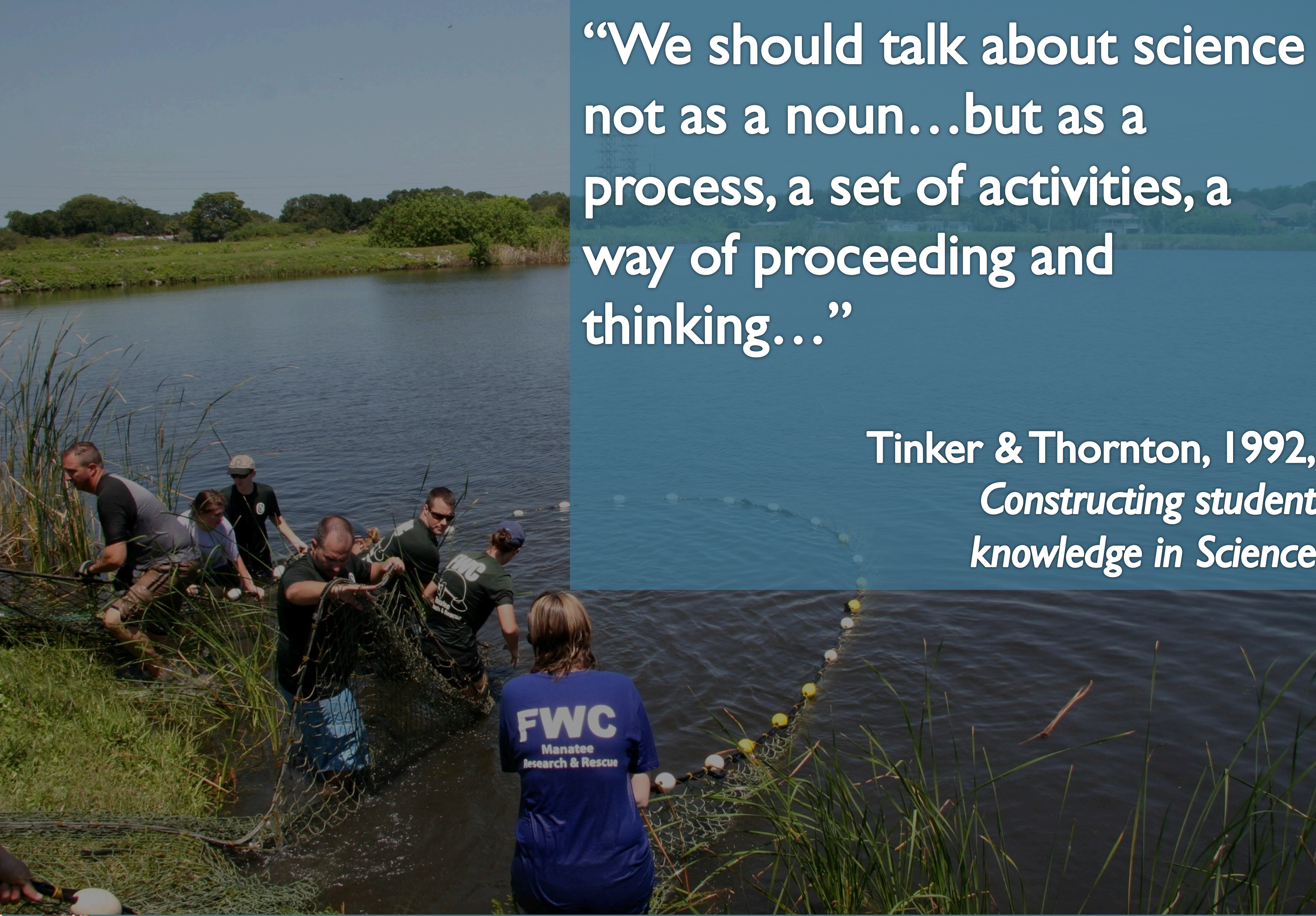
"Science is a set of methods designed to describe and interpret observed or inferred phenomena, past or present, and aimed at building a testable body of knowledge open to rejection or confirmation."

Michael Shermer,
Director of Skeptics Society

"Science is a limited way of knowing, looking at just the natural world and natural causes.

There are a lot of ways human beings understand the universe—through literature, theology, aesthetics, art or music."

Dr. Eugenie Scott
Executive Director
National Center for Science Education



"We should talk about science not as a noun…but as a process, a set of activities, a way of proceeding and thinking…"

Tinker & Thornton, 1992,
Constructing student
knowledge in Science

Science is...

- investigating using a variety of methods
- based on testable evidence
- open to revision
- explaining natural phenomena
- order and consistency
- a human endeavor

Activity Instructions

- Silently read the handout
- Discuss it with your small group
- Talk about how these ideas were represented in the student activities
- Be ready to share with the whole group

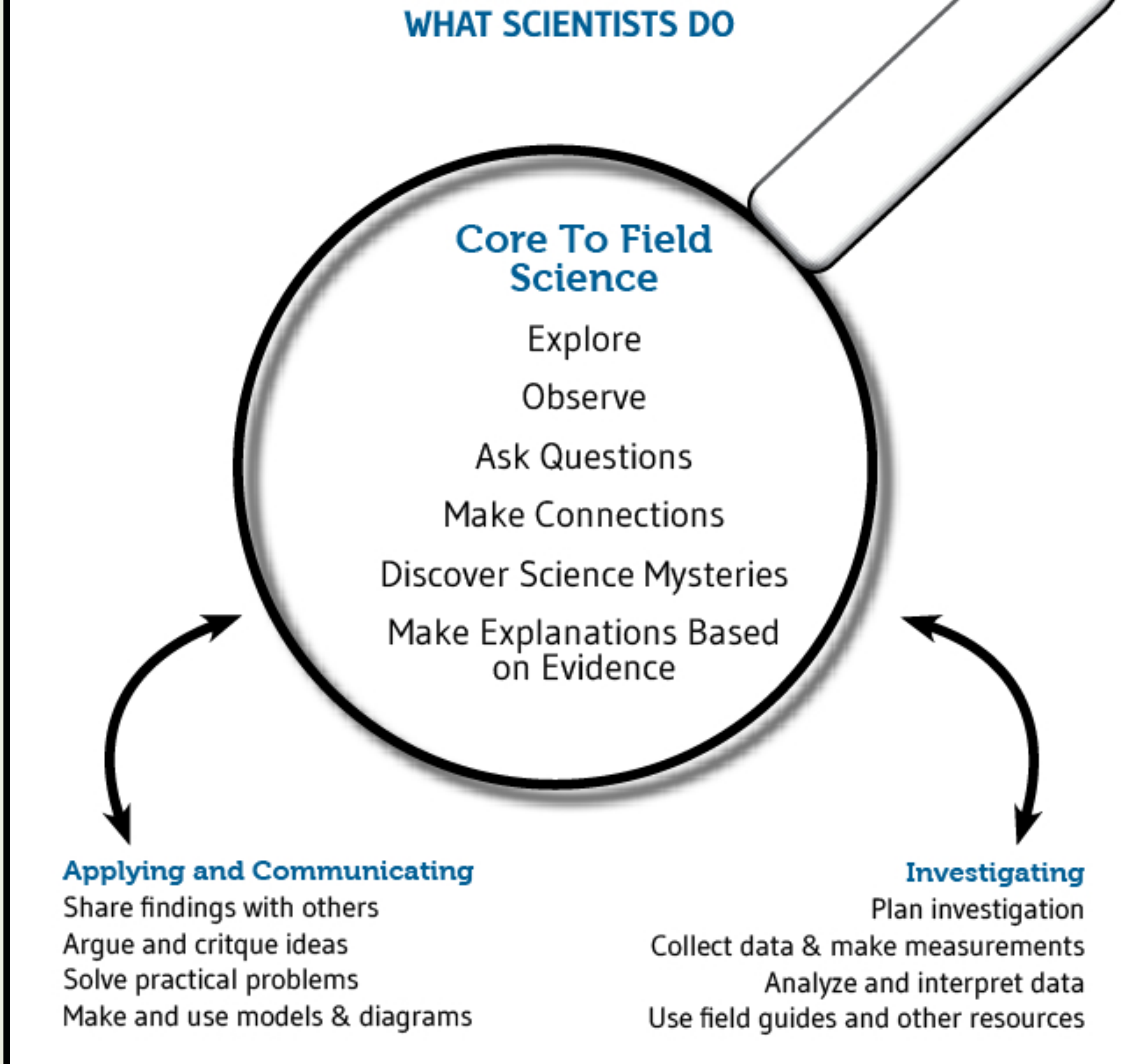
Science is not.......

- the absolute truth
- democratic
- anthropocentric
- a single Scientific Method

The traditional Scientific Method

- –Question
- –Hypothesis
- –Experiment
- –Results
- –Conclusion

An alternative way of explaining what scientists do…



"Isn't that the making of a little scientist? Curiosity, asking questions, not getting the right answer, deciding to find out for yourself, making a mistake, not giving up, and learning patience."
– Jane Goodall

Why teachers should learn about the nature and practices of science

"Students must have the opportunity to stand back and reflect on how the practices contribute to the accumulation of scientific knowledge. This means, for example, that when students carry out an investigation, develop models, articulate questions, or engage in arguments, they should have opportunities to think about *what they have done* and *why*."

The Next Generation Science Standards, Appendix H
The Nature of Science in the NGSS

Best Practices for Teaching Science:

- Focus on core ideas and use of science practices to build broader understanding.
- Emphasize both content knowledge and skills.
- Carefully build depth of understanding over time.
- Connect science to students' interests and authentic experiences.
- Acknowledge cultural contributions to promote equity and encourage participation in science.


Science
Everyone gets in, as long as they behave scientifically.
ALL PATRONS MUST EXPOSE THEIR IDEAS TO TESTING. THANK YOU.

Thought Swap Questions

- What is science?
- Why teach about science in outdoor science education programs?
- What aspects of science can be taught in outdoor science education programs?
- How can we help students think like scientists?

Reflection

Reflect on how your ideas about what science is and how it works may have changed…and if so, what do you think created the shift?

How might you apply these ideas to your science instruction?

NGSS Optional Follow-up Presentation

Next Generation Science Standards (NGSS) in Outdoor Science Instruction

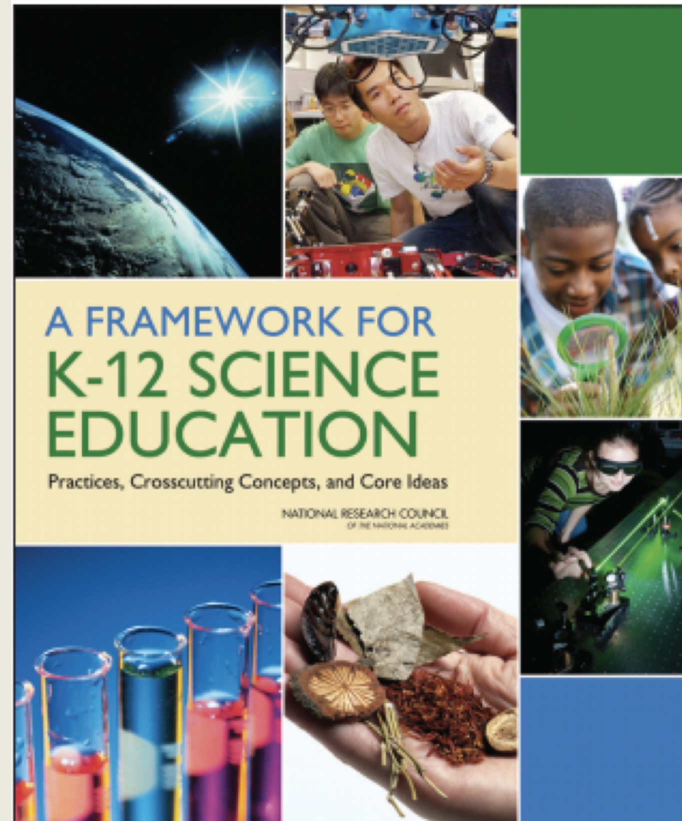
Goals:

- Appreciate the complexities of the NGSS science practices
- Explore how these practices can add richness and depth to outdoor learning experiences
- Incorporate the NGSS practices into EE program development

Important Guiding Documents for Educators

✧The National Research Council's: A Framework for K-12 Science Education

✧Next Generation Science Standards



NEXT GENERATION SCIENCE STANDARDS

Principles of the Framework

- Children are born investigators and have capacity for reasoning.
- Focusing on core ideas and engaging in practices builds a broader understanding of science.
- Deep understanding develops over time and through making connections.
- Science learning involves both knowledge and practice. (knowing and doing)
- Connecting to students' interests and experiences helps sustain curiosity and wonder.
- All students should have access to learning and engaging in science.

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Commonly Heard Comments:

"It's the same stuff; they just named it differently. NGSS Practices are just another name for inquiry skills."

"We already do inquiry, so we are already really doing the NGSS."

"A large amount of our content in NGSS is the same as our current state standards, so it won't be a big shift for us"

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The Science Framework and NGSS actually represent a new and exciting vision for what students should know and be able to do in science!!

The 3 Dimensions of the NGSS

NEXT GENERATION SCIENCE STANDARDS

Scientific and Engineering Practices (doing science)

Disciplinary Core Ideas (facts)

Crosscutting Concepts (connecting science)

Student Performance Expectation (PE)

Former Science Standards

Facts about science

Doing science

The Next Generation Science Standards (NGSS)

Scientific and Engineering Practices (capabilities for doing science)

Disciplinary Core Ideas (selected facts, big ideas & concepts)

Crosscutting Concepts (thinking tools used in all sciences)

Dimension 1
Science and Engineering Practices

1. Asking questions (science) and defining problems (engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (science) and designing solutions (engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Dimension 2
Crosscutting Concepts

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

Dimension 3- Disciplinary Core Ideas

Life Science

LS1: From Molecules to Organisms: Structures and Processes

LS2: Ecosystems: Interactions, Energy, and Dynamics

LS3: Heredity: Inheritance and Variation of Traits

LS4: Biological Evolution: Unity and Diversity

Physical Science

PS1: Matter and Its Interactions

PS2: Motion and Stability: Forces and Interactions

PS3: Energy

PS4: Waves and Their Applications in Technologies for Information Transfer

Earth & Space Science

ESS1: Earth's Place in the Universe

ESS2: Earth's Systems

ESS3: Earth and Human Activity

Engineering & Technology

ETS1: Engineering Design

ETS2: Links Among Engineering, Technology, Science, and Society

NGSS Earth & Space Science performance expectations for Grade 5

Students who demonstrate understanding can:

a. Use models to describe interactions between the geosphere, hydrosphere, atmosphere, and biosphere and identify the limitations of the models.

b. Use evidence from observations to explain the role of the ocean in supporting ecosystems and their organisms, shaping landforms, and influencing climate.

c. Develop and revise models to describe how wind and clouds interact with landforms to determine patterns of weather.

OLD (!!) California Earth Science Standard for Grade 5

3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept:

a. *Students know* most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.

b. *Students know* when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.

c. *Students know* water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.

d. *Students know* that the amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.

e. *Students know* the origin of the water used by their local communities.

NGSS Handout Directions:

1. Form groups of ~4-5 at each table
2. Quietly read the descriptions of each practice.
3. Select a practice to discuss, and read the sample activities.
4. Together discuss additional opportunities for youth to engage in the practice at a 3-5th grade level.
    a) Discuss: What will instructor do to provide opportunity for students to engage in the practice?
    b) Discuss: What will students do?
5. Recorder summarizes group thinking and discussion on chart paper.

Shifting to an NGSS Approach

from science inquiry only	→	to a broader view of science practices
from learning *about*	→	to *figuring things out*
from knowing a list of ideas	→	to knowing how ideas fit together
from simple explanations	→	to more complex explanations
from knowing "that"	→	to knowing "why" or "how"

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