Water Density Stations

Learning & Teaching

"I ulu no ka lālā I ke kumu"
The branches grow because of the trunk.
(Traditional Hawaiian Proverb 1261; Pukui, 1983).

- Without our source or teacher we would not be here
- Both the teaching and learning perpetuate sharing and discovery of new knowledge
- "Aʻo mai, Aʻo aku - teaching and learning are a two-way street".

How do you learn?

Discuss & record the following with a partner:

- Discuss one of your favorite teachers or your favorite class.
- Make a list of the things you enjoyed about learning with that teacher or class.
- Describe how your list is similar and different from the way you learned in your home and your community growing up

Water density: Station Rotations

Activity Goal

- Use your metacognitive skills to think about how your learning experience is impacted by the design of the activity

- Focus on PROCESS vs. content.

Water density: Station Rotations

- ROTATE: Station A → B → C → D

- 8 - 10 minutes each
- CLEAN UP stations as you go

Water density: Station Rotations

First Rotation

00 : 10 : 08

Water density: Station Rotations

Second Rotation

00 : 08 : 23

Water density: Station Rotations

Third Rotation

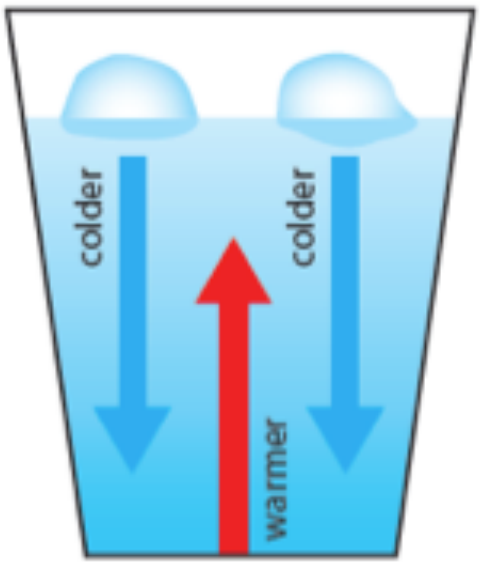
00 : 08 : 23

Water density: Station Rotations

Fourth Rotation

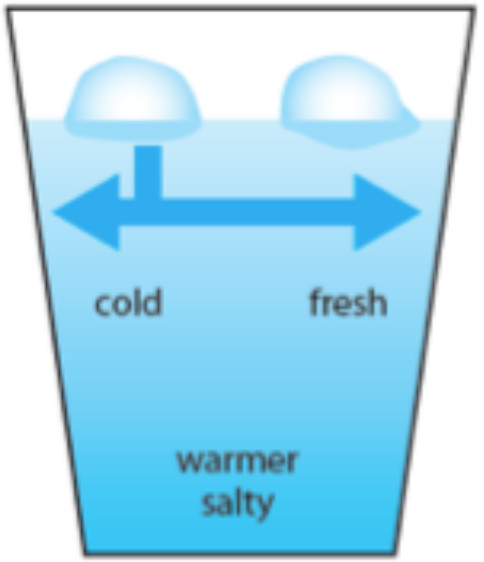
00 : 08 : 23

Water density: Station Rotations



fresh water

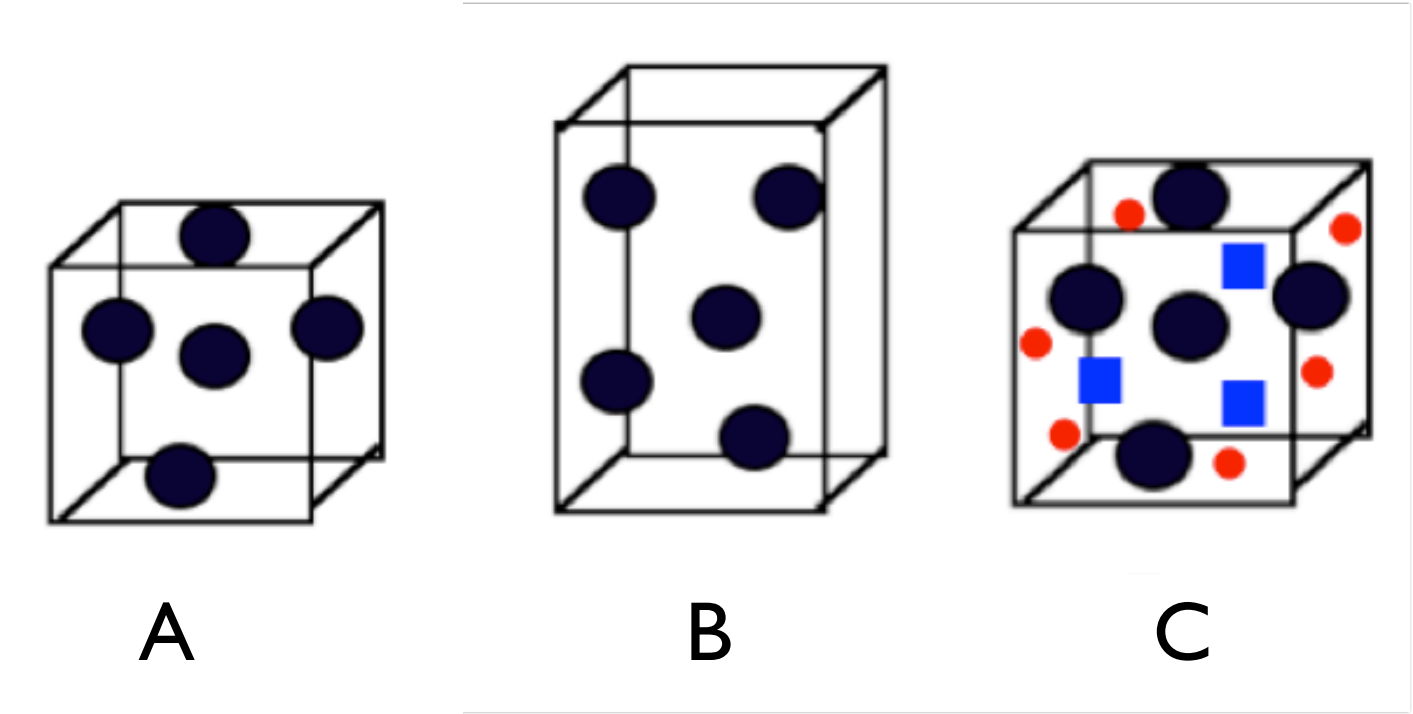
A



salt water

B

Density & Scientific Reasoning



Density

Learning stations

A: Open-ended Exploration

This station was intentionally unstructured in an exaggerated fashion, in order to provoke reaction and discussion.

- How did Station A make you feel?
- Did you learn from this station?

Learning stations

A: Open-ended Exploration
B: Structured Activity
C: Problem-solving Challenge
D: Read and Answer

- Talk in your group about how each of the other stations made you feel.
- Discuss if you learned from each station equally.
- Discuss how stations relate to past experiences, culture, and how you learn best

Vote on stations

A: Open-ended Exploration
B: Structured Activity
C: Problem-solving Challenge
D: Read and Answer

- Which station did you like best?
- Are there any class trends?
- Does your preference relate to how you teach?

Different learning stations

- Record advantages of each type of approach (station)
  - think of at least one advantage per station
  - write on big papers around the room

Open-Ended Exploration (A)

- Encourage learners to work together without direct educator intervention
- Develop and identify concepts, processes and skills, raise questions and problems
- Provide a common base of experiences
- Practice observation skills

Structured Activity (B)

- Introduce concepts, vocabulary, processes, skills, and investigation methods.
- Guide learners toward specific discoveries.
- Provide a common base of experiences
- Provide successful activities with predictable outcomes

Problem-Solving Challenge/Application (C)

- Model what scientists do
- Provide a sense of accomplishment
- Challenge learners' conceptual understanding and skills by applying them to new situations
- Develop deeper and broader understanding through real world applications

Read and Answer (D)

- Provide specific content information and vocabulary on a topic
- Extend the information from an activity into descriptions of related experiences that are impractical in a classroom setting
- Provide alternative explanations for observed phenomena.
- Make connections to other subject areas.

Different learning stations

- Choices of approach depend on goals, available time, home and school culture, and experiences of students and educator.

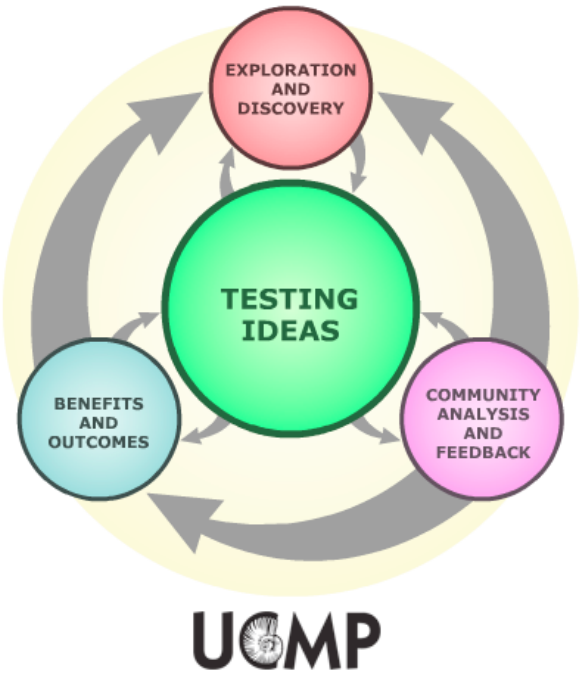
- Order of stations (learning activity) also effects knowledge acquisition and learning experience

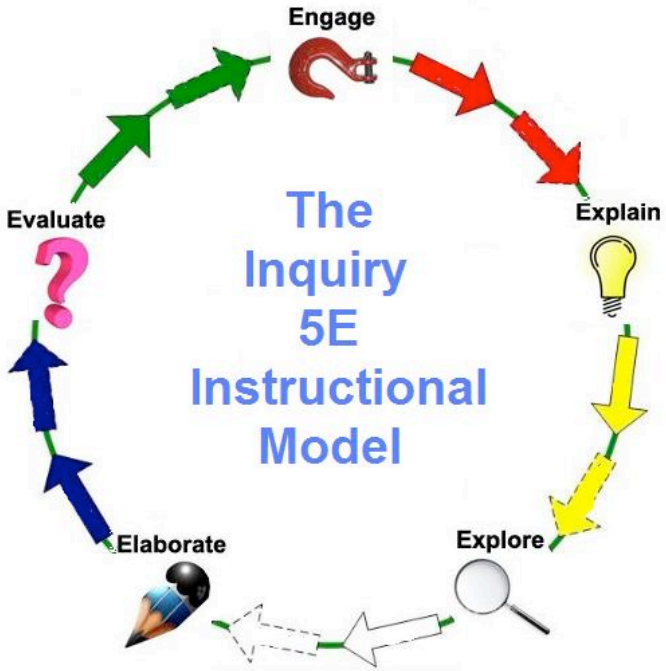
- Multiple types of inquiry together in meaningful ways = learning cycle

Learning Cycles

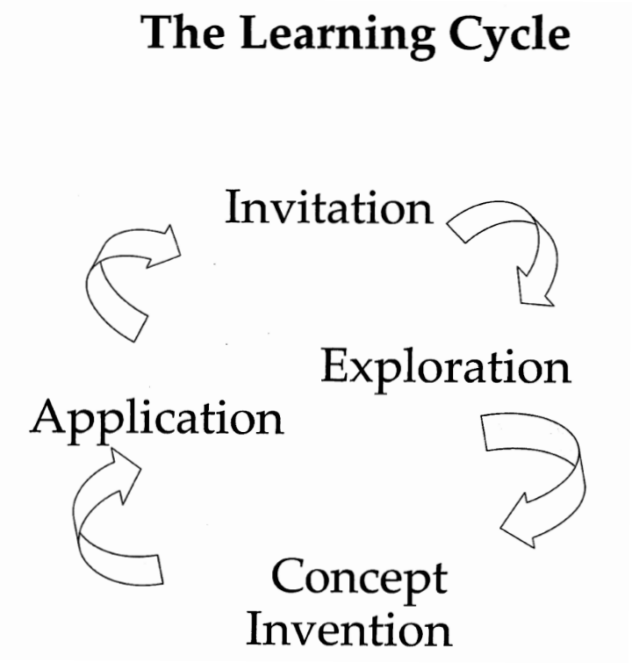
- Grew out of science education research in 1960s
- Refined through findings in neuroscience & cognitive psychology
- Helps provide educational experiences consistent with how people learn

- Learner centered (utilize prior understanding)
- Allow first-hand experience
- Integrate and apply new concepts

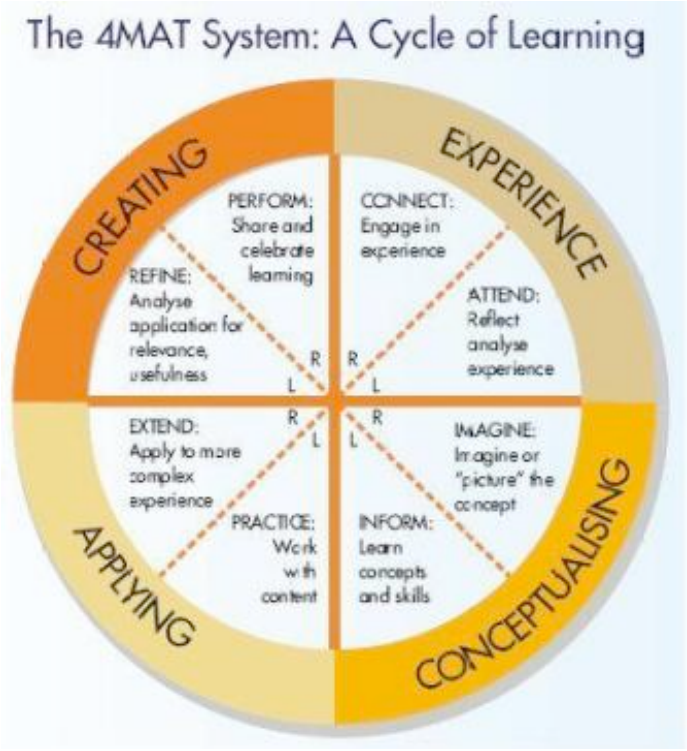




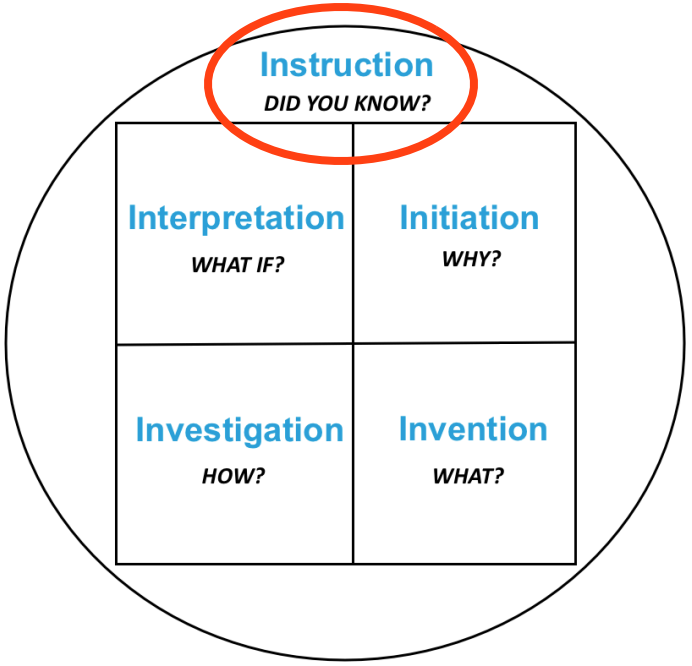
Bybee's 5 E's



Lawrence Hall of Science

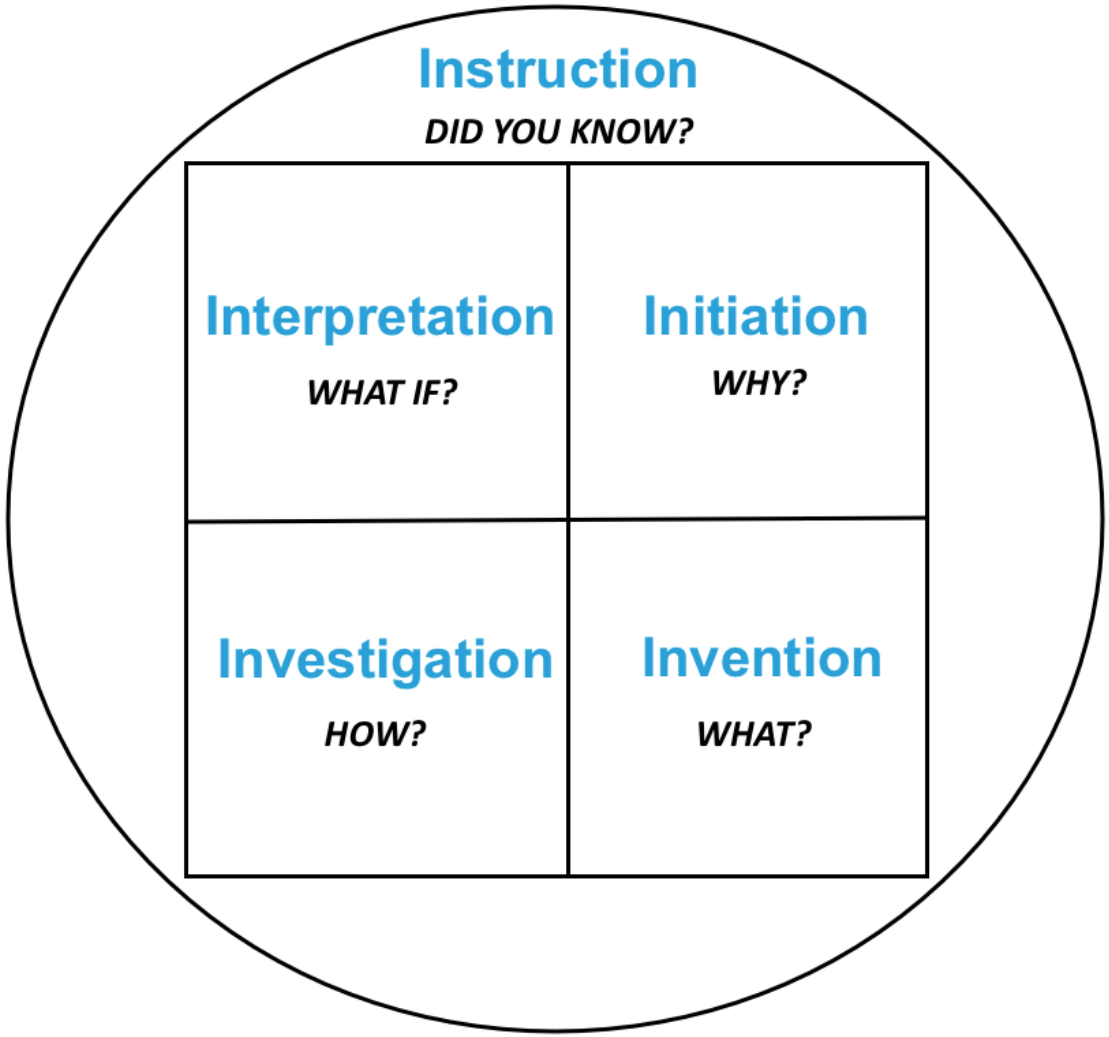


Inquiry Models



TSI Five Phases of Inquiry

- Muti-directional learning process
  - Based on constructivist learning theory
  - Building knowledge rather than memorizing facts



Inquiry Phases

- **From a global, or unit level, perspective**: individual lessons target particular inquiry phases

TSI Inquiry Phases

Instruction

Interpretation
What if?

Consensus

Connections

Analysis

Evaluation

Initiation
Why?

Hook

Connection to place

Relevance

Discrepant event

Investigation
How?

Records

Manipulation

Observation

Repetition

Invention
What?

Ideas

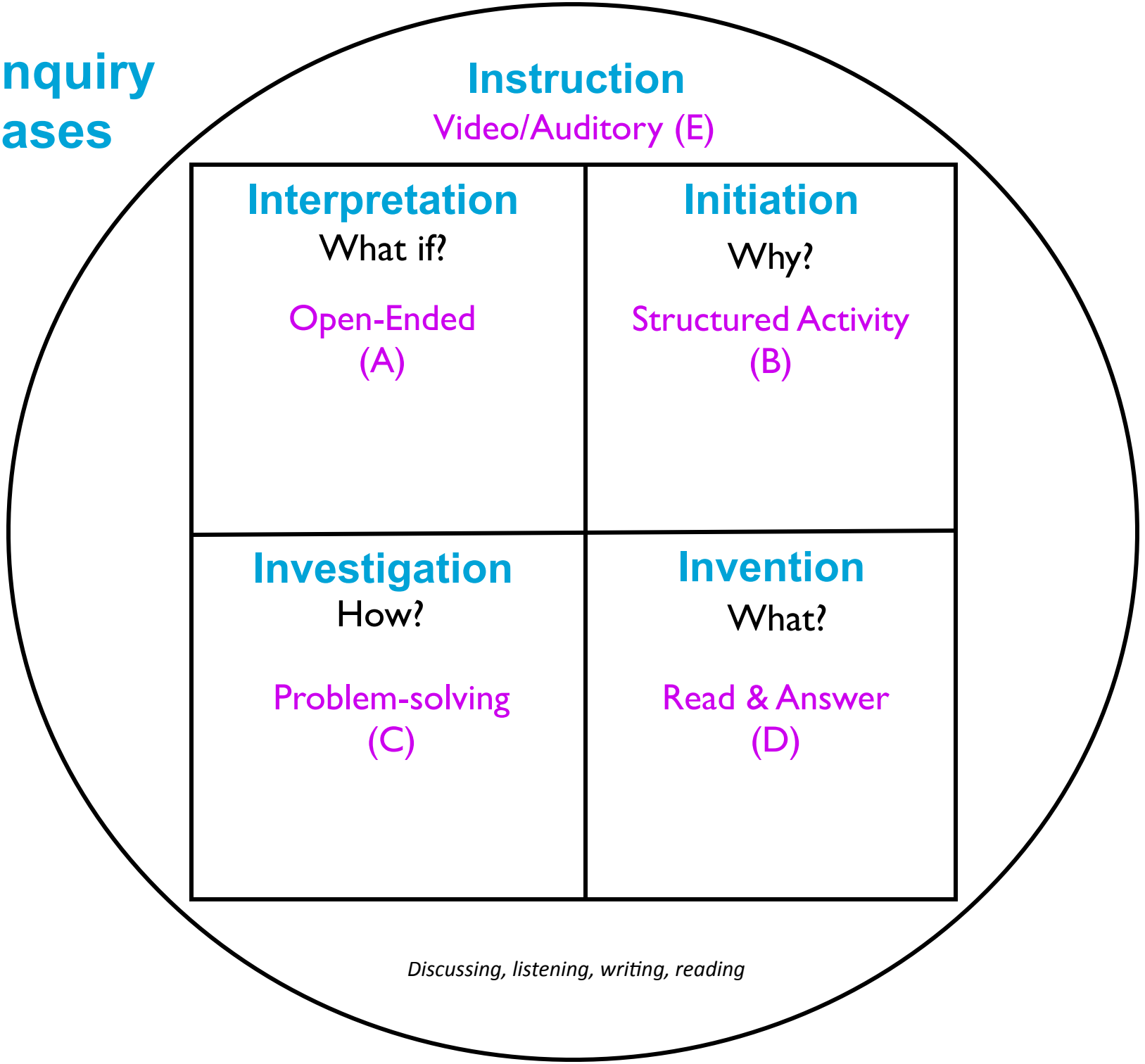
Connection to prior knowledge

Engineering

Methodology

Discussing, listening, writing, reading

TSI Inquiry Phases

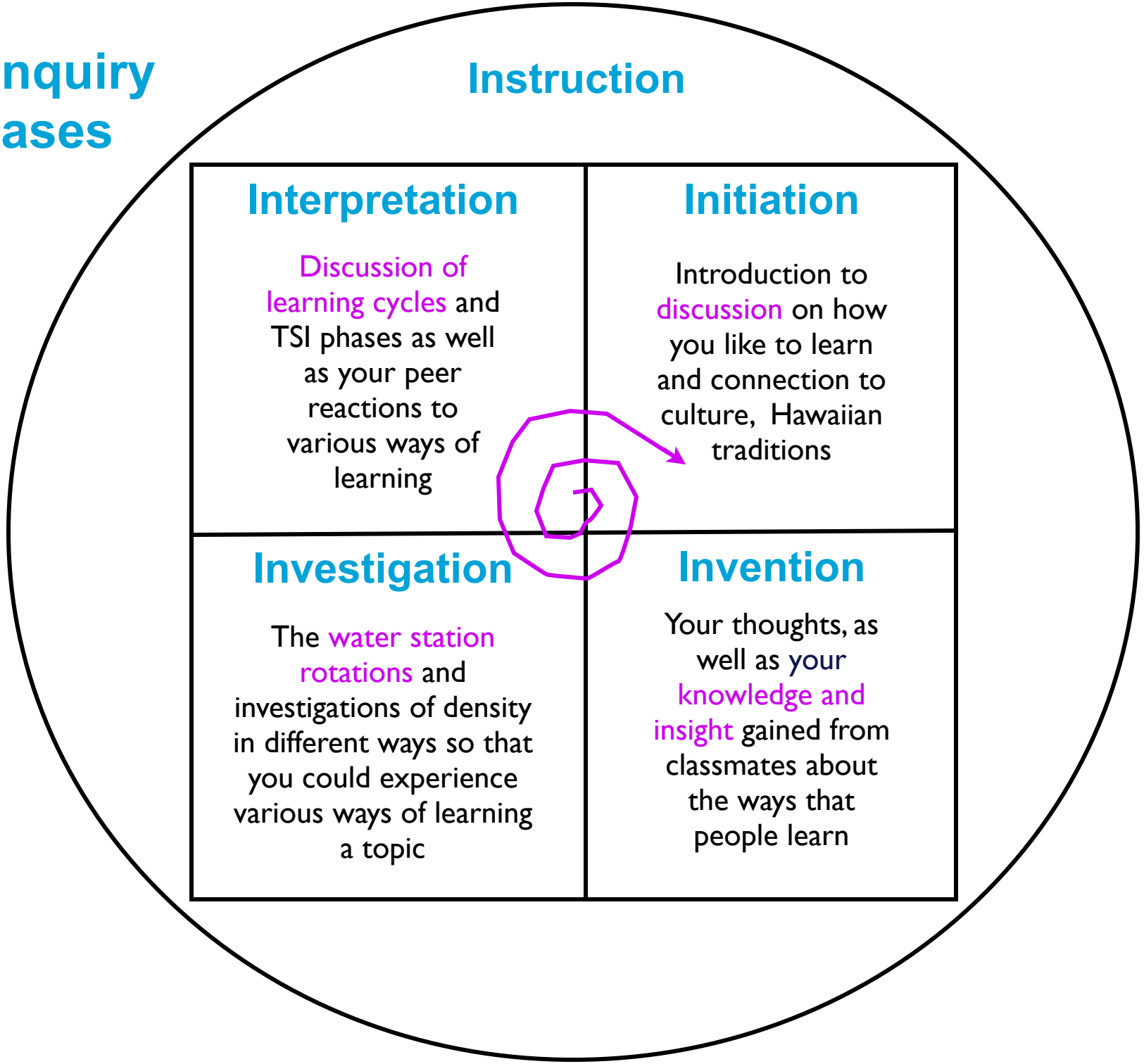


Inquiry Phases

- **From a global, or unit level, perspective**: individual lessons target particular inquiry phases

- **From a lesson, or activity, perspective:** aspects of the lesson target particular inquiry phases

TSI Inquiry Phases



Inquiry Phases

- **From a global, or unit level, perspective**:
  individual lessons target particular inquiry phases

- **From a lesson, or activity, perspective:**
  aspects of the lesson target particular inquiry phases

- **From action, thought, or metacognitive, perspective:**
  individual actions align with particular inquiry phases

Water density: Station Rotations

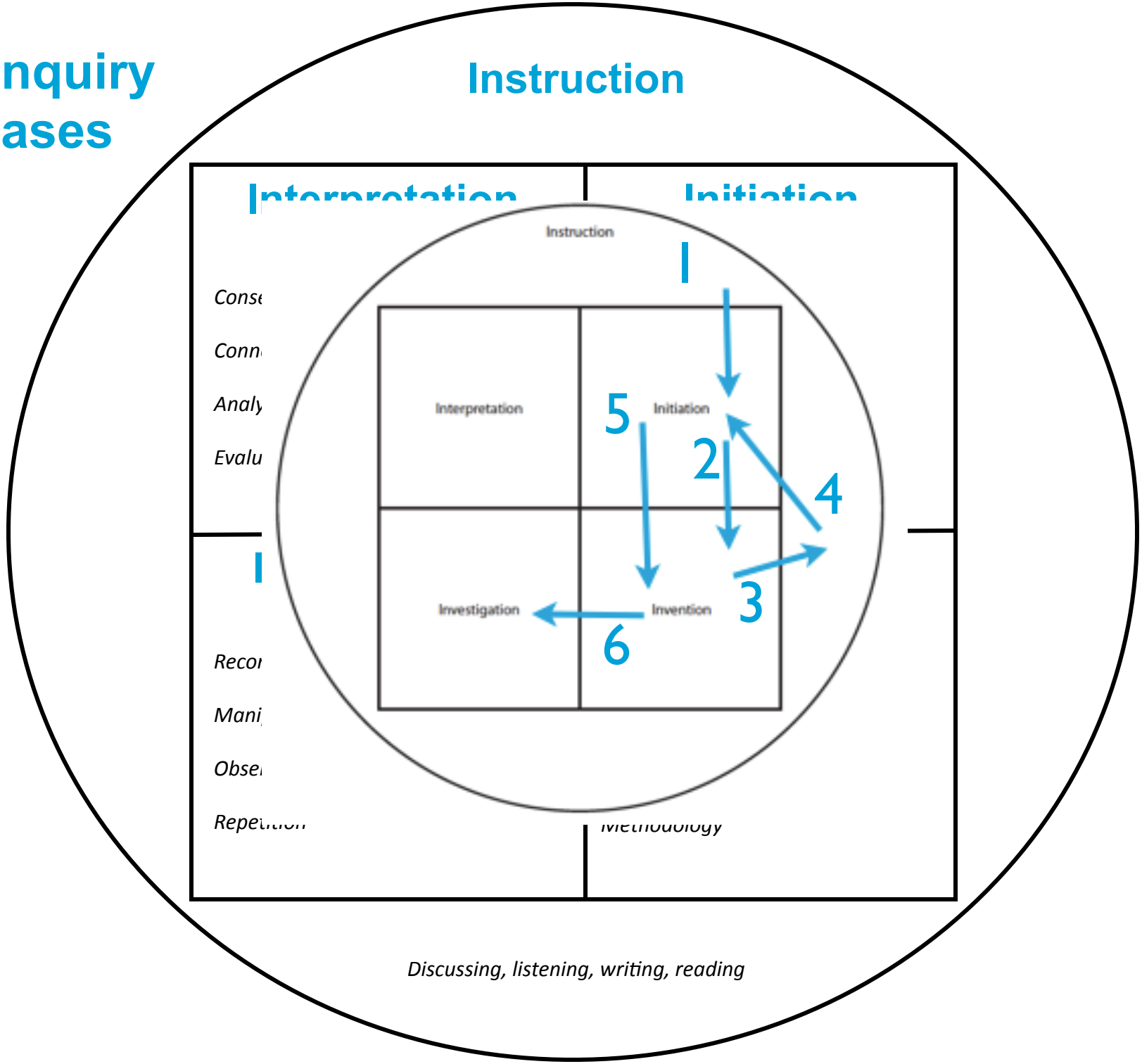
- On piece of paper - write down the processes your group went through for station C, the problem solving station

- Write down *every little thing* your group did, no details are too small

Water density: Station Rotations

- Group your processes based on the phase categories on the index cards

TSI Inquiry Phases

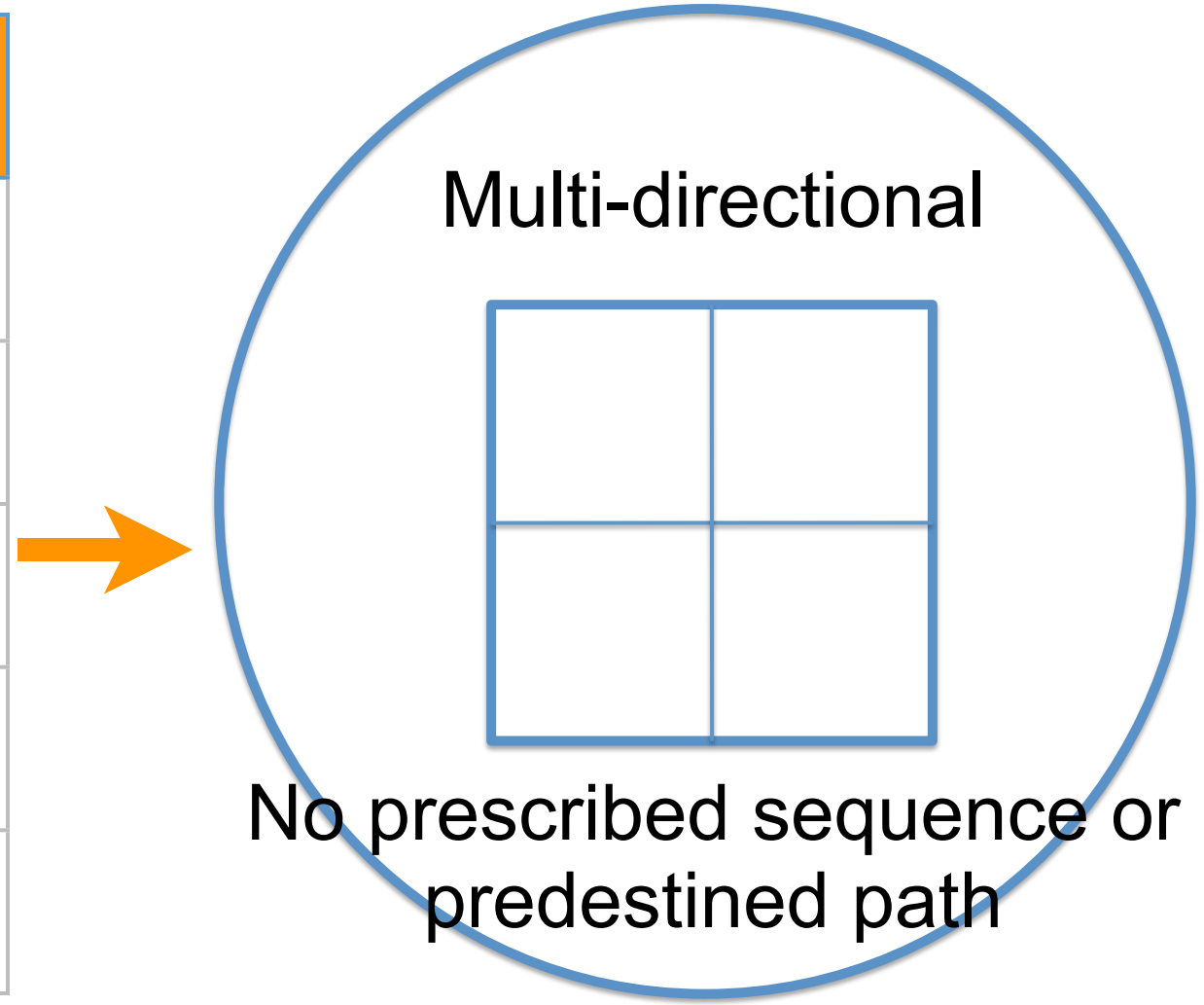


Inquiry Phases

- **From a global, or unit level, perspective**: individual lessons target particular inquiry phases
- **From a lesson, or activity, perspective:** aspects of the lesson target particular inquiry phases
- **From action, thought, or metacognitive, perspective:** individual actions align with particular inquiry phases
  - You may design a lesson to move through a learning cycle, or the phases of inquiry, in a particular way, but how each student's cognitive process flows will be unique

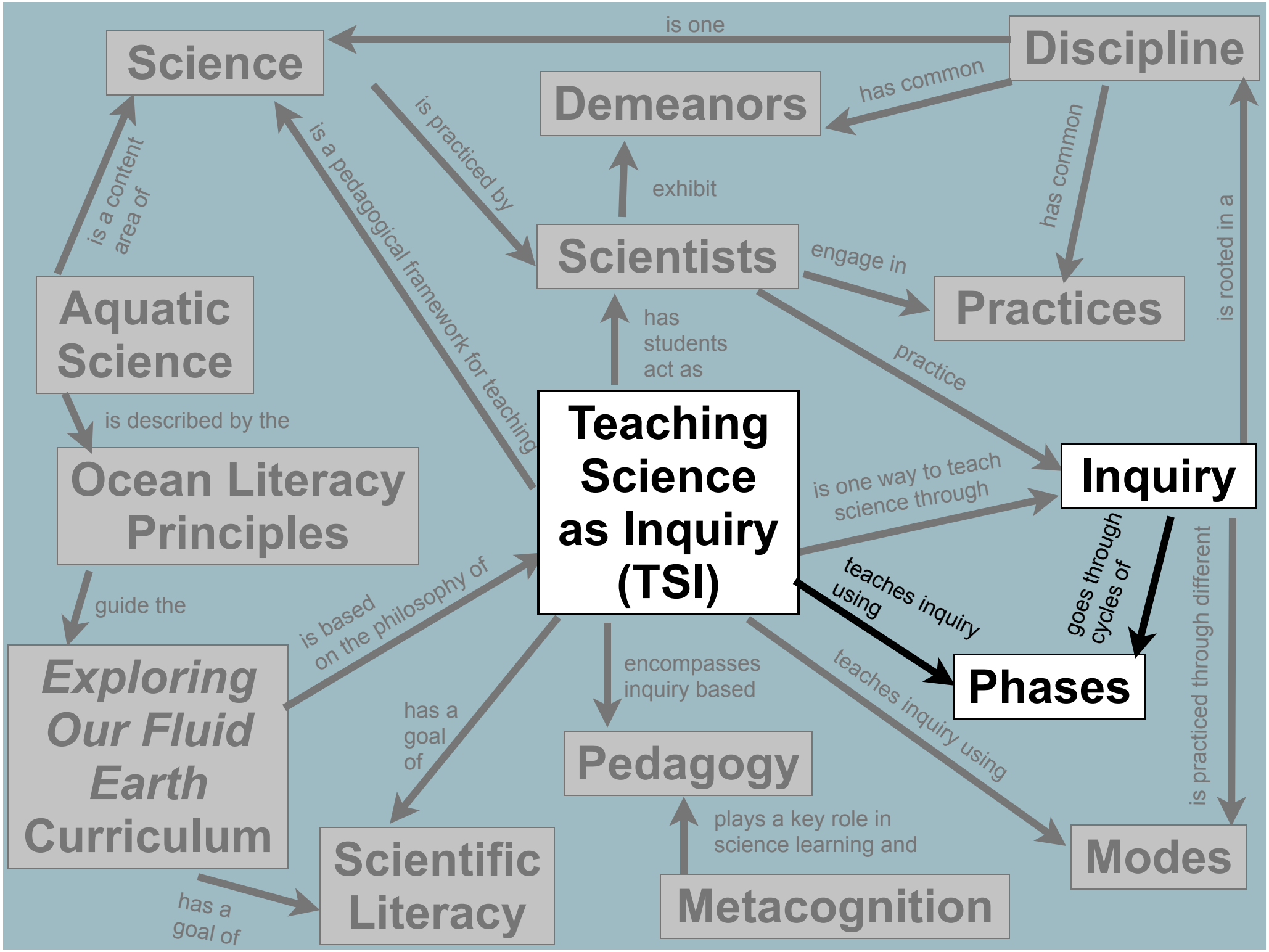
Phases of Inquiry

Phases of Inquiry
Initiation
Invention
Investigation
Interpretation
Instruction



Instruction = Community

- **Importance of instruction phase**
  - Science as a human endeavor
  - Community verification & sharing
    - peer sharing
    - student - teacher - student sharing
    - public community
    - scientific community
  - Communication of results - Important component of new science framework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Teaching Science as Inquiry (TSI)
Inquiry
is one way to teach science through
goes through cycles of
guide the
is based on the philosophy of
teaches inquiry using
Phases
Exploring Our Fluid Earth Curriculum
encompasses inquiry based
has a goal of
teaches inquiry using
is practiced through different
Pedagogy
Scientific Literacy
plays a key role in science learning and
Modes
has a goal of
Metacognition

“What scientists do and how scientists think encompasses more than steps in a stereotypical scientific method”

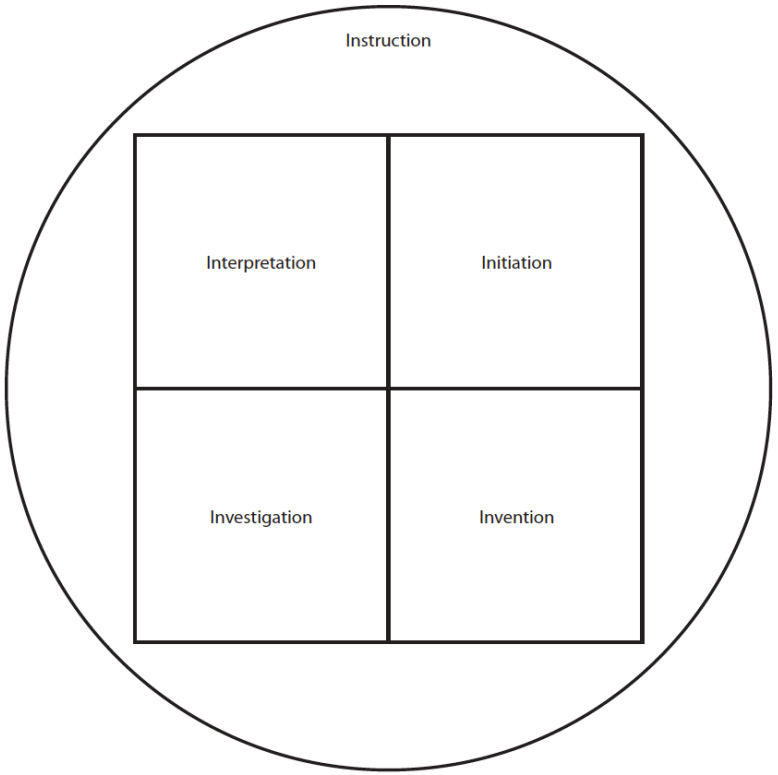
- Chiapetta & Koballa, 2006, pp. 96-99

Phases of Inquiry

Phases of Inquiry		Scientific Method
Initiation		Question
Invention	≠	Hypothesis
Investigation		Experiment/Results
Interpretation		Conclusion
Instruction		Communication

Phases of Inquiry

Process



Metacognition
Cycle of Learning & Teaching

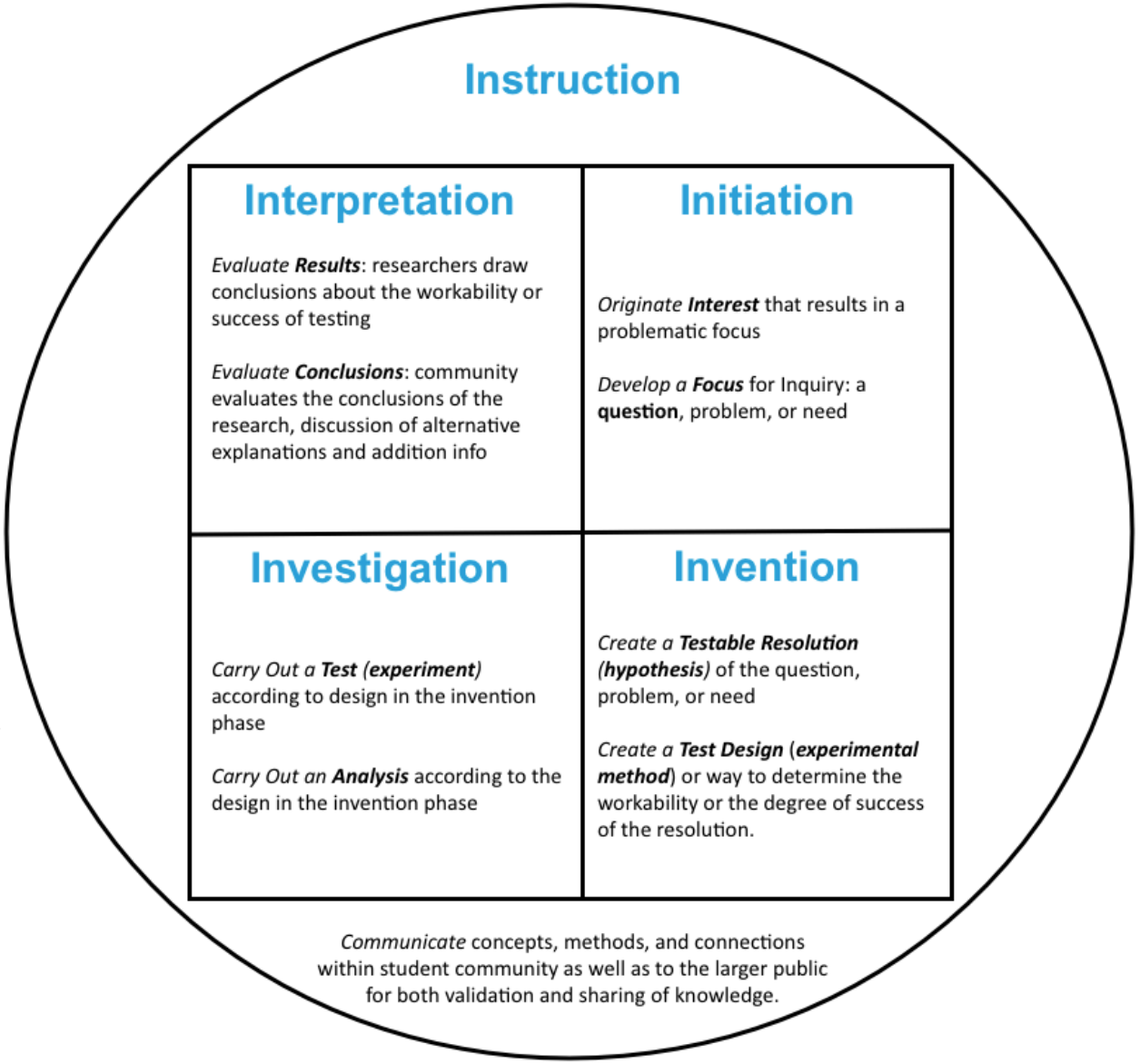
Reporting

Scientific Method
Question
Hypothesis
Experiment/Results
Conclusion
Communication

Lab Reports
Publications

TSI Phases of Inquiry

- Metacognitive Approach
- Muti-directional learning process
  - Based on constructivist learning theory
  - Building knowledge rather than memorizing facts
- Process vs. Product



Process of Science

Scientists practice in many different ways inquiry

Learning new words that help describe the variety of ways scientists gain knowledge through scientific inquiry

Curiosity

Search for new knowledge...

in external environments through informal or spontaneous probes into the unknown or predictable

Technology

Search for new knowledge...

in satisfaction of a need through construction, production and testing of artifacts, systems, and techniques

Induction

Search for new knowledge...

in data patterns and generalizable relationship in data association - a hypothesis finding process

Replication

Search for new knowledge...

by validating inquiry through duplication; testing the repeatability of something seen or described

Unusual Object

Description

Search for new knowledge...

through creation of accurate and adequate representation of things or events

Authoritative knowledge

Search for new knowledge...

through discovery and evaluation of established knowledge via artifacts or expert testimony

Sunscreen Savings

Experimentation

Search for new knowledge...

through testing predictions
derived from hypotheses

Sunscreen Cost

Budget Brand	Special Splurge
$5	$20
10.4 fl oz	2.4 fl oz
$0.48 per fl oz	$8.33 per fl oz

Transitive knowledge

Search for new knowledge...

in one field by applying knowledge from another field in a novel way

Product Evaluation

Search for new knowledge...

about the capacity of products of technology to meet valuing criteria

Light Bulb

If *all* glass is fragile and can break, then *this* light bulb is fragile, because it is made of glass

Deduction

Search for new knowledge...

in logical synthesis of ideas and evidence - a hypothesis making process

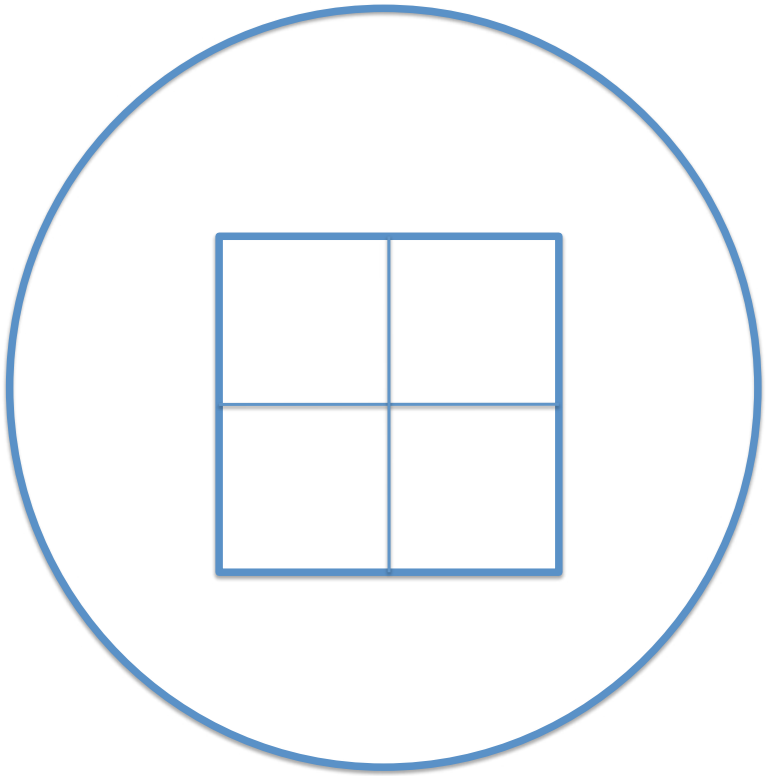
Modes of Inquiry

Remind us that there are multiple ways to do science

- Experiments are just one way to practice inquiry and learn using the scientific process.
- Remind us to seek knowledge in many ways.
- Many of the modes are not hands-on.

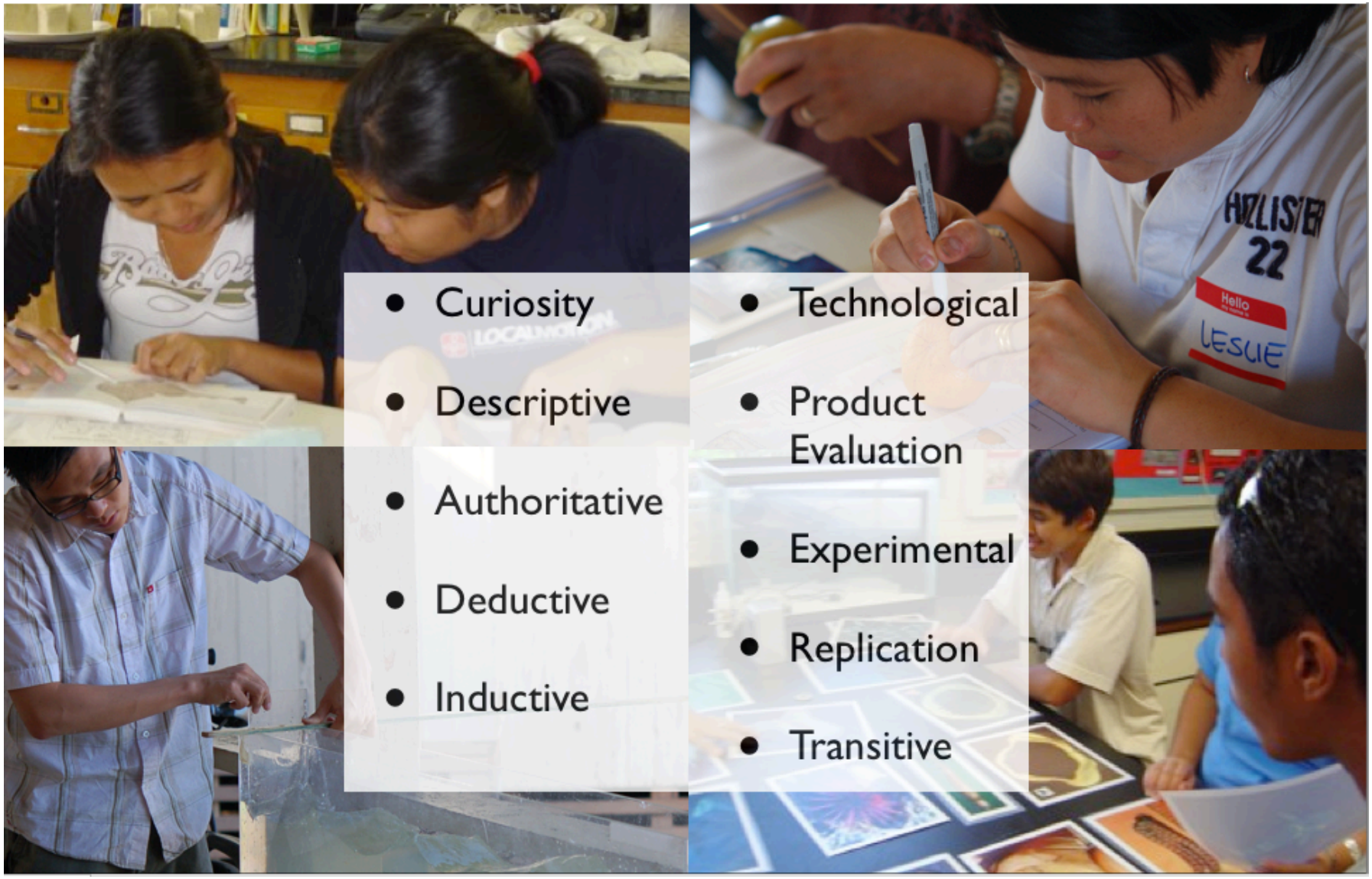
TSI Phases & Modes

- **Phases** - stages of inquiry
- **Modes** - different ways of carrying out the processes of inquiry



Modes make TSI unique!

TSI Modes of Inquiry



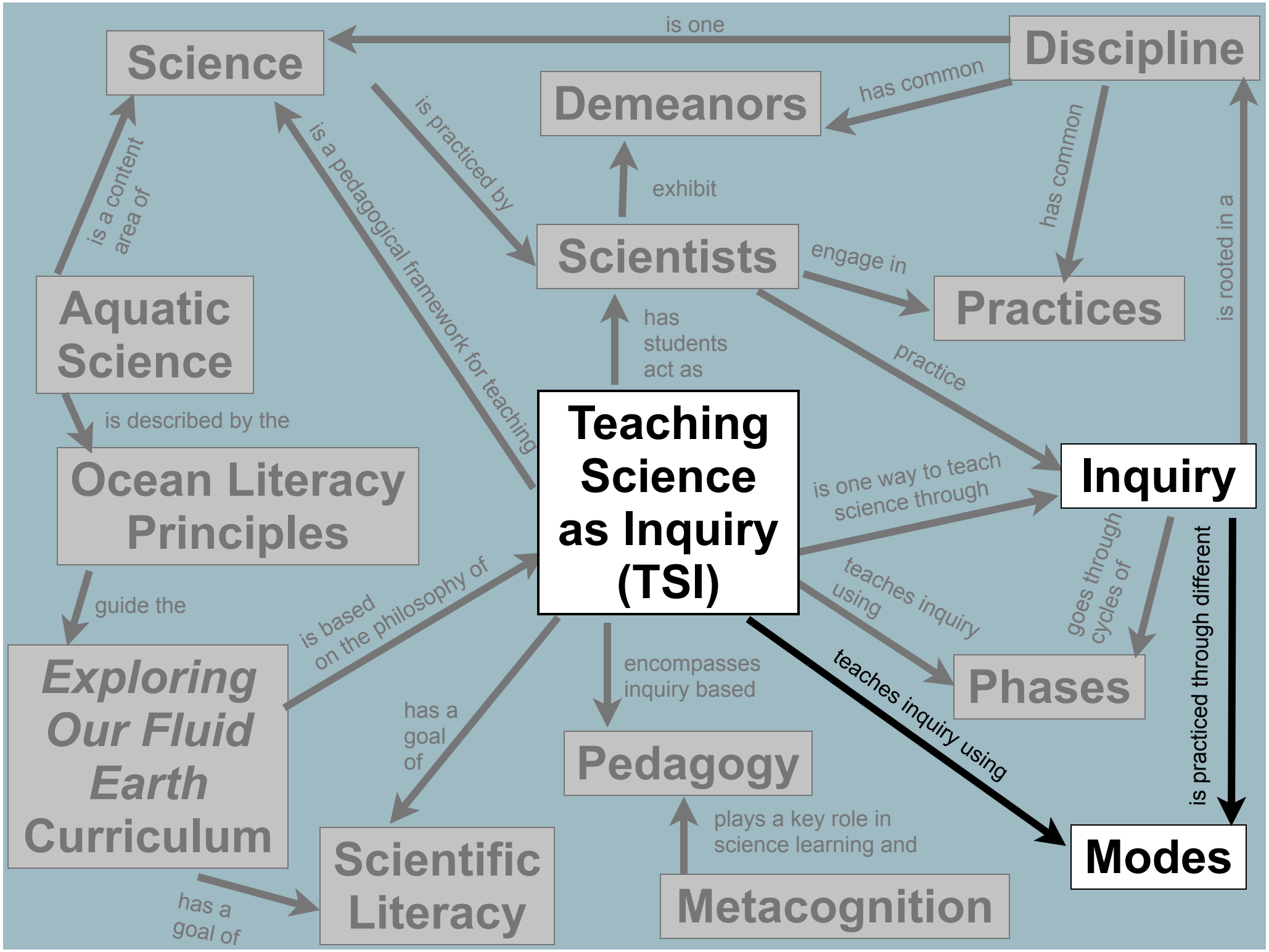
What modes of inquiry were you using in Density Bags activity?

Multiple Ways to Learn

‘A’ohe pau ka ‘ike I ka haulau ho’okahi
All knowledge is not taught in the same school.

(Traditional Hawaiian Proverb 1261; Pukui, 203).

One can learn from many sources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