Broadening Horizons of Science Learning II

Constructivism

Day :1
Session: V

Perspective of NCF 2005

The NCF was framed Considering the articulated ideas in the past such as

- to shift learning from rote method .
- to connect knowledge to life outside the school.
- to integrate examination into classroom learning and make it more flexible.
- to enriching the curriculum so that it goes beyond textbooks.
- to nurture an over-riding identity informed by caring concerns within the democratic polity of the country.

Science Education:

At the upper primary stage (Classes VI to VIII) the child should be engaged in :

- learning the principles of science through familiar experiences,
- working with hands to design simple technological units and modules (e.g. designing and making a working model of a windmill to lift weights) and
- continuing to learn more about the environment and health, including reproductive and sexual health, through activities and surveys.

At the upper primary stage (Classes VI to VIII) the child should be engaged in : contd

- Scientific concepts are to be arrived at mainly from activities and experiments.
- Science content at this stage is not to be regarded as a diluted version of secondary school science.
- Group activities, discussions with peers and teachers, surveys, organization of data and their display through exhibitions, etc. in schools and the neighbourhood should be important components of pedagogy.

At the secondary stage (Classes IX & X),

- students should be engaged in learning science as a composite discipline in working with hands and tools to design more advanced technological modules than at the upper primary stage and in activities and analyses on issues concerning the environment and health, including reproductive and sexual health.

- Systematic experimentation as a tool to discover/verify theoretical principles and working on locally significant projects involving science and technology are to be important parts of the curriculum at this stage.

Three main aspects in the PISA Scientific Literacy Framework

1. Content Knowledge	
Knowledge of science	**Knowledge about science**
Physical systems: Structure of matter; Properties of matter; Chemical changes of matter; Motions and forces; Energy and its transformation; Interactions of energy and matter	**Scientific inquiry:** the central process of science and the various components of that process.
Living systems: Cells; Humans; Populations; Ecosystems; Biosphere	**Scientific explanations:** the results of scientific enquiry.
Earth and space systems: Structures of Earth systems; Energy in Earth systems; Change in Earth systems; Earth's history Earth in space	
Technology systems: Role of science-based technology; Relationships between science and technology; Concepts; Important principles	

2. Competences

Identify scientific issues includes planning of inquiry activities and collection of data. Identifying verbs such as observe, experiment, inquiry, investigate

Draw evidence-based conclusions includes the use of textual, pictorial or table information in drawing conclusions. Identifying verbs such as interpret, explain, discuss, make, formulate

Explain scientific phenomena include applying knowledge of science or knowledge about science in a given situation. Identifying verbs such as apply, use, describe, solve

3. Contexts (personal, social, and global)
Health: maintenance of health, accidents, nutrition, epidemics, spread of infectious diseases
Natural resources: populations, quality of life, security, renewable and non-renewable energy sources, natural systems
Environmental quality: population distribution, disposal of waste, environmental impact, local weather, biodiversity, ecological sustainability, control of pollution
Hazards: rapid changes, climate change, impact of modern warfare

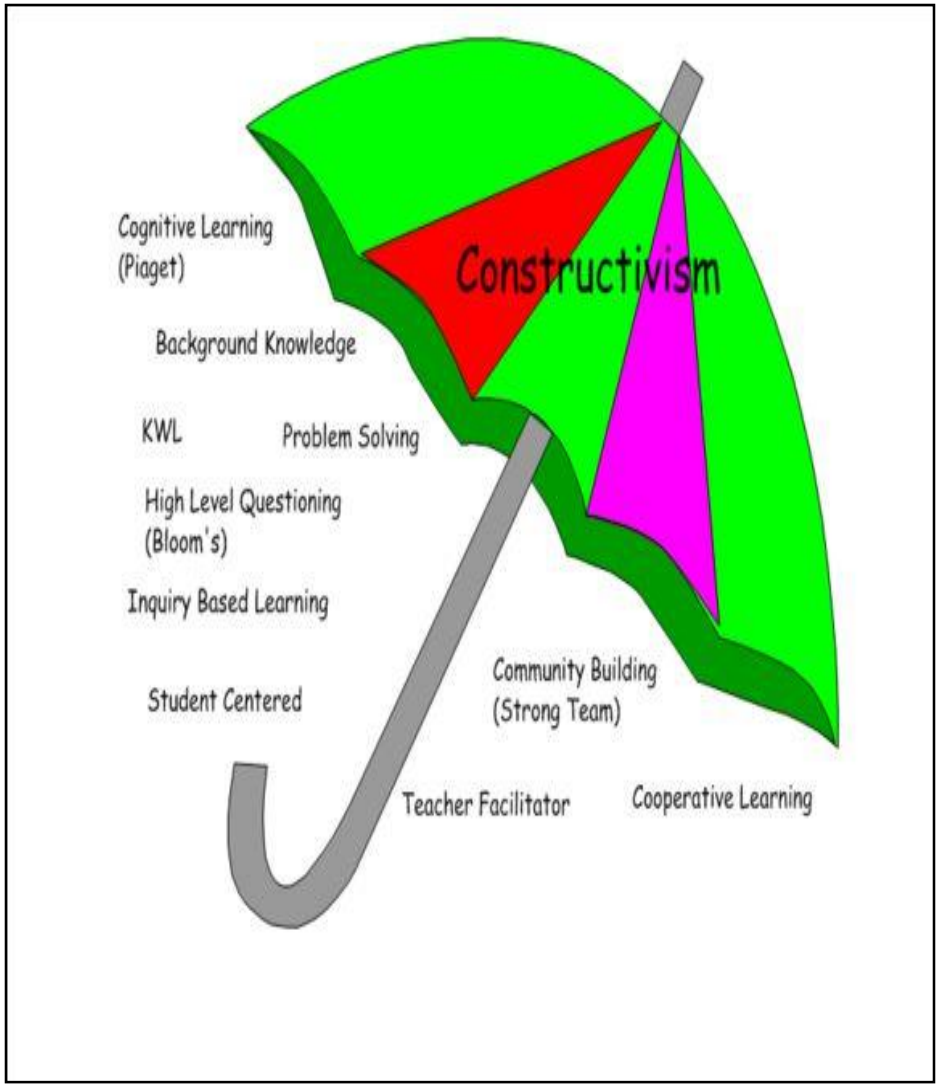
Definition of Learning

Learning is an active process in which learners construct their own meaning based on prior knowledge and experience.

Teaching & Learning of Science from the Perspective of **Constructivism**

Constructivism

A view of learning that suggests that students can develop their own understanding through active participation



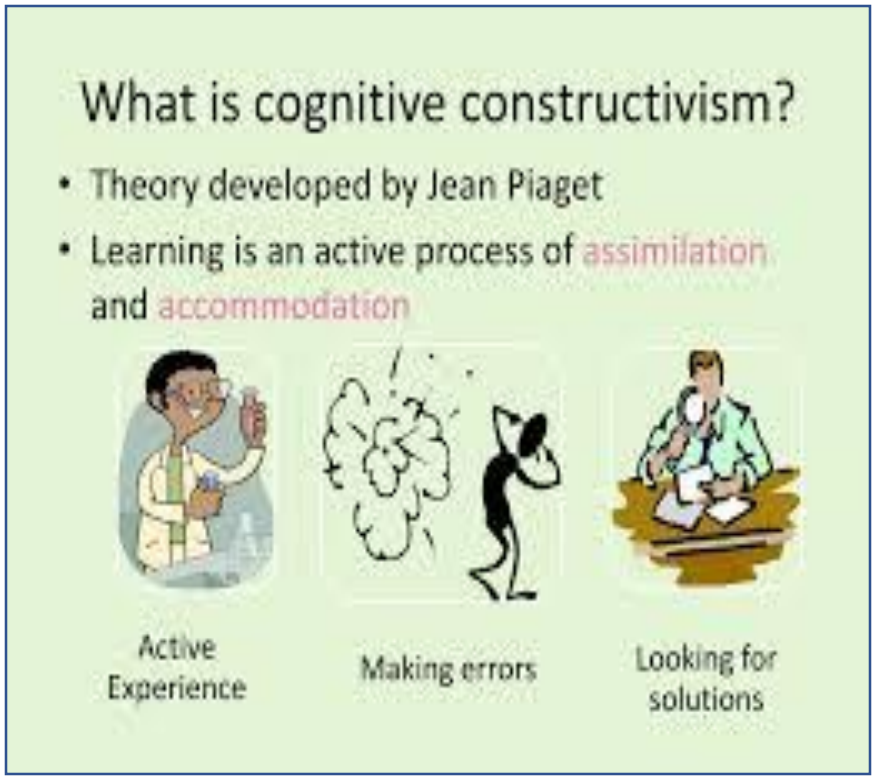
What is the history of constructivism, and how has it changed over time?

"As long as there were people asking each other questions, we have had constructivist classrooms. Constructivism, the study of learning, is about how we all make sense of our world, and that really hasn't changed."

— Jacqueline Grennan Brooks (1999)
CONCEPT TO CLASSROOM INTERVIEW

Types of Constructivism

1.Cognitive Constructivism (Individual)



2. Social Constructivism

Some of the Pioneers of Constructivism in Education

1) Cognitive Constructivism

To name a few

- **Jean Piaget (1896-1980)**

Piaget focused on how humans make meaning in relation to the interaction between their experiences and their ideas.

- **John Dewey (1895-1952)** education depends on experience

Some of the Pioneers of Constructivism in Education

1) Cognitive Constructivism

- **Jerome Seymour Bruner (1915–2016)** significant contributions to human cognitive psychology and cognitive learning theory in educational psychology
- **Ernst von Glasersfeld (1917–2010)** developed his model of radical constructivism (the art of teaching has little to do with the traffic of knowledge, its fundamental purpose must be to foster the art of Learning)
- **David Ausubel (1918-1962)** who first introduced his Assimilation Learning Theory in 1962. Ausubel's theory primarily explains **cognitive learning** – with the central idea being that learning occurs through the assimilation of new concepts into existing concept frameworks held by the learner

Jean Piaget and **John Dewey** developed theories of childhood development and education, what we now call **Progressive Education**, that led to the evolution of constructivism.

Piaget believed that humans learn through the construction of one logical structure after another. He also concluded that the logic of children and their modes of thinking are initially entirely different from those of adults. The implications of this theory and how he applied them have shaped the foundation for constructivist education.

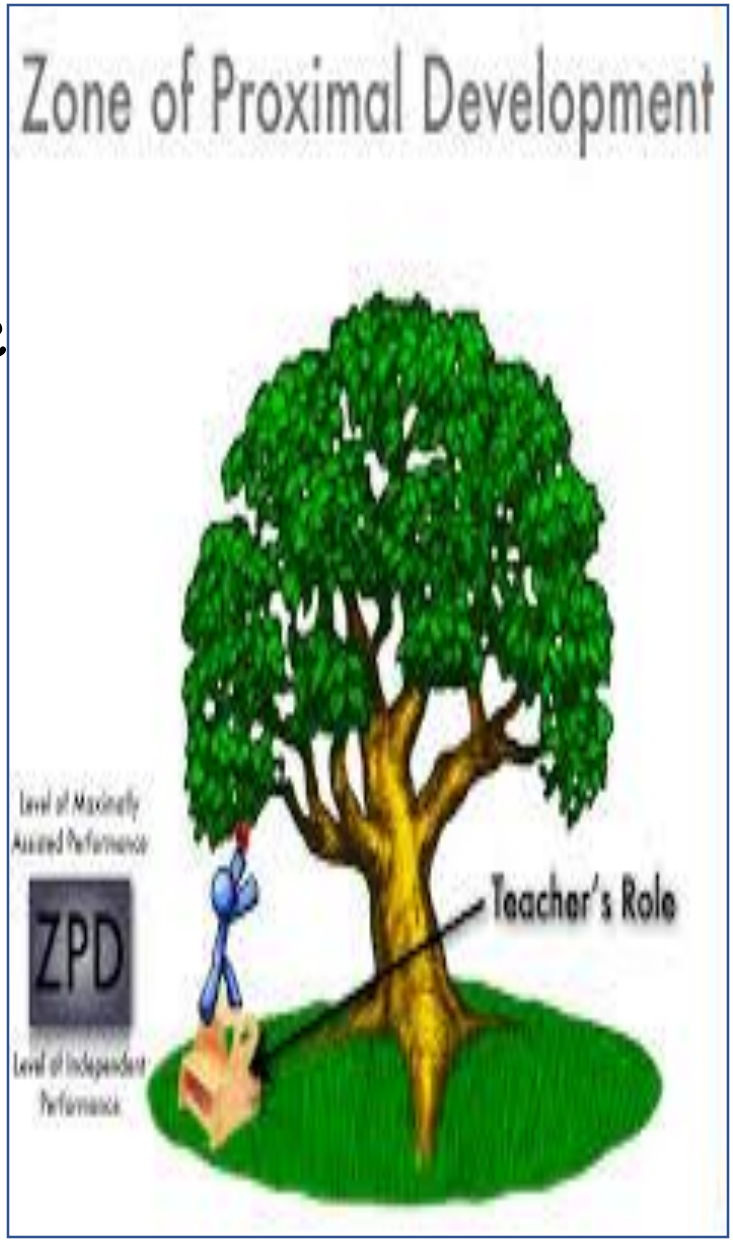
Dewey called for education to be grounded in real experience. He wrote, **"If you have doubts about how learning happens, engage in sustained inquiry: study, ponder, consider alternative possibilities and arrive at your belief grounded in evidence."** Inquiry is a key part of constructivist learning.

Jerome Bruner

"To instruct someone... is not a matter of getting him to commit results to mind. Rather, it is to teach him to participate in the process that makes possible the establishment of knowledge. We teach a subject not to produce little living libraries on that subject, but rather to get a student to think mathematically for himself, to consider matters as an historian does, to take part in the process of knowledge-getting. Knowing is a process not a product."

2. Social Constructivism

- **Lev Vygotsky** introduced the social aspect of learning into constructivism. He defined the "zone of proximal learning," according to which students solve problems beyond their actual developmental level (but within their level of potential development) under adult guidance or in collaboration with more capable peers.



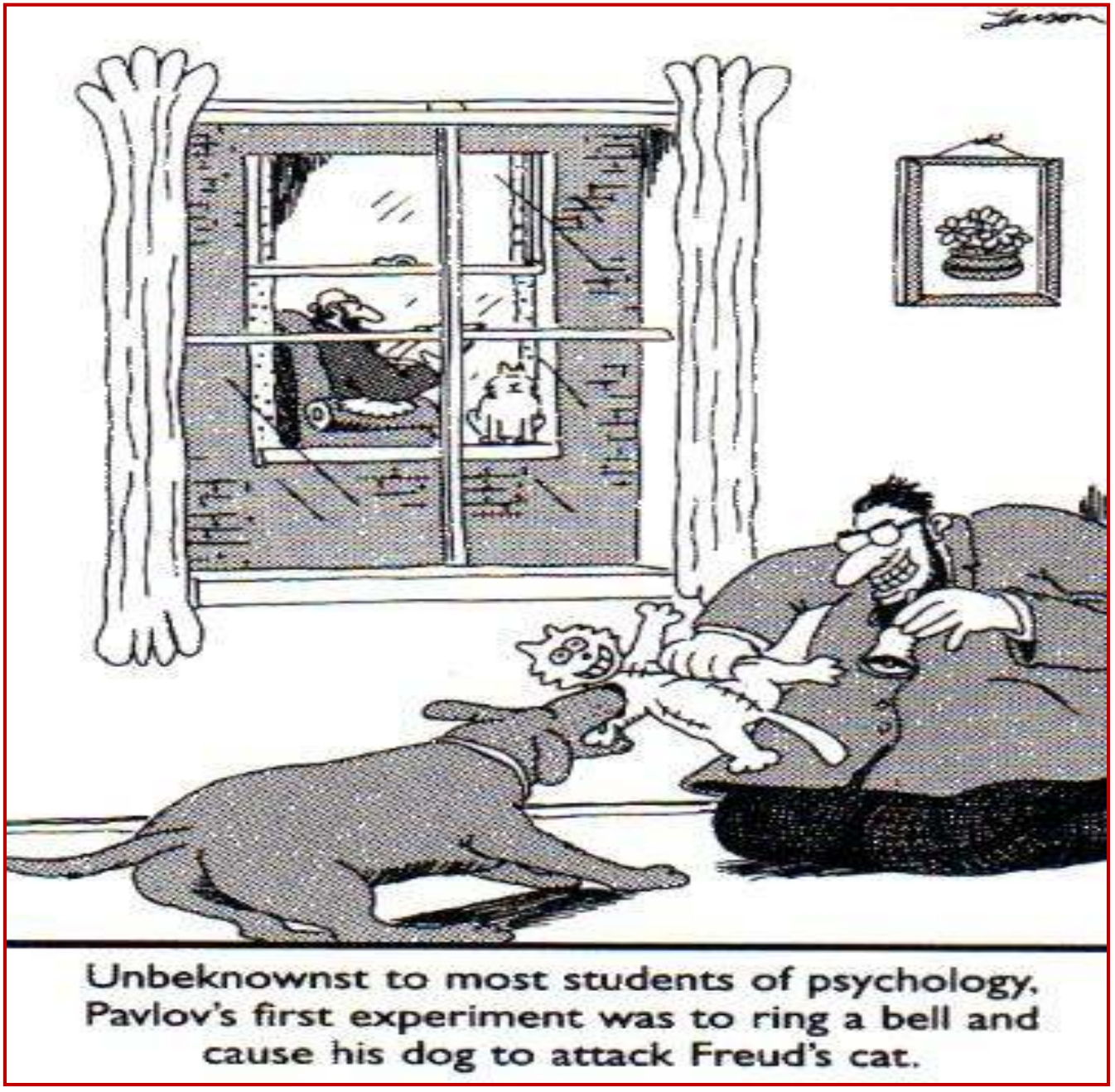
- Among the educators, philosophers, psychologists, and sociologists who have added new perspectives to constructivist learning theory and practice are
- **Lev Vygotsky**

Seymour Papert's

- groundbreaking work in using computers to teach children has led to the widespread use of computer and information technology in constructivist environments.

Modern educators who have studied, written about, and practiced constructivist approaches to education include **John D. Bransford**, **Ernst von Glasersfeld**, **Eleanor Duckworth**, **George Forman**, **Roger Schank**, **Jacqueline Grennon Brooks** and **Martin G. Brooks** to name some.

Role of Prior Knowledge



Prior Knowledge

- **Schema** (In **psychology** and cognitive science, a **schema** describes a pattern of thought or behaviour that organizes categories of information and the relationships among them. ... People use **schemat/a** to organize current knowledge and provide a framework for future understanding.)

- **Draw a house!**

- **Draw a scenery**

- **Personal theories**

- **Interpretations**

Houses

2 Learning Theories: Knowledge

Cognitive Constructivism ***Piaget***	**Social Constructivism** ***Vygotsky***
Building on your existing knowledge by discovering and exploring new knowledge.	Knowledge is socially constructed.

2 Learning Theories: Learning

Cognitive Constructivism	**Social Constructivism**
Active assimilation and accommodation of new information to existing cognitive structures. Discovery by learners.	Integration of students into Knowledge community. Collaborative assimilation and accommodation of new information.

ASSIMILATION VS. ACCOMMODATION

• With preexisting mental structures (schema)	• No preexisting mental structure
• No restructuring - overall beliefs and understanding of the world do not change as a result of the new information	• With restructuring - tried something but did not get expected reaction
↓	↓
• Add or combine new knowledge to own schema (existing mental structure)	• Change own belief or schemas to "accommodate" the new information or knowledge

- assimilation and accommodation are related
- both serve as means to achieve the state of equilibration
- interpret and alter external reality to fit into internal mental structures until a state of equilibrium is achieved

↓

Development

2 Learning Theories: Motivation

Cognitive Constructivism	Social Constructivism
Intrinsic. Learners set their own goals and motivate themselves to learn.	Intrinsic and extrinsic. Learning goals and motives are determined both by learners and extrinsic rewards provided by the Knowledge community.

2 Learning Theories: Instruction

Cognitive Constructivism	**Social Constructivism**
The teacher facilitates learning by providing an environment that promotes discovery and assimilation & accommodation.	Collaborative learning is facilitated and guided by the teacher. Dialogue and interactivity with others.

Constructed

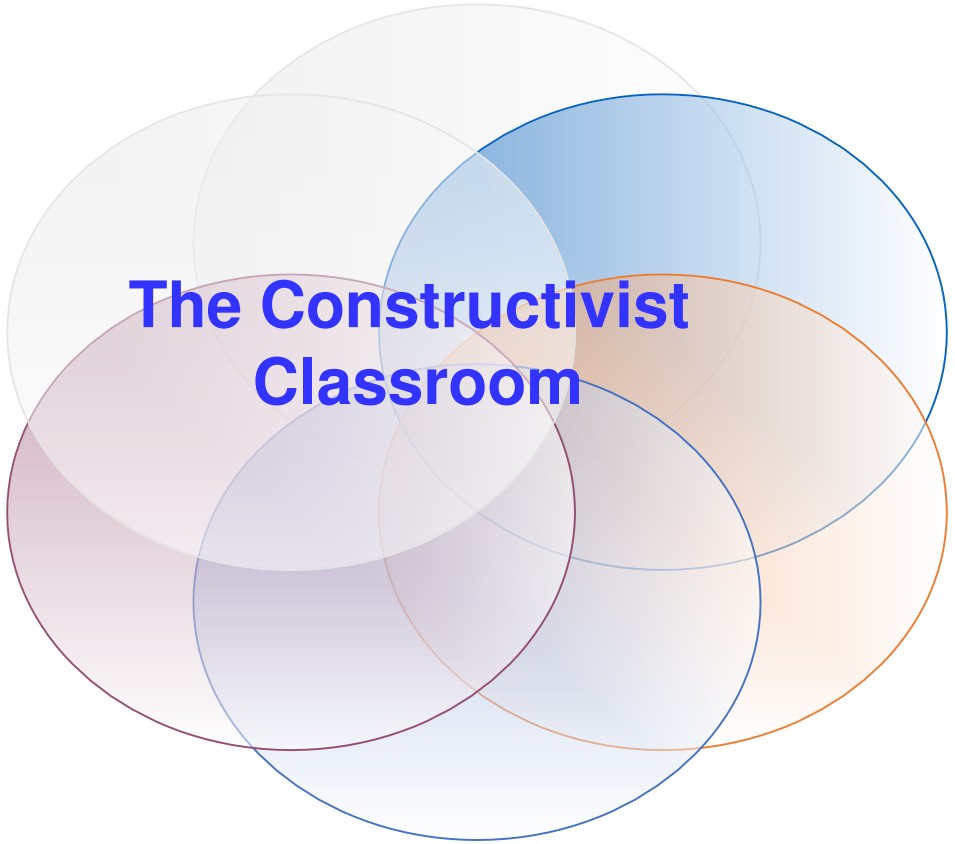
building upon
previous knowledge
to create new knowledge

Evolving

ideas are change
throughout process
of learning

Active

the student experiments,
asks questions,
and sets goals



Inquiry-based

exploration of questions

Reflected

students discuss learning
experiences and reflect
upon understandings

Collaborative

students work together
and learn from one another

Promoting Change

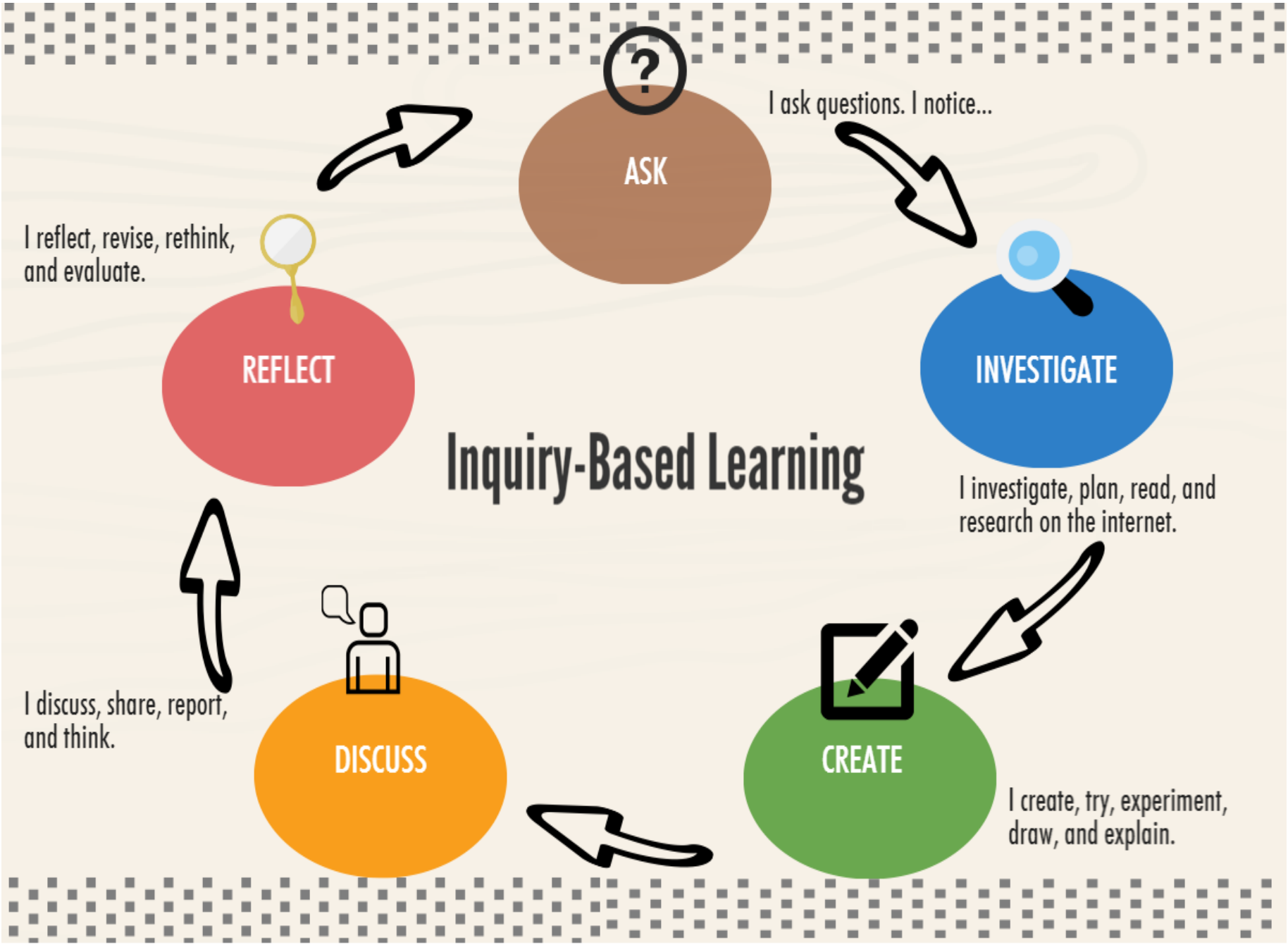
1. Identify existing misconceptions *before* instruction begins.
2. Convince students that their existing beliefs are inadequate.
3. Motivate students to learn correct explanations.
4. Monitor what students say and write for persistent misconceptions.

Implications

- Children should be provided with study materials, activities, and tools that are matched to and capitalize on their developing cognitive capabilities

Implications

- Present others' ideas
- Emphasize conceptual understanding
- Promote dialogue
- Create a community of learners


Inquiry-Based Learning
ASK
I ask questions. I notice...
INVESTIGATE
I investigate, plan, read, and research on the internet.
CREATE
I create, try, experiment, draw, and explain.
DISCUSS
I discuss, share, report, and think.
REFLECT
I reflect, revise, rethink, and evaluate.

Inquiry Based Learning: 5E's Learning Cycle

- Engage
- Explore
- Explain
- Elaborate
- Evaluate

Attention-focusing questions

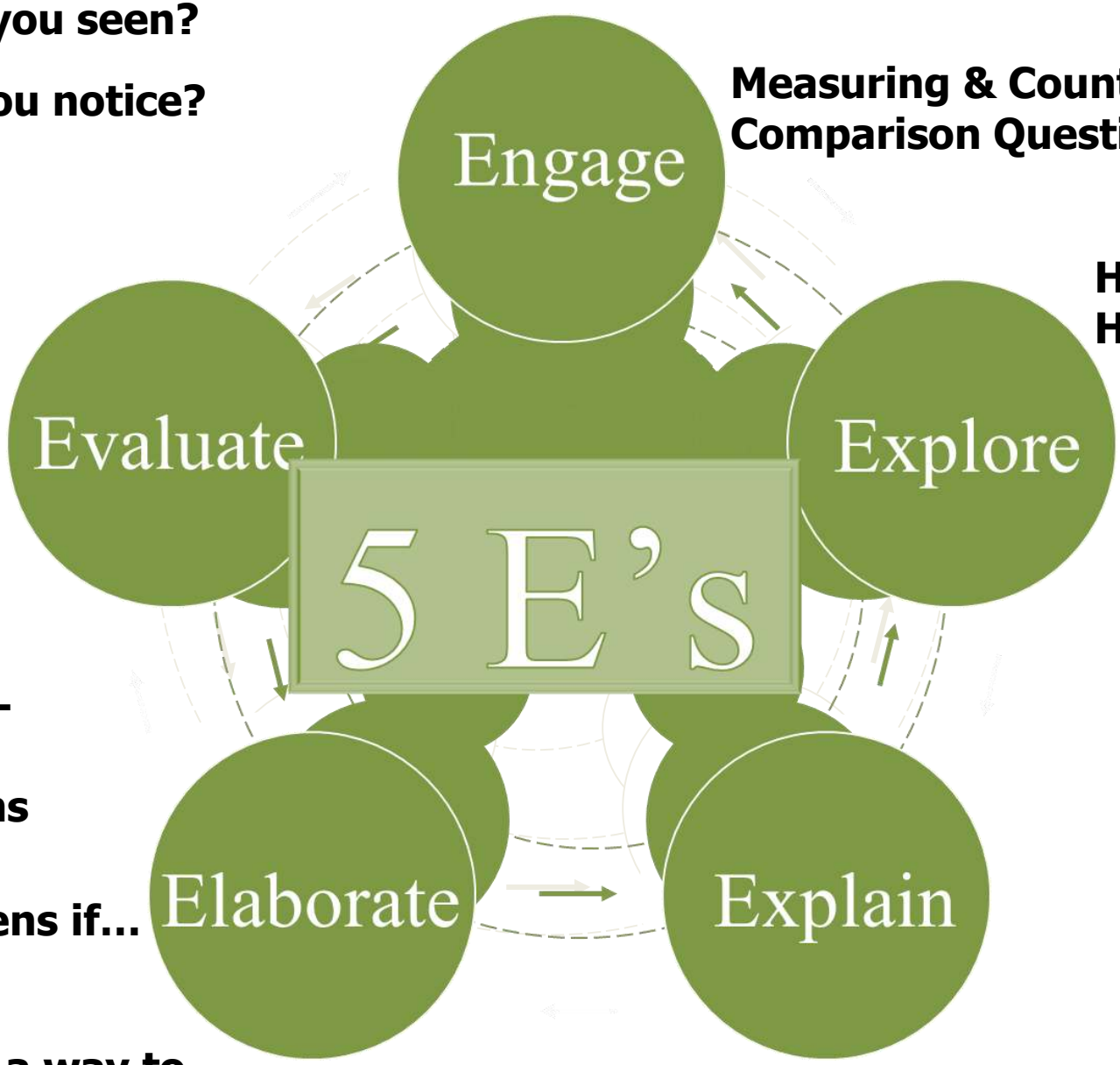
Have you seen?

Do you notice?

Measuring & Counting and Comparison Questions

How many?
How long?

In how many ways?



Action & Problem-Solving Questions

What happens if…

Can you find a way to…

THANK YOU!