

# The Importance of Phenomena in IQWST: Helping Students Understand Scientific Concepts through Experiences

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### Particle Nature of Matter

6th Grade Chemistry Unit

**Particle Nature of Matter Key Concepts**

- All matter is made of particles.
- There is empty space (vacuum) between each of the particles

**Phenomenon**  
Pushing or pulling on a corked syringe compresses or expands the air in the syringe



**Commons Student Misconceptions**

- Matter is continuous
- Particles have no space between them

**The phenomenon in the classroom**  
Experiencing the compression or expansion of air in a syringe provides evidence that air particles are not continuous, but in fact have spaces between them so that students can improve their model of the particle nature of matter.

## Phenomenon: anything interesting for which data can be collected

Science is about explaining phenomena.

IQWST units allow students to have experiences with varied phenomena. Without experiencing the phenomena either through first-hand experience when feasible or vicariously when not feasible, students just learn empty words. Students need to experience phenomena to have a concrete representation to tie the various explanations together. Students experience the phenomena in various investigations, anchoring events, staging events and benchmark lessons.


### Behavior of Energy

7th Grade Physics Unit

**Behavior of Energy Key Concepts**

- Energy is conserved
- Energy can be transferred between objects and states

**Phenomenon**  
A tennis ball rebounds higher than the height from which it was dropped when dropped with a basketball.



**Commons Student Misconceptions**

- Energy does not need to be conserved
- Energy is a relatively short lived product that is generated, active and then disappears or fades.

**The phenomenon in the classroom**  
Experiencing a tennis ball rebound higher than the height it was dropped from when dropped with a basketball provides evidence that energy can be transferred from one object to another. This evidence helps students build an understanding about the behavior of energy.

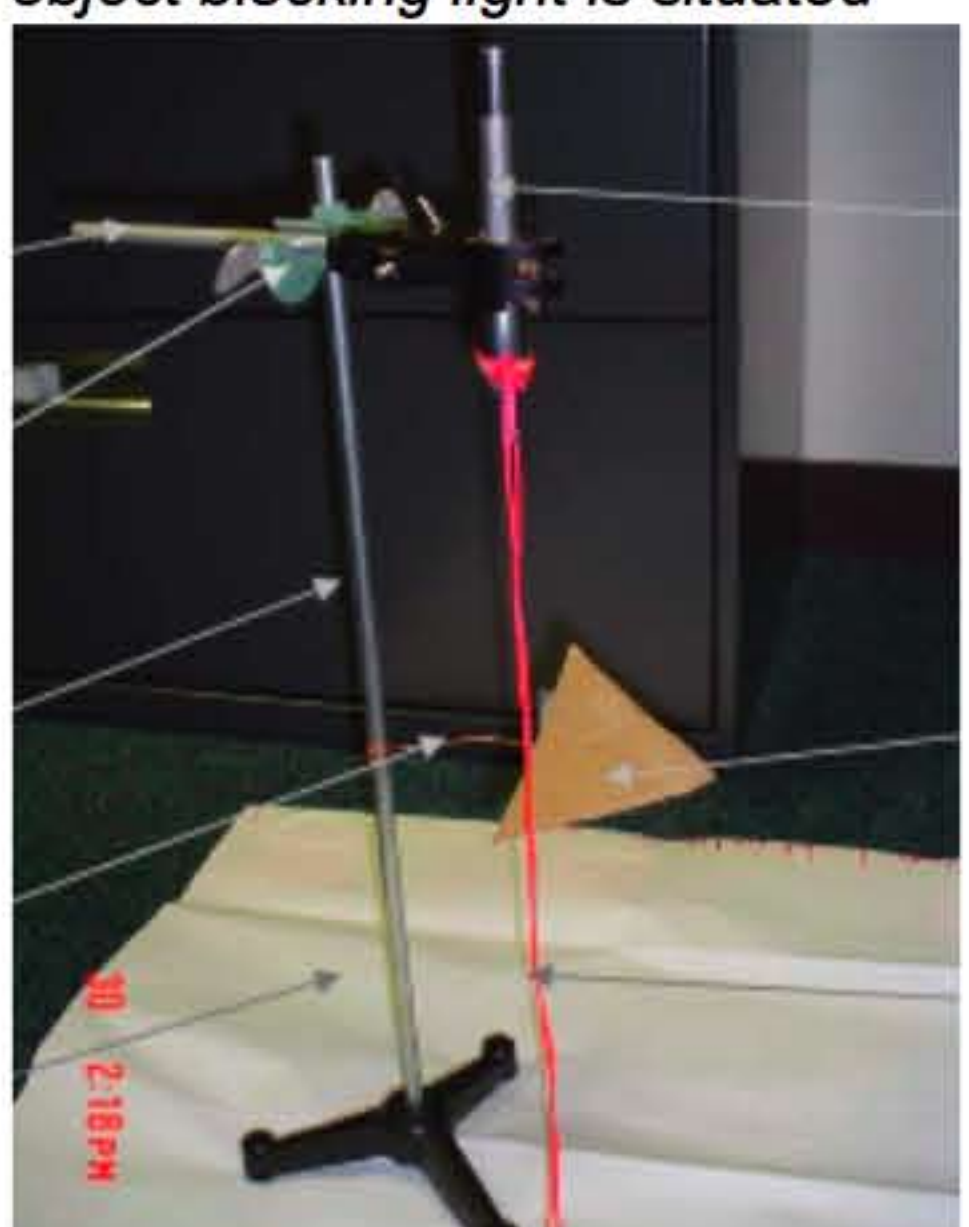
### Behavior of Light

6th Grade Physics Unit

**Behavior of Light Key Concepts**

- Light from a light source moves in all directions in a straight line
- Objects can block light to form shadows

**Phenomenon**  
Shadows are dependent on how an object blocking light is situated



**Commons Student Misconceptions**

- Light fills a space
- Darkness is needed to see a shadow

**The phenomenon in the classroom**  
Experiencing light interacting with an object to create a shadow on a screen provides evidence that 1) light moves in a straight line and 2) helps students build a model of how light interacts with objects so that they can be seen.


### Organisms in Ecosystems

6th Grade Biology Unit

**Organism Structures Key Concepts**

- Organism structures are related to their functions
- An organism's structure contributes to its ability obtain food and reproduce

**Phenomenon**  
Sea lampreys do not have stomachs. Perch do have stomachs.



**Commons Student Misconceptions**

- Organisms have the same structures

**The phenomenon in the classroom**  
Experiencing that sea lampreys and perch have different internal structures provides evidence that 1) organisms have structures that relate to function and 2) an organism's structure contributes to its ability to feed. Understanding these concepts helps students understand how organisms relate to their ecosystems.


### Chemical reactions in organisms

8th Grade Chemistry Unit

**Biochemical Reactions Key Concepts**

- Organisms break down glucose and  $O_2$  and to make  $CO_2$  and  $H_2O$
- Organisms create usable energy by undergoing cellular respiration

**Phenomenon**  
Like animals, plants undergo generate carbon dioxide, but only in the dark.



**Commons Student Misconceptions**

- Plants do photosynthesis, but not cellular respiration

**The phenomenon in the classroom**  
Experiencing plants giving off  $CO_2$  that changes a bromothymol blue indicator when placed in the dark provides evidence that plants perform cellular respiration helping students understand that plants use the chemical energy that they transformed using energy from the sun.


### Properties of Matter

7th Grade Chemistry Unit

**Chemical Reactions Key Concepts**

- During a chemical reaction atoms rearrange to form a new substance
- During a chemical reaction, matter is conserved
- Different substances have different properties

**Phenomenon**  
Magnesium burns to generate matter with new properties.



**Commons Student Misconceptions**

- Material "burns away" or disappears
- Burning is not a chemical reaction

**The phenomenon in the classroom**  
Experiencing the properties of Mg before burning and MgO after burning provide evidence that 1) burning is a chemical reaction and 2) that a new substance has formed from the old substance. This evidence supports the students understanding of chemical reactions.

Each IQWST unit uses multiple phenomena to help students make connections between real-world experiences and scientific concepts.

Phenomena can be used to:

- Help construct conceptual models
- Elaborate or revise conceptual models
- Provide evidence that supports a claim
- Motivate students and further engage them in scientific investigations.


### Water and earth materials

6th Grade Earth Science Unit

**Flowing Water Key Concepts**

- Flowing water moves and shapes earth materials through erosion and deposition

**Phenomenon**  
Water flows over sand, shaping the structure of the sand.



**Commons Student Misconceptions**

- Water flows only in rivers, creeks and streams
- Water only flows South

**The phenomenon in the classroom**  
Experiencing how water flowing over sand shapes the structure of the sand provides students evidence to help explain how water flow has shaped earth materials through erosion and deposition.