



## Next Generation Science Standards Alignment Supports *THE PRIVATE EYE*® — (5X) *LOOKING / THINKING BY ANALOGY*® Correlation



### Crosscutting Concepts & The Private Eye Process

(Five are native to The Private Eye)

The crosscutting concepts are themes or ideas that cut across all the scientific disciplines and engineering. They are ideas that ... prove fruitful in explanation, in theory, in observation, and in design. —Science for All Americans, AAAS 1989 as quoted in: "A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas", National Academy of Sciences, 2012

#### 1. Patterns:

The Private Eye increases pattern awareness and pattern recognition. The 5x loupe gives students a wallop of wonder and surprise; linked to the first Private Eye Question "What else does this remind me of?" — patterns appear and a hunt for similarities begins. Answers not only make pattern personal (and thus more memorable), they become clues to: "Why does this pattern exist?" What causes this pattern? (Clues are in the form of compressed analogies: i.e., metaphors / similes.) With a new found curiosity about patterns and with built-in clues to why a given pattern exists in nature, students generate hypotheses about patterns.

#### 2. Scale, Proportion and Quantity:

All The Private Eye steps and activities engage students in *experiencing* and using the concept of "Scale, Proportion and Quantity." Students view objects and phenomena with one's unaided eye, see smaller and smaller parts using a 5x loupe, then move to a 10x view (two loupes are nested). With this incremental change students comfortably loupe-leap to the microscopic. They use microscopes and/or SEMs to view the objects at even smaller scales. This helps students of all ages smoothly build the concept that: "Natural objects exist from the very small to the immensely large." \*

#### 3. Structure and Function [also called "Form and Function"]

The Private Eye method is based on the structure/function relationship underlying all of nature. The relationship between structure and function is so tight in nature that where there are similarities in form (structure) between two different things or systems, there may be similarities in function. Students loupe-view (or microscope view) their object — and the small structures in the object — asking "What else does it remind me of? What else? What else?" Their answers create an analogy list — a list which explores characteristics and properties of a phenomena through the lens of comparison and provides clues to why something is the way it is.

Students use the second Private Eye Question, "Why did it remind me of that?" to explain the characteristics and properties embedded in the analogies. Now they have a way to answer: "Why is it like that? Why is this thing shaped or formed or structured the way it is?" by asking: "If it reminds me of \_\_\_\_\_, could it function or work like that in some way for the survival of the object or phenomenon?"

#### 4. System and System Models:

Systems follow the same principles of Structure and Function relationships that the rest of the universe follows: Using The Private Eye students learn that form and function are so interdependent in nature that where there are similarities of form between two different things *or systems*, there may be similarities in function. Thus, to understand a new, unfamiliar system, students using The Private Eye ask "What else — what other systems — does this remind me of?", because "the two may function or work in similar ways". "Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering."\*

#### 5. Cause and Effect: Mechanism and explanation.

By heightening pattern-awareness, analogical thinking, and an understanding of Structure and Function relationships, students using The Private Eye more readily and successfully investigate cause and effect in phenomena: faced with a puzzling event, the quickest way to figure out the mechanism behind that event is to use The Private Eye strategy: "What else does this relationship / mechanism remind me of? What else? Because... if it reminds me of an event for which I already know the mechanism and cause, maybe the same kind of mechanism — or a similar mechanism — is causing this puzzling event." "A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated... [which are then] used to predict and explain events in new contexts."\*

**6. Energy and Matter: Flows, cycles, and conservation.** "Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations."\*

**7. Stability and Change:** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

