“INVENTION” PHASE OF THE LEARNING CYCLE  
(Chiappetta & Koballa Jr., 2006, p. 151).

- “The invention phase allows students to determine relationships between objects and events that they have experienced.”

- “Initially, the teacher serves as a guide to channel thinking, encouraging students to construct appropriate labels for the relationships they have just discovered.”

- “Then, the teacher provides key terms to explain the concept under study.” However, the teacher can wait a bit to do this (e.g., see the Feynman piece below), letting the students invent their own names for concepts temporarily.

“CONCEPT INVENTION” PHASE  
(Weld, 2004, p. 154)

- “The teacher assists students in developing science concepts.”

- “Names are given to the concepts that students experienced in the previous [exploration] phase.” However, the teacher can wait a bit to do this (e.g., see the Feynman piece below), letting the students invent their own names for concepts temporarily.

- “The teacher assumes a more direct teaching role as he or she helps students to develop the concepts they are learning through multiple modes of instruction.”

THE NAME OF A CONCEPT IS LESS IMPORTANT THAN KNOWING “WHAT GOES ON” WITH THE CONCEPT  
(Feynman, 1966)

“So we went alone for our walk in the woods. But mothers were very powerful in those days as they are now; and they convinced the other fathers that they had to take their own sons out for walks in the woods. So all fathers took all sons out for walks in the woods one Sunday afternoon. The next day, Monday, we were playing in the fields and this boy said to me, ‘See that bird standing on the wheat there? What’s the name of it?’ I said, ‘I haven’t got the slightest idea.’ He said, ‘It’s a brown-throated thrush. Your father doesn’t teach you much about science.’

“I smiled to myself, because my father had already taught me that that doesn’t tell me anything about the bird. He taught me, ‘See that bird? It’s a brown-throated thrush, but in Germany it’s called a halzenflugel, and in Chinese they call it a chung ling and even if
you know all those names for it, you still know nothing about the bird. You only know something about people; what they call that bird.’

‘Now that thrush sings, and teaches its young to fly, and flies so many miles away during the summer across the country; and nobody knows how it finds its way;’ and so forth. There is a difference between the name of the thing and what goes on.”

WHAT MAKES A GOOD EXPLANATION/GENERALIZATION?
(adapted in part from Hoffmann, 2003)

Simplicity: Given two explanations/generalizations of the same phenomenon, the one that is simpler yet explains a lot, is usually the better one. [See, for example, Sagan’s (1996, p. 211) description of Occam’s Razor.]

Portability: An explanation/generalization should be applicable to explaining other similar situations.

Providing a Mental Framework: An explanation/generalization that provides a framework (for the mind) for ordering several different observations is very good.

Productivity: An explanation/generalization that stimulates further questioning and investigation is often appreciated by other scientists, even if it is later disproved (e.g., phlogiston or caloric).

REFERENCES

• Feynman, R. (1966).

