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Mystery Powders *a la* the Learning Cycle

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MYSTERY POWDERS *A LA* THE LEARNING CYCLE

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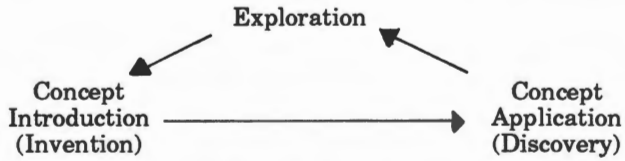
Even as the 1990s seem to be ushering in a new wave of "hands - on" science, one cannot help but look back to the late 1960s when a previous wave of experiential science programs was crashing ashore. Two programs notable among those spawned during the late 1960s and early 1970s were Elementary Science Study (ESS) and the Science Curriculum Improvement Study (SCIS).

ESS units, originally a group of fifty-six independent units covering topics from the physical, biological and earth sciences for K-9, incorporated an instructional strategy called "messing around." "Messing around," which took place during the early portion of an ESS unit, allowed the children to play with and/or explore the equipment and materials utilized in the unit. The ideas behind the "messing around" strategy were to let the students become familiar with the unit's equipment and materials as well as to begin learning something on their own without a lot of teacher guidance or input.

The SCIS program, on the other hand, was developed as a K-6 program, drawing its content from the life and physical sciences. The content was based on a conceptual hierarchy within and across grade levels. SCIS utilized a three stage instructional strategy called the Learning Cycle. The three stages were exploration, invention and discovery. Currently, these stages of the Learning Cycle are identified as exploration, concept introduction and concept application.



The exploration stage of the Learning Cycle is very similar to the "messing around" stage used in the ESS program. During the exploration stage, children are encouraged to learn by their own manipulation of and experimentation with the equipment and materials. The teacher's guidance of the students during the exploration stage is kept to a minimum.

During the invention or concept introduction stage of the Learning Cycle, the teacher has a more focused role. He or she formally introduces the new concept that the children have explored during the previous stage. In this stage, definitions are given, questions are answered and examples are discussed.

Finally, in the discovery or concept application stage, the children are presented with a new situation or situations to which they must transfer or apply what they have learned in the previous two stages of the Learning Cycle. These discovery or concept application activities serve to reinforce, broaden and refine the original concept. The concept application stage's effectiveness is maximized when the student transfers the newly acquired concept to a wide range of examples presented in a variety of situations. In some cases during the concept application activities, the children may actually begin to explore a new but related concept. This leads to a new exploration stage and so the Learning Cycle is repeated.

The similarity between the "messing around" instructional strategy of ESS and the exploration stage in the Learning Cycle would permit a number of ESS units to be taught in a Learning Cycle format. Since 41 ESS units have stood the test of time and are still available through Delta Education, and since Learning Cycle is currently enjoying popularity as an instructional strategy at both the elementary and secondary school levels, it is "useful" to examine how ESS units could be taught using the Learning Cycle format.

One ESS unit that lends itself particularly well to the Learning Cycle is *Mystery Powders*. As designed by ESS, *Mystery Powders* has children investigate common household substances such as sugar, salt, corn starch and baking soda. *Mystery Powders* a la the Learning Cycle might proceed as follows.

Exploration Stage

The children are given four unidentified mystery powders (sugar, salt, baking soda and corn starch) and are asked to use their observation skills to identify these four substances. After seeing, smelling, feeling and tasting the powders, a class discussion follows and the mystery powders are identified.

Now the real challenge begins. Testing kits including iodine solution, vinegar, candles, matches, aluminum foil and clothespins are given to the students, and they are asked to find out what happens when each powder is "tested" with iodine, vinegar and heat (the clothespins are used to hold foil "pans" containing each powder over the lighted candle). The students should be instructed to wear safety goggles during this phase of the activity. The teacher may give the students a chart on which to collect the data, or instruct them to develop their own data collection system.

Concept Introduction

Once the students have made and recorded their observations, a general discussion of their findings ensues. Most children will have recorded the following: iodine turns corn starch deep blue or black; vinegar causes baking soda to fizz; sugar smokes, melts and turns black while being heated; salt "pops" when heated. At this time, the teacher

can introduce the concepts of positive and negative tests. A positive test for the presence of corn starch, for example, occurs when a powder turns blue/black when iodine is added. Positive tests are used to identify the *presence* of a substance. A negative test for the lack ofcorn starch, on the other hand, happens when iodine is added to a powder and it does not turn blue/black. Negative tests are used to identify the *lack* of a particular substance.

Concept Application

Prior to the concept application stage, the teacher prepares a number of mystery mixtures. A mystery mixture is any combination of two or more of the original substances (salt, sugar, corn starch and baking soda). During the concept application stage, the students are presented with the mystery mixtures and challenged to do their best to find out what powders are and what powders are not present in each mixture. The students then apply what they learned about positive and negative testing using iodine, vinegar and heat tests to meet this challenge. Finally, students discuss the strategies they employed and the results of their testing procedures. They then find out how accurately they identified the contents of the mystery mixtures.

To further the concept application stage, the teacher could present the students with additional mystery mixtures consisting of white powders other than the original four substances (e.g. plaster of paris, tooth powder and laundry soap). When the students' observations yield negative test results, a class discussion focusing on the students' inferences regarding their results could ensue. Possible follow-up activities might find the students hypothesizing what substances they think are contained in the new mystery mixtures and designing experiments to test their hypotheses.

One of the original intents of the ESS units was to supplement content-oriented science textbooks with "hands-on" activities. Although many science textbooks today do include activities, ESS units can still be used as valuable supplements. Further, the value of many ESS units can be enhanced if they are taught a la the Learning Cycle.

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