Appendix D

Learning Cycle Lesson Models

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| **Licensure area** | **Physics** |
| Topic | Pendulums |
| Objectives | Identify factors that affect pendulum rate |
| New vocabulary | Pendulum, bob, (rate) |
| Concept Discovery | Students brainstorm factors that may affect rate of a pendulum, craft individual hypotheses for each, then are broken into teams of 2-4 to test out one factor using any of the provided materials. Students individually write up their lab report (in class), then groups share out to the rest of the class what they tested, how they tested it, what they found, and what they would change in future tests. After all groups have shared, the class decides on controls for testing and retests their hypotheses. |
| Concept Clarification | Student groups share out their findings and field questions as I record the findings on the board. I make clear and ask them to record in their notes which factors do (length) and do not (mass, release height) affect pendulum rate, as well as the direction of the relationship between length and rate (longer equals slower, shorter equals faster) |
| Concept Application | Students individually make hypotheses about the impact of replacing a 12 oz jar of peanut butter with a 16 oz jar of peanut butter on a pendulum with a zip-tie that cinches right below the lid. They then carry out the experiment in pairs and write up their conclusion independently. |

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| **Licensure area** | **Chemistry** |
| Topic | Calculating molecular mass |
| Objectives | Using a periodic table, calculate the molecular mass for a given molecule. |
| New vocabulary | molecular mass, formula mass |
| Concept Discovery | Students are provided with a chart that shows three examples of molecular formulas and their masses. They use their periodic tables as a tool to help them figure out how molecular masses are calculated. They confer with their assigned partner, then check their strategies with a new set of examples that I post. |
| Concept Clarification | Teacher invites students up to share their strategies—including specific ways of writing out their computations—on the screen. After many strategies are shared, teacher leads a discussion of which formats of recording computations might be most useful or efficient for students. Students think-pair-share through three increasingly challenging sets of examples using their choice of recording strategy, then share their computation strategies on the screen. |
| Concept Application | Students individually write out their solution to one easy and one more challenging molecule. |

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| **Licensure area** | **Life Science** |
| Topic | Plant anatomy and reproduction |
| Objectives | * Categorize foods in biologically correct categories of fruits and vegetables and defend each choice with evidence and reasoning. * Label the parts of a plant [partially addressed] |
| New vocabulary | fruit, vegetable, vegetative, ovary, seed, stem, root, leaf |
| Concept Discovery | Students number 1-20 on their paper and create three columns: *Fruit*, *Vegetable*, and *Other*. I pass around brown paper bags of various foods (apple, mushroom, bok choy, ginger, eggplant, broccoli, mango, cucumber, etc.) and ask them to check what category to which they believe each belongs. I then ask them to write a definition for “fruit” and for “vegetable” based on what they checked as fruit (this is really assessment of prior knowledge, not Concept Discovery yet, but the activity is inextricably linked to the Concept Discovery activity, coming next). I reveal that there are 14 items that are “fruits” according to the biological definition, and 4 that are “Vegetative” parts of plants. I then ask them to work with their partner to try to determine which 14 might be fruits, which might be “vegetative structures,” and what the biological definition of each might be. Finally, I share the numbers of the 14 fruits and 4 “vegetables” and ask them to revise their definitions as needed, being ready to defend their definition with evidence. |
| Concept Clarification | I call on students to share out their partnership’s definitions. I share a biological definition of fruit and show images of other fruits as well as the flower ovaries from which they develop. I provide a biological definition of “vegetative” parts of plants (roots, stems and leaves) and show examples of things that are truly “vegetables”—a vegetative part of a plant. |
| Concept Application | Students are given samples of new items and asked to sort them into the *Fruit*, *Vegetable*, and *Other* category, providing evidence for each decision. They then individually create an advertisement for a “fruit” juice, candy, or gum that uses things that are biologically fruits, though in the grocery store they would be called vegetables. For a challenge, students are invited to make an argument for how botanists might categorize peas and pea pods. |

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| **Licensure area** | **Life Science** |
| Topic | Natural Selection |
| Objectives | * Describe the steps of natural selection * Use the steps of natural selection to propose how a specific adaptive trait *may have* developed in a population. |
| New vocabulary | adaptation, adaptive trait, favorable trait, natural selection |
| Concept Discovery | Students play the role of “oogawoks” who forage for “starfruit” (tightly wrapped taffy candies) with their fuzzy talons (cotton swabs). A new mutation of pointy talons (cocktail toothpicks) proves favorable and sweeps the population over generations. Students write summaries of what happened to the population and how it happened. |
| Concept Clarification | With leading questions from the instructor, students share details of their summaries as I format that into the four steps of natural selection. I use student input to define “adaptation” and “favorable trait.” I then use direct instruction and guided practice to model using those four steps to explain how a population may have developed that trait over time. |
| Concept Application | Students choose an organism and an adaptive trait, then write out the steps of natural selection that may have led to that trait becoming the norm in the population. |