KENAN FELLOWS PROGRAM

Cate Colangelo - 2012 Kenan Fellow "Cell Science—A 21st Century Approach"

<table>
<tr><td></td><td colspan="2">Proto-ZOO-ology: A Problem-Based Protist Inquiry Unit
Lesson 1: A Protist Protest</td></tr>
<tr><td>Introduction</td><td colspan="2">Protists are used easily to examine classification systems, population diversity, life-sustaining processes, stimulus/response in the environment, and many other "big" concepts that are repeated when studying larger, more complex organisms. A strong foundation in these concepts at the unicellular level will improve student understanding throughout the life science/biology learning progression. The conceptual lens used throughout this unit is the student development of a zoo exhibit for protists. Lesson 1 specifically addresses the six characteristics of all living organisms, as AAAS (American Association for the Advancement of Science) assessment data indicates that only 50-53% of middle school students correctly identify that all cells/organisms have life-sustaining characteristics in common.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="2">1. Lesson Outcome: Students will distinguish between living and nonliving things through the use of evaluation criteria when creating an individual Biotic/Abiotic T-Chart.
2. Lesson Outcome: Students will recognize that despite the great diversity of organisms, all (including unicellular) have life-sustaining characteristics in common through the creation of a group Affinity Diagram.
3. Unit Outcome: Students will create a poster that demonstrates the organelles, abilities, and importance of protists.</td></tr>
<tr><td>Curriculum Alignment/ Framework</td><td><u>NC Science 2009 Essential Standards</u>
7.L.1 Understand the processes, structures and functions of living organisms that enable them to survive, reproduce and carry out the basic functions of life.</td><td><u>21st Century Skills</u>
Critical Thinking & Problem Solving
• Reason Effectively
• Use Systems Thinking
• Make Judgments and Decisions
Communication & Clarification
• Communicate Clearly
• Collaborate with Others
Leadership & Responsibility
• Be Responsible to Others
<u>NC Professional Eval. Instrument</u>
Standard II: Respectful Environment for Diverse Learners
Standard III: Content Knowledge
Standard IV: Facilitation of Learning: Critical Thinking, Collaboration, Variety of Assessment Methods</td></tr>
<tr><td>Classroom Time Needed</td><td colspan="2">Lesson 1: 2 Class Periods: approximately 120 minutes, although class size will affect the timing of some activities</td></tr>
<tr><td>Teacher</td><td colspan="2">The teacher should have made arrangements for the NC Zoo picture collage to</td></tr>
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Preparation	be projected for the entire class to see. In addition, the teacher should have previously purchased post-it notes to use in the Affinity Diagram activity and made copies of the "6 Characteristics" foldable (optional), "6 Characteristics Examples" guided practice assignment, and "Plant vs. Ice Cube" Independent Practice. The teacher will also need to have laminated poster board to use as the organizational surface for the Affinity Diagram if interested in it being re-usable.
Materials Needed	NC Zoo habitat picture collage, T-Chart "Living vs. Nonliving," Post-It Notes, T-Chart "Observations/Conclusions," "6 Characteristics" Foldable, "6 Characteristics" Guided Practice/Independent Practice Questions, Laminated poster board per group (optional), student whiteboards or "flashcard" response set (optional)
Technology	SmartBoard/LCD/Overhead projector for illustration and student directions Smartboard clicker response system (optional)
Prerequisite Knowledge/ Skills for Students	From previous K-6 life science learning progressions, students should be aware of the differences between the living and non-living. However, certain collage pictures are included to verify this understanding (i.e. the statue of a hippopotamus—students at an earlier cognitive level will have trouble placing this non-living object because it is a representation of a living organism). Students should also be able to classify using criteria and work collaboratively with others. The Affinity Diagram process will act as a scaffold for those still in the developmental stages of these skills.
<u>Pre-Activities</u> Exploration Time Frame: 10 minutes	Day One 1. (2 min) The teacher will explain that a group representing protists are protesting the lack of credit given by the North Carolina Zoo to protists, along with its native flora and fauna. The NC Zoo Board is taking this protest seriously, but since protists are not recognized as plants or animals, the Board is questioning if they are alive. The class had been asked to research the characteristics of living things and help the Board decide if protists are living organisms that can be included in the zoo. 2. (3 min) On the right side of their interactive notebooks/science journals, students should create individually a T-chart on approximately ¾ of the page and label it "living" and "nonliving." The teacher should then project the NC Zoo collage for the students to view. This illustration provides a "common ground" for all students in the room, as well as begins to introduce the overarching theme for this unit. 3. (5 min) Individually, students should write the names of the organisms and objects from the illustration in the T-chart section that they personally choose. Challenge students to list as many different items for each category as possible.
<u>Activities</u>	1. (5 min) The teacher should explain the process of creating an affinity

Model System Time Frame Day One: 30 minutes	diagram (see Appendix) and provide Post-It notes for each student group of approximately four students. The topic for the diagram should be "What does it mean for an organism to be alive?" 2. (5 min) In Stage I, students should generate their own ideas silently on the Post-Its. 3. (5 min) In Stage II, students should silently place their Post-Its on the group poster board or a common surface and work collaboratively to group similar ideas together. 4. (5 min) In Stage III, students should place category labels above each major grouping of similar ideas. 5. As students are working in their groups, the teacher should be monitoring student progress and recording any anecdotal notes that may be of assistance later—i.e. students who are having difficulty generating multiple responses, students who are using more advanced vocabulary in their responses, dysfunctional groups, etc. 6. In addition, the teacher may choose to ask the following leading questions to ensure that all six characteristics are found somewhere among all the different student groups or may simply introduce the missing concepts in the content wrap-up: "Where did the _____ 'come from' in the illustration?" (Reproduction) "Does nonliving mean the same thing as dead?" (Life Span) "Does that _____ always stay in the same place? Why or why not?" (Response to Environment) "Do the _____ and _____ look alike? Why or why not" (Growth & Development/Response to Environ.), If _____ is alive, what must it do every day to stay that way? Why? (Metabolism) What is _____ made of? (Cellular Composition/Organization)
Content Wrap-Up Time Frame Day One (20 min)	7. (10 minutes) On the matching left page to the T-chart, students should create a second T-chart labeled "Observation" and "Questions Raised/ Conclusions." The teacher should direct students to rotate among the different groups' affinity diagrams with the specific objective to record the different groups' categories in the "Observation" column of their notes. 8. For Day One Homework, students should complete the "Questions Raised/ Conclusion" column of their T-chart by identifying common and unique categories among the groups, drawing any additional conclusions from the information, and posing any questions that they have about the class's Affinity Diagrams. Day Two
Content	9. (10 minutes) Students should share out their "Conclusions" with the class

Wrap-Up Time Frame Day Two (50 min)	as the teacher records on the board. Do not cross out or eliminate any incorrect or irrelevant information yet. Tell students that they will have the opportunity to discuss the conclusions and the questions raised after the initial information is recorded. 10. (10 minutes) Begin any relevant discussions that may have been generated throughout the process. For instance, if students have included specific body parts that are not universally used by living things (brain, heart, etc.), and students have not already addressed this issue when they've shared their "Questions Raised," the teacher will need to raise the question for the class to address together. 11. Once the teacher determines that discussion is over, the teacher should point out the number of student categories that match scientists' characteristics of life. In most cases, 5-6 of the six characteristics will have been generated by students themselves. 12. The teacher should introduce the more scientific terms "biotic" and "abiotic" to replace the initial "living" and "nonliving" common terms, as well as the concept that unicellular organisms like protists also must meet these six criteria, a concept that will be further developed as students continue through this unit. Finally, the teacher should emphasize that organisms must meet all six characteristics in order to be considered biotic. 13. (30) The teacher then should lead students through the completion of the "Six Characteristics of Life" foldable (see Appendix) on a right-side page of their notebooks. The examples given on the left side of the foldable could be modified to include student suggestions from their Affinity Diagrams to provide more student ownership if the teacher desires.
Guided Practice Day Two: Formative Assessment (10 minutes)	1. Hand out the "6 Characteristics Examples" Guided Practice worksheet (see Appendix). Students should glue it on the left side page opposite their "6 Characteristics" foldable. 2. Students should indicate their answers to the first set of examples through SmartBoard response clickers, individual whiteboards, or a "flashcard" method to allow the teacher to gather individual & whole class data.
Independent Practice: Formative Assessment Day Two	HW: Students should complete the second section of the "6 Characteristics Examples." Student response data should be used to inform teacher instruction and student grouping as necessary.
Lesson Modification	1. Consider providing ELL students with the appropriate translation dictionary or a "translation buddy" to aid in the transfer of ideas from the illustration to

Opportunities	written work throughout the lesson. The Foldable could also be given to the student in CLOZE format to ensure both participation and accurate information. 2. Consider allowing use of T-chart during the affinity diagram portion to allow students access to previously generated ideas. 3. Consider leading EC groups (or other teacher-identified populations) that work best with one direction at a time through the affinity diagram activity directions one stage at a time to prevent confusion. The Foldable could also be given to the student in CLOZE format to ensure participation and accurate info. 4. Consider expanding on the unit's conceptual lens with students who are advancing quickly through this activity. Ask them to brainstorm ways that zoos have to accommodate these six characteristics in order to be successful.
Summative/ Alternate Assessments	Student consideration/inclusion of the 6 characteristics when designing their zoo exhibit poster for protists; Written unit test Page Keeley's "Functions of Living Things" probe from Volume 1 Uncovering Student Ideas in Science, pg147 Student-created art collage using internet or magazine/newpaper illustrations with written explanation demonstrating an understanding of the 6 characteristics.
Supplemental Information	Affinity diagrams-how and why—see "Websites" Interactive NBs-how and why—see "Websites" Marzano's Classroom Instruction that Works: gains through classification of information—see "Websites"
Critical Vocabulary	General Vocabulary Terms: Characteristic—a feature or quality that is typical of an object/organism/group Category—a group based on shared characteristics Content Specific Terms: Abiotic—nonliving; never had the characteristics of life Biotic—living; has or once had the characteristics of life, including death Cell—the smallest unit of life Unicellular--describes an organism composed of a single cell (ex. bacteria) Multicellular--describes an organism composed of many cells (plants, animals) Growth & Development- the multiplication of cells in an existing organism to add mass or change its shape/structure Metabolism--the energy-sustaining processes that use raw materials/ produce products like oxygen, carbon dioxide, sugars, etc. Environmental Response--the ability of an organism to react to its surroundings to improve its chance of survival Reproduction-- the asexual or sexual creation of a new organism by an existing organism or organisms Life Span-- the limited time range before an organism's cells break down

	beyond its ability to replace or repair them
Websites	http://asq.org/education/docs/affinitydiagram.pdf for directions for creating an affinity diagram, as well as other Quality Tools for teachers http://www.slideshare.net/arholder/interactive-science-notebook-full-version for research supporting the use of interactive notebooks, as well as step-by-step instructions for teachers and students for their set-up and use http://classroom.leanderisd.org/webs/marzano/ for a study guide designed by ASCD to enhance understanding of Classroom Instruction That Works: Research-Based Strategies for Increasing Student Achievement http://assessment.aaas.org/ for Project 2061 test data bank items classified by topics, sub-ideas, and misconceptions for 6-8 and 9-12 grade levels
Comments	A common student misconception is to decide that an object is "living" when it meets just one or a few of the six criteria, instead of ALL six (i.e. Virus Debate). This misconception will be explicitly addressed during the content wrap-up phase, as well as again through the "Plant vs. Ice Cube" and the "Glue Monster" activity during Lesson 2 of this unit.
Author Info	Cate Colangelo, M.Ed. Science Education, NBCT Early Adolescence Science North Johnston Middle School Science Lead Teacher 17 years teaching experience Class of 2012 Kenan Fellow This lesson is part of my unit being developed for my NC DPI Kenan Fellowship implementing the 2009 Science Essential Standards. Kenan Fellowship Mentor: Mary Russell, NCDPI REGION 3 Professional Development Lead, Office of Educator Recruitment and Development

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Courtesy of NC Zoo www.nczoo.org photo gallery

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"NC Zoo Illustrations"

After creating a T-chart labeled "living" and "nonliving," write the names of as many different items as you can find in this collage in each of the two sections.

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Sample "Living vs. Nonliving T-Chart"

Living	Nonliving
Lion cubs	Water
Lion mom	Sky
Bumble bee	Soil/dirt
Purple flower	Snow
People	Garbage can lids
Lettuce & Potatoes	Rocks
Fish	NC Zoo sign
Fancy-looking ducks	Hippo statues
Turtle	Clothing
Elephants	Tablecloth
Polar bears	
Grass & Trees	

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Please Note: Although it is tempting to allow speaking during the affinity diagram process, the silence prevents a verbally-dominating student from taking charge of the group and maximizes the participation of a shy or verbally-disadvantaged student. In addition, it is tempting to minimize the number of Post-Its used by having students share ideas and only record them once; however, this defeats the purpose of having students build their "common" diagram and can again lead to domination by the "quickest draw."

Affinity Diagram

Description

A tool to generate, organize, and consolidate information gathered through brainstorming.

Utility

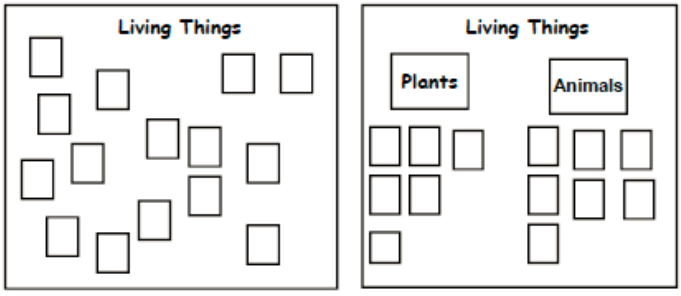
Affinity Diagrams help to give a sense of the ideas that a group has concerning a given issue, provides an anonymous, nonjudgmental format for gathering group input. They can be used to give the group a sense of how serious a concern is because of the number of thoughts written on the issue. They can also indicate the gaps in a group's thoughts. They also focus on how the group is similar in thought.

Construction

1. The leader (teacher) states the topic, problem, or issue to be addressed.
2. The group (~4 students) individuals brainstorm and record all ideas, one per slip of paper, silently. (Use index cards or Post-Its.)
3. The group posts the ideas on a board or arrange on a table.
4. The entire group moves the cards into piles by like ideas or common themes.
5. The group names or titles each pile/set of cards with a header that summarizes the content.
6. The group organizes the ideas under headers to create the visible diagram.
7. Discuss the piles. Look at the frequency of recurring themes, ask questions as needed and address the final conclusion or next steps.

Modified from http://asq.org/education/docs/affinitydiagram.pdf

Affinity Diagram



The teacher posts a question on chart paper.
Students record responses to each of the questions on single Post-it® notes.
When all responses have been collected,
students sort them into like categories and discuss.

Identifying similarities and differences

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http://springfieldpublicschoolsmo.org/staffdev/CCI/docs/MarzanoHYScards.pdf

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Sample "Observations" & "Questions/Conclusions" T-Chart

☆ =each time said by a different group

Observations	Questions/Conclusions
Has to move ☆☆☆	Almost every group said:
Breathes ☆☆☆☆☆	1. It moves
Eats ☆☆☆☆	2. It breathes
Has parts (brain, heart, stomach, lungs, eyes) ☆☆☆☆	3. It eats
Lives in one location	4. It has parts
Takes in nutrients	5. It grows
Adapts ☆	6. It reproduces
Grows ☆☆☆☆☆	7. It needs water
Reproduces (has babies) ☆☆☆☆	My questions are:
Communicates	Do plants move?
Has predators	Plants don't have some of these parts, so should we include plant parts, too?
Sleeps	Does everything sleep?
Must stay warm	Do all living things communicate?
Needs water ☆☆☆	
Needs a home/protection	

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"6 Characteristics of Life" Foldable

The following foldable can be photocopied 2 per landscape letter size OR can be created by students in their interactive notebooks by gluing the top, left side, and bottom of two sequential pages together and then cutting six flaps consisting of three notebook lines each, allowing for a summary space below. "Underneath" each flap should be written the definition, description, or justification for each of the six characteristics based on the class discussions following the affinity diagram. Examples of definitions for the six sections are found in the "Critical Vocabulary" section of the lesson plan and on the next page. On the "back" of each flap is space for students to record examples, which may be teacher or student-provided, as shown on the next page.

It's Alive . . . Or is it?

To be judged biotic, an organism must show ALL of the:

Six Characteristics of Life
1 or More Cells
Growth and Development
Metabolism
Response to Environment
Reproduction
Definite Life Span

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"6 Characteristics of Life" Foldable inside sections

Back of Flap	Under the Flap
Unicellular example: bacteria Multicellular example: a plant or animal	**Cell**—the smallest unit of life **Unicellular**—single-celled organism **Multicellular**—organism made of many cells
Examples: seed to sapling to tree egg to larva to pupa to adult butterfly	the multiplication of cells in an existing organism to add mass or change its shape/structure
Examples: green plants absorbing sunlight student eating a hamburger	the energy-sustaining processes that use raw materials/ produce products like oxygen, carbon dioxide, sugars, etc.
Examples: vines twisting to be in the best light possums "playing dead" around predators	the ability of an organism to react to its surroundings to improve its chance of survival
Examples: plant leaf cuttings to make a new plant pollen & seed combined to make new plant	the asexual or sexual creation of a new organism by an existing organism or organisms
Examples: Average for an oak tree: 350 years Average for aquarium goldfish: 5-10 years	the limited time range before an organism's cells break down beyond its ability to replace or repair them

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"Examples of the Six Characteristics"

Identify the example by which characteristic of living organisms it demonstrates and be prepared to justify your decision.

A. Composed of 1+ cells
C. Metabolism
E. Reproduction
B. Growth & Development
D. Environmental Response
F. Definite Life Span

_____1. adult mayflies live for one day
_____2. "puff up" when feel threatened
_____3. stores fats for energy source
_____4. pollen carried from flower to flower
_____5. why snakes shed their skin
_____6. root, stem, leaf
_____7. lays thousands of eggs
_____8. migrate because of seasonal changes
_____9. bacteria are the smallest of these
_____10. need insulin injection to help use sugars
_____11. average in US is 78 years
_____12. eggs—tadpoles—adult frogs

_____13. nerve, blood, epithelial
_____14. sweat when too hot/shiver when too cold
_____15. digesting a pizza slice
_____16. copy genetic material and divide into two
_____17. 3,200 yrs: oldest known sequoia
_____18. 5 cm taller in two months
_____19. ostrich egg is largest of these
_____20. use of chlorophyll to trap sunlight
_____21. bird calls when predator near
_____22. average for an elephant is 70 years
_____23. sperm and eggs in humans
_____24. infant-toddler-pre-teen-teenager-adult

"Examples of the Six Characteristics" ANSWER KEY

Identify the example by which characteristic of living organisms it demonstrates and be prepared to justify your decision.

A. Composed of 1+ cells
C. Metabolism
E. Reproduction
B. Growth & Development
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F. Definite Life Span

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__D__2. "puff up" when feel threatened
__C__3. stores fats for energy source
__E__4. pollen carried from flower to flower
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