The AP Biology Summer Inquiry Project (SIP)

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Background Information

This lesson is designed for students to complete as a summer learning experience in Inquiry Science. The AP Biology Curriculum and Common Core are changing to reflect Inquiry in student learning and assessment. Students work through the FIVE SIP Lessons during the summer months. Teachers are encouraged to recommend due dates for each lesson. Lesson five must be started not later than the first week in August. The due date for all FIVE lessons including a final abstract and final poster is the first day of school.

Teachers: Please take time to work through the SIP lessons BEFORE launching the lessons with their students. In this way, teachers will be aware of what is expected, may modify lessons, and will be better able to inform students of their own personal expectations.

It is also important for teachers to let their students know how to communicate to get clarification or other help while working through the *Moodle* lessons. Students can always email me or call my home phone number. Each teacher needs to clarify how communication will be used during the lessons—*ie* forums or message boards or email.

Teachers are free to alter the submissions products for each lesson—*ie* invite students to create a wiki after the forum or a *Prezi* or a hand-written lab journal in lieu of a simple word document as noted throughout these lessons. These lessons include hands-on experimentation requiring safety permission forms, reading, video analyses, forum, data analyses, writing of technical text in several drafts, critical and creative thinking, independent work, and collaborative publications. Teacher may want students to form groups earlier in the process than is noted in these lessons, however if grouping is formed too early on in the process, then the teacher runs the risk of squelching the independent, creative thinking processes of her students. A rich array of possible experimental designs comes about if teachers wait until the end of lesson four to group students. Teachers can decide how to group students or leave it to them to find thir own Pill Bug Explore Teams of four.

The SIP not only provides students with a quality taste of research and the kind of thinking required; but also provides the teacher with feedback on student thinking and research processes. Teachers start the year off knowing a lot about each student! Students get a flavor for the kind of laboratory investigations they will be required to do throughout the AP Biology Curriculum.

As you enter the SIP moodle lessons, you will see the five lessons. Below is a screenshot of this Moodle lesson and additional details including the website resource:

Screen Shot

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AP BIO, SIP: Summer Inquiry Project

Work independently to complete the FIVE lessons in Moodle which will take you through the SIP process. Then, as a member of a team of researchers and for the summative assessment regarding your learning about research, experimental design and behavior, work with your lab partners to design, implement and publish on your very own "Train a Pill Bug" investigation.

- Lesson One: The Scientist in YOU!
  - Draw a Scientist--YOU!
  - Your thoughts on Science Methods
- Lesson Two: Animal Behavior
  - Behavior Mechanisms
  - Guppies RS
- Lesson Three: Sifting through Research Summaries
  - Research Summary from Science Daily
- Lesson Four: Time for PILL BUGS!
  - Pill Bug Word Document
  - Experimental Design
  - Final Experiment (One per Pill Bug Explore Team)
- Lesson Five: The Pill Bug Experiment, Abstract, and Poster
  - Finally
  - Sample Abstract for Students to Use
  - FINAL Abstract
  - POSTER Template
  - Final Poster Submission

Additional SIP Lesson Details:

Lesson One: (*Approximate Time 90 minutes*)
The Scientist in YOU

Draw YOU as a scientist
Explore Science Methods
http://www.ncbi.nlm.nih.gov/pubmed/17327589
http://depts.washington.edu/rural/RURAL/design/scimethod.html#communicating
http://www.nsta.org/about/positions/animals.aspx

Types of Research—Bench to Bedside
A Vending Machine for Crows
http://www.ted.com/talks/lang/en/joshua_klein_on_the_intelligence_of_crows.html

Reporting Out—the Scientist in YOU!

Lesson Two: (*Approximate Time 3 hours*)
Animal Behavior

Read UP! Animal Behavior
http://163.16.28.248/bio/activelearner/50/ch50intro.html

Can YOU train a dog like Pavlov?
http://www.nobelprize.org/educational/medicine/pavlov/pavlov.html

Simulated Design Your Experiment with Digger Wasps
http://kisdwebs.katyisd.org/campuses/MRHS/teacherweb/hallk/Teacher%20Documents/AP%20Biology%20Materials/Ecology/Animal%20Behavior/51_A01s.swf

OH MY! What behavior to choose—animations illustrating animal behavior experiments
Do varying prey sizes impact foraging in blue gill sunfish? introduction, animation, conclusion, quiz
http://bcs.whfreeman.com/thelifewire/content/chp53/5302002.html
The cost of defending territory…lizards
http://bcs.whfreeman.com/thelifewire/content/chp53/5302001.html
Simple Stimuli Trigger Fixed Behaviors Herring Gull Chick Feeding Behavior; Begging Behavior is the fixed behavior and stimulus is the red dot on the parent's bill (excellent graph)
http://www.sumanasinc.com/webcontent/animations/content/behaviors.html

Blind as a Bat—the historical discoveries of biosonar
http://www.biosonar.bris.ac.uk/

GUPPIES—student practice writing out a research project using the research described
http://www.youtube.com/watch?v=EJoGJCL12BA&feature=related

Submissions for Lesson Two

Lesson Three: (*Approximate Time 60 minutes*)
Sifting through Research Summaries
Research summaries on Animal Behavior from Science Daily
Aggression boldness gene in zebra fishes
http://www.sciencedaily.com/releases/2011/10/111006084242.htm

Bees, Genes Regulation in the Brain and Behaviors
http://www.sciencedaily.com/releases/2011/09/110926151733.htm

Chick (child) abuse in birds
http://www.sciencedaily.com/releases/2011/10/111003132454.htm

Locate your own research summary in Science Daily
Upload lesson three, your research summary

Lesson Four: (*Approximate Time 2 hours*)
Time for Pill Bugs
Introduction Video to Pill Bugs
http://www.youtube.com/watch?v=DWW8Caur8Co

Read up! Pill Bugs
http://www3.northern.edu/natsource/INVERT1/Pillbu1.htm
http://www.zoo.org/page.aspx?pid=511

Review Pill Bug Primary Research Papers/Abstracts

Turn Alternation in the Pill Bug
http://www.sciencedirect.com/science/article/pii/S000334726680012X

Problem solving and autonomous behaviors in pill bugs
http://www.tandfonline.com/doi/abs/10.1207/s15326969eco1604_2

Animal Cognition The Ability to Express Multiple-Choice Behavior in Pill Bugs
http://sciencelinks.jp/j-east/article/200520/000020052005A0787414.php

Thermal Physiology
http://www.bio.puc.cl/caseb/pdf/prog1/temperatura_eer.pdf

Turn Alternation
http://www.sciencedirect.com/science/article/pii/0003347267900139

Upload Pill Bug document
Safety and Permission Forms
Pill Bug Experimental Design
Forming the PB Explore Teams (group of four)

Lesson Five: (*Approximate Time Plan at least 2 weeks setting aside 30 minutes to 3 hours a day*)
The Pill Bug Experiment, Abstract and Poster

The Pill Bug Student-Designed Experiment
The Pill Bug Abstract
Upload the FINAL Abstract for the PB Explore Team
The Pill Bug Poster
http://www.youtube.com/watch?v=MqgjgwIXadA&feature=fvwrel
Final Poster Submission for the PB Explore Team

Learning Outcomes/Curriculum Alignment

Standards
Common Core High School Mathematics

Standard L1: REASONING ABOUT NUMBERS, SYSTEMS, AND QUANTITATIVE SITUATIONS

Summarize, represent, and interpret data on a single count or measurement variable.
S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

Reason quantitatively and use units to solve problems.
N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

S1.1.1 Construct and interpret dot plots, histograms, relative frequency histograms, bar graphs, basic control charts, and box plots with appropriate labels and scales; determine which kinds of plots are appropriate for different types of data; compare data sets and interpret differences based on graphs and summary statistics.

Data Collection and Analysis

S3.1.1 Know the meanings of a sample from a population and a census of a population, and distinguish between sample statistics and population parameters.

S3.1.2 Identify possible sources of bias in data collection, sampling methods and simple experiments; describe how such bias can be reduced and controlled by random sampling; explain the impact of such bias on conclusions made from analysis of the data; know the effect of replication on the precision of estimates.
S3.1.3 Distinguish between an observational study and an experimental study and identify, in context, the conclusions that can be drawn from each.

Understand and evaluate random processes underlying statistical experiments.

S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
S.IC.6 Evaluate reports based on data.

Michigan HSCE ELA

CE 1.4.4 Interpret, synthesize, and evaluate information/findings in various print sources and media (e.g., fact and opinion, comprehensiveness of the evidence, bias, varied perspectives, motives and credibility of the author, date of publication) to draw conclusions and implications.

CE 2.3.7 Participate as an active member of a reading, listening, and viewing community, collaboratively selecting materials to read or events to view and enjoy… .

CE 3.2.4 Respond by participating actively and appropriately in small and large group discussions about literature (e.g., posing questions, listening to others, contributing ideas, reflecting on and revising initial responses).
CE 2.1.4 Identify and evaluate the primary focus, logical argument, structure, and style of a text or speech and the ways in which these elements support or confound meaning or purpose.

CE 2.1.6 Recognize the defining characteristics of informational texts, speeches, and multimedia presentations (e.g., documentaries and research presentations) and elements of expository texts (e.g., thesis, supporting ideas, and statistical evidence); critically examine the argumentation and conclusions of multiple informational texts.

CE 2.3.4 Critically interpret primary and secondary research-related documents (e.g., historical and government documents, newspapers, critical and technical articles, and subject-specific books).

CE 1.5.1 Use writing, speaking, and visual expression to develop powerful, creative and critical messages.

CE 4.1.5 Demonstrate use of conventions of grammar, usage, and mechanics in written texts, including parts of speech, sentence structure and variety, spelling, capitalization, and punctuation.

CE 1.3.4 Develop and extend a thesis, argument, or exploration of a topic by analyzing differing perspectives and employing a structure that effectively conveys the ideas in writing (e.g. resolve inconsistencies in logic; use a range of strategies to persuade, clarify, and defend a position with precise and relevant evidence; anticipate and address concerns and counterclaims; provide a clear and effective conclusion).

CE 1.4.1 Identify, explore, and refine topics and questions appropriate for research.

CE 1.3.2 Compose written and spoken essays or work-related text that demonstrate logical thinking and the development of ideas for academic, creative, and personal purposes: essays that convey the author's message by using an engaging introduction (with a clear thesis as appropriate), well-constructed paragraphs, transition sentences, and a powerful conclusion.

CE 1.5.5 Respond to and use feedback to strengthen written and multimedia presentations.

CE 1.4.3 Develop and refine a position, claim, thesis, or hypothesis that will be explored and supported by analyzing different perspectives, resolving inconsistencies, and writing about those differences in a structure appropriate for the audience.

CE 1.3.1 Compose written, spoken, and/or multimedia compositions in a range of genres (e.g., personal narrative, biography, poem, fiction, drama, creative nonfiction, summary, literary analysis essay, research report, or work-related text): pieces that serve a variety

of purposes (e.g., expressive, informative, creative, and persuasive) and that use a variety of organizational patterns (e.g., autobiography, free verse, dialogue, comparison/contrast, definition, or cause and effect).

CE 1.1.1 Demonstrate flexibility in using independent and collaborative strategies for planning, drafting, revising, and editing complex texts.

CE 1.1.2 Know and use a variety of prewriting strategies to generate, focus, and organize ideas (e.g., free writing, clustering/mapping, talking with others, brainstorming, outlining, developing graphic organizers, taking notes, summarizing, paraphrasing).

CE 1.1.3 Select and use language that is appropriate (e.g., formal, informal, literary, or technical) for the purpose, audience, and context of the text, speech, or visual representation (e.g., letter to editor, proposal, poem, or digital story).

CE 1.1.4 Compose drafts that convey an impression, express an opinion, raise a question, argue a position, explore a topic, tell a story, or serve another purpose, while simultaneously considering the constraints and possibilities (e.g., structure, language, use of conventions of grammar, usage, and mechanics) of the selected form or genre.

CE 1.1.5 Revise drafts to more fully and/or precisely convey meaning—drawing on response from others, self-reflection, and reading one's own work with the eye of a reader; then refine the text— deleting and/or reorganizing ideas, and addressing potential readers' questions.

CE 1.1.6 Reorganize sentence elements as needed and choose grammatical and stylistic options that provide sentence variety, fluency, and flow.
CE 1.1.7 Edit for style, tone, and word choice (specificity, variety, accuracy, appropriateness, conciseness) and for conventions of grammar, usage, and mechanics that are appropriate for audience.

CE 1.1.8 Proofread to check spelling, layout, and font; and prepare selected pieces for a public audience.

CE 1.5.4 Use technology tools… to produce polished written and multimedia work (e.g., literary and expository works, proposals, business presentations, advertisements).

CE 1.4.7 Recognize the role of research, including student research, as a contribution to collective knowledge, selecting an appropriate method or genre through which research findings will be shared and evaluated, keeping in mind the needs of the prospective audience… .

CE 1.4.2 Develop a system for gathering, organizing, paraphrasing, and summarizing information; select, evaluate, synthesize, and use multiple primary and secondary (print and electronic) resources.

CE 1.4.6 Use appropriate conventions of textual citation in different contexts…

CE 1.2.1 Write, speak, and use images and graphs to understand and discover complex ideas.

CE 1.3.7 Participate collaboratively and productively in groups (e.g., response groups, work teams, discussion groups, and committees)—fulfilling roles and responsibilities, posing relevant questions, giving and following instructions, acknowledging and building on ideas and contributions of others to answer questions or to solve problems, and offering dissent courteously.

CE 2.1.1 Use a variety of pre-reading and previewing strategies (e.g., acknowledge own prior knowledge, make connections, generate questions, make predictions, scan a text for a particular purpose or audience, analyze text structure and features) to make conscious choices about how to approach the reading based on purpose, genre, level of difficulty, text demands, and features.

CE 2.1.3 Determine the meaning of unfamiliar words, specialized vocabulary, figurative language, idiomatic expressions, and technical meanings of terms through context clues, word roots and affixes, and the use of appropriate resource materials such as print and electronic dictionaries.

Biology MME

B1.1A Generate new questions that can be investigated in the laboratory or field.
B1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.

B1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).

B1.1E Describe a reason for a given conclusion using evidence from an investigation.

B1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.

B1.1g Use empirical evidence to explain and critique the reasoning used to draw a scientific conclusion or explanation.

B1.1h Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.

B1.2A Critique whether or not specific questions can be answered through scientific investigations.

B1.2D Evaluate scientific explanations in a peer review process or discussion format.

B2.6a Explain that the regulatory and behavioral responses of an organism to external stimuli occur in order to maintain both short- and long-term equilibrium.

B2.r6b Explain that complex interactions among the different kinds of molecules in the cell cause distinct cycles of activities, such as growth and division. Note that cell behavior can also be affected by molecules from other parts of the organism, such as hormones. *(recommended)*

L3.p2A Describe common relationships among organisms and provide examples of producer/consumer, predator/prey, or parasite/host relationship. *(prerequisite)*

L3.p2B Describe common ecological relationships between and among species and their environments (competition, territory, carrying capacity, natural balance, population, dependence, survival, and other biotic and abiotic factors). *(prerequisite)*

L3.p4A Recognize that, and describe how, human beings are part of Earth's ecosystems. Note that human activities can deliberately or inadvertently alter the equilibrium in ecosystems. *(prerequisite)*

L4.p2A Explain that the traits of an individual are influenced by both the environment and the genetics of the individual. Acquired traits are not inherited; only genetic traits are inherited. *(prerequisite)*

L5.p1A Define a species and give examples. *(prerequisite)*

B5.1B Describe how natural selection provides a mechanism for evolution.

B5.2a Describe species as reproductively distinct groups of organisms that can be classified based on morphological, behavioral, and molecular similarities.

Online Moodle Resource
http://moodle.oakland.k12.mi.us/os/course/view.php?id=1248

Other sources (websites) used are noted in the Lessons Descriptors