Curriculum Sample Template
Max. 8 Pages

Grade Level	8	**Content Area**	Science
Course Title (grades 9-12 Only)			
Expected Prior Knowledge *The knowledge/skills mastered earlier in the year foundational to the mastery of the required Standard in the current sample.*	The study of homeostasis is most often introduced very early in middle school life science textbooks. It is typically defined briefly and superficially. It is rarely mentioned again until later studies involving Human Anatomy and Physiology. Yet, homeostasis is a major theme cross-cutting all aspects of biology. This study unit seeks to provide a more substantial introduction to the term and provides a foundation for scaffolding future learning endeavors involving ecology, evolution, anatomy, physiology, and cell division. The lessons first focus on survival of living organisms of the southwest desert region pertaining to endothermal and ectothermal adaptations and behaviors for maintaining homeostasis. It provides a STEM focus involving mathematical surface area and volume ratio. The unit briefly overviews human homeostasis and provides scaffolding for future study of human body organs and systems.		
Alignment to Program of Instruction *Briefly outline methods of instruction found in this sequence of lessons that align to the Program of Instruction described in A.3.*	This sample also demonstrates the three distinctive features of SySTEM Phoenix's Program of instruction: 1) Integration: Math and Science standards are taught in a mutually reinforcing manner 2) Problem-Based Learning: The standard is introduced to students within the context of a real-world problem that they continually hook their new knowledge into in order to create a viable solution or make an evaluative judgment 3) All final products are authentic documents that students will present to an audience of stakeholders.		
Standard Number and Description *List the Number* and the full description for the Required Standard or Science Performance Objective listed in section A.6.*	8.4.4.2 Describe how an organism can maintain a stable internal environment while living in a constantly changing external environment.		
Materials/Resources Needed	Lab Activity: surface area to volume ratio – 3 different sized boxes per group. Online graphic organizer application: www.mind42.com Plant stomata micrographs document file. "Body Control Center" http://www.teachersdomain.org/asset/tdc02_int_bodycontrol/ "Heat Exchange" http://www.teachersdomain.org/asset/lsps07_int_heatexchange/		

* ***Standard Number****: For English Language Arts (Reading and Writing), use Grade, Strand, Standard (e.g., 3.RI.2). For K-8 Math, use Grade, Domain, Standard (e.g., 6.EE.7). For HS Math, use Conceptual Category-Domain, Standard (e.g., A-REI.6). For Science, use Grade, Strand, Concept, PO (e.g., 4.1.3.1).*

Lesson (add as needed)	**Instructional Strategies**	**Student Activities**
1	***1. Essential Question:*** If a rabbit can live outdoors in the desert, why can't I? ***2. Launch/Intro:*** **The Case:** You are an outreach coordinator for the Central Arizona Shelter Services. Every year, you encounter homeless men and women who suffer from the effects of the Arizona heat. Your task is to create a poster to display in facilities across the state to increase awareness about things people can do to stay safe during the summer months. Your challenge is to understand how desert organisms respond to the abiotic and biotic factors in their environment in order to maintain a stable internal environment. This is called 'homeostasis' and includes maintaining sufficient water & salt balance (plants and animals), food (animals), elimination of waste, and maintaining body temperature. ***4. Vocabulary:*** Ectotherms, endotherms, heat transfer, radiation, conduction, convection, adaptations, behavior, surface area, volume, mathematical ratio, plants, animals. ***5. Presentation/Direct Instruction:*** The teacher will provide definitions and examples for the terms homeostasis, ectotherms and endotherms then assist students in registering and starting a new Mind42.com graphic organizer (mind map) for each group. ***7. Debrief/Summarize:*** The teacher will provide guidance as each group presents the online mind maps. The teacher will ensure the following learning target is generalized: *1) Students can differentiate endotherms from ectotherms which include plants. 2) Students can differentiate between structural adaptations and behaviors. 3) Student groups have successfully started an online mind map and captured research from activity 6b.*	3. ***PBL Casework:*** **Meet the Problem:** Students will be organized into collaborative working groups of four, which will stay consistent throughout the entire case. *S*tudents will examine the case and get familiar with the provided case material. **Know/Need to Know:** Students will identify information and ideas into a KWHLS (see Resources) chart. The group facilitator will prompt group members to **Define the Problem Statement.** Though the definition of the problem may evolve as the team progresses. ***6. Investigate/Explore:*** a) Using the micrographs of plant leaf stomata, students compare/contrast between red oak and palo verde leaves. The facilitator will ensure students observe palo verde stomata are smaller and fewer in number than red oak stomata. Students write a hypothesis statement pertaining to how these adaptations help the palo verde survive desert environment. Students should mention that smaller, fewer stomata helps the plant conserve against water loss to transpiration. b) Students will research other desert plant adaptations and note how the adaptations help them survive in the desert. These can include thorns, leaf size, leaf angling, closing leaves inward and water storage. c) Students will post their pictures and notes pertaining to desert plant adaptations on their online mind map. Each group will present their mind maps. ***8. Formative Assessment:*** List and describe at least 3 adaptations desert plants have to help them survive. Students will be assessed on their ability to articulate how these adaptations help plants maintain homeostasis. ***9. PBL Casework:*** **Explore:** Students will revisit their KWHLS chart and reflect on how their new knowledge relates to the case. In teams, students will create a plan to: gather information, acquire skills/knowledge, share information, and generate possible solutions.

		The group may delegate tasks to individual group members. ***9. Reflection/Closure:*** Ask students to observe their natural surroundings on their way home from school and around their neighborhood. What do the plants and trees look like. From today's lesson, can they determine which are non-native and native?
2	***1. Introduction:*** The southwest desert endures wide ranging seasonal and daily temperatures. The dilemma facing all desert organisms of the desert is heat. A major adaptation we find to maintain homeostasis in high temperatures is body size. ***4. Debrief/Summarize:*** The teacher will emphasize the relationship between surface are and volume of a 3D object as a ratio and may choose at this time to briefly survey how many biological structures grow out surface area to counter this problem (pili in small intestines, red blood cell involution, etc). The teacher will ensure the following learning target is generalized: *1) Students will describe the slower increase in surface area as the ratio in volume increases and relate this to desert animal body/plant leaf size as being generally small. 2) Smaller body size equates to faster heat dissipation and cooling.*	***2. Accessing Prior Knowledge:***-Given several contextualized writing prompts, students will review and apply formulas for calculating the surface area and volume of a 3D object (Math Common Core Standards 6.G.2, 6.G.4, 7.G.6). ***3. Investigate/Explore:*** STEM Lab - Surface area to volume ratio. a) Working in groups, students will measure the volume and surface area of three different sized boxes. Students will organize their data in a table that will include an additional column for surface area to volume ratio. The teacher will guide students in noting that volume increases faster than surface area. Some students may need a data table template to get started. b) Students can heat two same sized containers of water to the same temperature. One has 10 cm of water and the other has 30 cm of water. Place insulating material around the outside of each container as the water cools. Students will note the time it takes for each container of water to cool back down to room temperature. They should correctly note the container with less volume cooled more quickly. Prompt students to relate each containers to each of the boxes sa:vol ratio. Students should correctly surmise that the small box is most like the small volume of water in that the sa:vol ratio is increased relative to its volume. c) Have students think of the boxes as the body size of a desert animal. Students will discuss among their groups how they think this might be related to desert life homeostasis and heat. The teacher will monitor discussions of each group and provide probative questions where and when needed. Each group should conclude that smaller body size equates to an increased sa:vol ratio and faster heat dissipation. d) Students will research online for pictures of desert animals with small body size. Pictures and notes should be entered into the each group's online mind map.

		5. Formative Assessment: Display a picture of a large dinosaur (e.g., Apatosaurus) and have students write their thoughts on why these animals are no longer hypothesized to be ectotherms but rather endothermic to a degree. Students will be assessed on discussing how surface area was probably too small in relation to body volume in order to maintain homeostasis in hot or cold temperatures. ***6. PBL Casework:*** **Explore:** Students will revisit their KWHLS chart and reflect on how their new knowledge relates to the case. In teams, students will create a plan to: gather information, acquire skills/knowledge, share information, and generate possible solutions. The group may delegate tasks to individual group members. ***7. Reflection/Closure:*** While desert animals are generally small, students might wonder why some animals are actually big (mountain lions for example). The teacher should facilitate a brainstorming discussion to explore this concept. Point out that small and large are suitable for desert living, middle sized animals or plants often are not.
3	***1. Introduction:*** Besides body size, desert plants and animals have many other structural and behavioral adaptations. ***4. Debrief/Summarize:*** Throughout the revision/completion process, the role of the teacher is facilitative. The teacher will actively observe groups, help students with group dynamic issues if needed, ask probing questions and/or direct towards further resources. The teacher will guide students to share their observations. The teacher will ensure the following learning target is generalized: *1) Students can list a variety of structural adaptations and behaviors other than body size and whether these belong to ectotherms or endotherms (or both). 2) Students will be able to describe the counter-current heat exchange and vasodilation/constriction mechanisms of homeostasis.*	***2. Accessing Prior Knowledge OR Stimulus:*** Show an illustration comparing the concept of heat transfer through conduction, convection and radiation (Arizona 6th grade science 5.3.4 Heat transfer conduction, convection, radiation) ***3. Investigate/Explore:*** a) Students view the simulations on counter-current heat exchange and vasodilation and vasoconstriction. b) Students will research online and using texts to find at least 3 behavioral and 3 structural adaptations desert animals and plants have to maintain homeostasis. Students will add notes, pictures and videos to their mind maps and each group will present their mind maps to the class. Adaptations can include extended extremities (legs, ears), small leaf size, water storage in cacti, feather, fur, hair, fat for insulation (keep heat in or out), sweating, panting, bathing, shivering, coloration, shiny exoskeletons counter-current blood flow, fur fluffing, vasoconstriction and vasodilation. Behaviors can include burrowing, basking orientation, food hoarding, nocturnal hunting, migration, nest orientation, hibernation, gular fluttering and urohydrosis. Student notes should adequately label their findings as physical adaptions or behaviors, as retaining warmth or cooling down, ectothermal or endothermal (or both). c) Allow time for students to exchange information to add to their

		online mindmaps. ***6. PBL Casework:*** **Explore:** Students will revisit their KWHLS chart and reflect on how their new knowledge relates to the case. In teams, students will create a plan to: gather information, acquire skills/knowledge, share information, and generate possible solutions. The group may delegate tasks to individual group members. ***7. Formative assessment***: Students will fold a piece of paper in quarters. Write terms ectoderm and endoderm across top of boxes and terms adaptation and behavior across side. They should place at least 2 adaptations and 2 behaviors in each quadrant.
4	***1. Introduction:*** Every year many people die during summer months from the heat. Now that students are familiar with how desert animals maintain homeostasis in the desert heat, they are ready to look at how humans attempt to maintain homeostasis. ***2. Presentation/Direct Instruction:*** The teacher will overview feedback sensors and how they elicit reaction to environment stimuli through the nervous and endocrine systems negative and positive feedback systems as well as specific responses involving thermoregulation. ***5.*** Throughout the activity, the role of the teacher is facilitative. The teacher will actively observe groups, help students with group dynamic issues if needed, ask probing questions and/or direct towards further resources. ***6. Debrief/Summarize:*** The teacher will ensure the following learning target is generalized: 1) Students will discern gross level response and systems interaction of human homeostasis involving respiration, circulation, blood sugar, and blood pressure. 2) Identify the hypothalamus as the mediator of stimuli and response through the nervous and endocrine (hormone) systems 3) Name 2 sensors involved in heat and water balance.	***3. PBL Casework:*** **Explore:** Students will revisit their KWHLS chart and reflect on how their new knowledge relates to the case. In teams, students will create a plan to: gather information, acquire skills/knowledge, share information, and generate possible solutions. ***4. Investigate/Explore****:* *a)* Using the web activity "Body Control Center," students will engage in a virtual game that attempts to maintain homeostasis in a human subject. The facilitator will ensure students observe the following: relationships among heartbeat, respiration, blood sugar, blood pressure and perspiration. b) The special case of the kangaroo rat. Students will research and describe why this special desert animal does not drink water but rather derives water from food. Students will compare their findings to human needs for water intake. ***7. Formative Assessment:*** Draw a cartoon showing how the hypothalamus controls falling and rising body temperatures. Students will be assessed on correctly identifying at least one response for each condition: vasodilation or vasoconstriction, shivering or sweating while drawing the hypothalamus as a sub-part within the brain. ***8. Closure/Self-Assessment:*** Individually, each student will self-assess their learning through a written summary which details how their individual contributions furthered the group's effort in addition to a reflection of learning. Students will provide evidence of their efforts.
5	3. ***Feedback/Conferencing:*** As students continue their casework, the teacher may observe or participate in group dialogue. The teacher willconference with each group to ask probing questions and discuss	***1. Summative Assessment:*** Students will take summative assessment. ***2. PBL Case:*** **Resolve:** Student groups will **determine the best fit**

	components of the rubric. The teacher will record level of mastery of the standard demonstrated by the product thus far (adequate, proficient, expert)	**solution** to the case. Students will continue to refine their poster and presentation based on the feedback received. ***4. Closure/Group-assessment:*** Groups will meet for group self-assessment and score their presentation on final rubric. Each score must be supported with clear evidence.
6	2. The presentation cycle for each group will include: a) Group solution presentation, b) Open forum clarifying questions , c) Open forum probing questions, d) Community member feedback ***3. PBL Case:*** **Resolve:** After all presentations are finished, teacher will facilitate **a debrief of the problem.**	***1. PBL Case:*** **Resolve:** Student groups will **present the solution** to the case. 2. As groups present, all audience members, teachers, students, and community members will write down key points and questions. All participants will have the opportunity to ask follow up questions after each presentation. 4. Closure: After group debrief, students will incorporate synthesis of learning experience into individual self-assessment.

Summative Assessment Items: *Attach here.* For each summative assessment item, include an answer key or scoring rubric describing how points are to be awarded.

Type I:

Select all characteristics from the list below proven to be beneficial for desert plants to survive the summer heat.

A. Small stomata
B. Large leaves
C. Vertical leaf alignment to sun
D. Large water storage capacity
E. High stomata density

SOLUTION: **A,C,D** **SCORING:** This item represents a level 2 mastery of the standard.

Type II:

Choose one characteristic from each of the four categories to create the ideal animal for surviving the desert summer heat.

Fur Color	Leg Length	Ear Length	Body Size
White Light Brown Dark	Short Long	Short Long	Small Large

Fur Color: _____
Leg Length: _____
Ear Length:_____
Body Size: _____

RUBRIC

Level 4 (Expert)	Level 3 (Proficient)	Level 2 (Adequate)	Level 1
Correctly identifies all four characteristics - light brown fur, long legs, long ears and small body	Correctly identifies three of four characteristics	Correctly identifies two of four characteristics	Correctly identifies one characteristic

---

Type III:

Short essay: Choose an organism (plant or animal) with successful adaptations for living in the desert. Describe at least three of the organism's adaptations and why they enable the organism to survive in the desert. Compare/contrast those three adaptations with humans to explain why the organism is better suited for desert living than a human.

RUBRIC

Level 4 (Expert)	Level 3 (Proficient)	Level 2 (Adequate)	Level 1
Names organism and comprehensively describes three adaptations and why they enable the organism to survive. Compares/contrasts all three adaptations with those of humans, mentioning that humans require external water intake,including respiration, blood pulse, blood sugar, blood pressure, perspiration.	Names organism and comprehensively describes two adaptations and why they enable the organism to survive. Compares/contrasts two adaptations with those of humans.	Names organism and identifies one adaptation and its benefit. Compares this adaptation to humans.	Incorrectly identifies organism. Does not accurately name any adaptations. Fails to relate adaptations to humans.