Biology Unit Plan
Salt: Savory or Stressful?

Template and design adapted from *Understanding by Design*
by Grant Wiggins and Jay McTighe (ASCD, 2005)

Desired Results

Established Goals:

From the NC SCOS Competency Goals for Biology:

Objectives

- 1.01 Identify biological questions and problems that can be answered through scientific investigations
- 1.02 Design and conduct scientific investigations to answer biological questions
- 1.03 Formulate and revise scientific explanations and models of biological phenomena using logic and evidence
- 2.03 Investigate and analyze the cell as a living system including maintenance of homeostasis and movement of materials into and out of cells
- 3.04 Assess the impact of advances in genomics on individuals and society
- 4.02 Analyze the processes by which different organisms accomplish essential life functions including transport, excretion, regulation, nutrition, growth, and development
- 4.03 Assess, describe and explain adaptations affecting survival and reproductive success.
- 4.04 Analyze and explain the interactive role of internal and external factors such as genetics, nutrition, and toxins in health and disease
- 5.03 Assess human population and its impact on local ecosystems and global environments

Understandings: ***Students will understand that . . .***	**Essential Questions:**
• Life cannot exist without a precise balance of certain essential minerals • The natural environment is a source of toxins threatening to life • Adaptation has given species' the tools to cope with challenges such as salt stress • Repeated stress on human systems has long term detrimental health effects • Societies must defend themselves against a lack of natural resources and threats to human health	• How can a scientific concept be altered for public consumption? • How might a naturally occurring mineral be toxic to life? • How is cellular function related to human behavior? • How do humans define and maintain health? • What impact do natural resources have on societies?
Students will know . . .	***Students will be able to . . .***
• How salts are defined in different areas of study • How plants defend themselves against salt stress • The role salts and other electrolytes play in the human body • Which species have adapted to survive in different environments • The motivations for genetic modification	• Identify minerals necessary for life • Compare plant and animal cellular function • Devise healthy nutrition plans for themselves and others • Evaluate ethical issues in human interaction with the earth's resources • Interpret and analyze data

Learning Plan

Learning Activities:

Day 1: Introduction of saline soil contamination following the Japanese earthquake and tsunami.
Learning goals: Summarize soil contamination as a problem. Establish reliable sources of information. Distinguish between different definitions of salt. Hypothesize effects of salinity on living organisms.

Day 2: Exploration of plant response to salt stress
Learning goals: Review plant cellular structure and function. Model membrane activity and cellular regulation. Explore visual effects of salt stress. Test for soil salinity.

Day 3: Exploration of human response to high salt diet
Learning goals: Explore salts and electrolytes in the body. Define the role of the kidney in removing toxins from the blood stream. Compare cellular function in human body with plant cellular function. Investigate various methods of achieving bodily saline homeostasis.

Day 4: Investigation of salt in different societies
Learning goals: Compare high-salt societies and low-salt societies in terms of geography. Reflect on consumption patterns. Examine federal dietary recommendations. Define hypertension and explore the salt-hypertension connection. Self-assess knowledge of salt in foods.

Day 5: Considering halophytes
Learning goals: Return to the issue of saline soil contamination and geographic implications. Discover how sea creatures defend against exposure to salinity. Explore plant species adapted to saline environments. Develop connection to alleviating threat of saline soil contamination. Introduce scientific work on genetic modification of foods and the debate surrounding the issue.

Final Assessment: Students will choose individual research projects based on a list of "Unanswered Questions" compiled throughout the unit. Projects will have various formats.

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Day 1 Lesson Design

Template adapted from Madeline Hunter's *Eight Components of an Effective Lesson*

I. Outcomes of the Lesson	
General Principle:	**Knowledge Outcomes of the Lesson:**
State what the students are expected to know and/or to be able to do as a result of the lesson.	• Evaluate reliable sources of information • Summarize information • Life cannot exist without a precise balance of certain essential minerals • Define salt in different areas of study • Identify minerals necessary for life
II. Elements of Lesson Design	
Definition of the Element:	**Plan:**
Anticipatory Set: Something at the beginning of the lesson that focuses the students' attention on the subject of the lesson.	1. Show videos of Japanese tsunami destruction Examples: http://youtu.be/g5l3n4I1S6M http://youtu.be/9dQDWmuNV_Y 2. Students group-read selected article on saline soil contamination (Appendix 1a) http://www.asahi.com/english/TKY201105170139.html
Statement of Objective and Purpose: Communication of the intended outcome(s) of the lesson and why it is important for the student to know the information or be able to perform the skills.	3. Essential Question: What is salt?
Instructional Input: Presentation of the information or skills to be learned.	4. Conduct student survey of assumed reliable sources of information 5. Discuss why Wikipedia may or may not be a reliable source
Modeling: Presentation of appropriate examples or a demonstration by the teacher of the behavior the student is expected to emulate.	6. Teacher completes a concept map with a Wikipedia article on a related topic (sample at Appendix 1b)
Checking for Understanding: An activity that allows teacher to determine if students have understood the instructional input and modeling before proceeding to practice.	7. In groups, create a concept map on the Wikipedia article 'Salt' 8. Groups check each other for accuracy
Guided Practice: An in-class activity in which students practice the skills or information just learned. Teacher is present to monitor and give feedback.	9. Each group is assigned a section of article to study, then Jigsaw with other groups to share information 10. Class version of 'Salt' concept map is completed by group members (sample at Appendix 1b)

Instructional Input	11. Visual Quiz: Which of these is salt? (Appendix 1c) 12. Teacher explains that all the pictures represent different types of salts and that salt has a chemical definition in addition to our common definition. 13. Mini-lecture: Why do we need salt anyways? (ppt Day 1)
Modeling	14. Lab introduction and How to: Preparing a slide
Checking for Understanding *Guided Practice*	15. Elodea and saline solutions lab (Appendix 1d) http://biology.arizona.edu/sciconn/lessons/mccandless/elodea.html Note: Teaching tips and evaluation keys included on website
Independent Practice: Any practice activity which the student is capable of performing away from the class and without the teacher's supervision.	16. Homework: Design a lab to test plant growth in saline soils
Artful Ending: An act to adjourn the class, summarize today's learning, and/or preview the next lesson in the sequence.	17. Ticket Out the Door: Create a concept map for what was learned in today's class

III. Learning Assessments to Determine If Outcomes Have Been Met

General Principle:	Assessments:
Assessment may be formal or informal but should let the teacher know which students have mastered which outcomes (and therefore serve as a basis for the next sequence of lessons).	• Group Wikipedia summary • Elodea lab report • Ticket Out the Door concept map • Homework lab design

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Day 2 Lesson Design

Template adapted from Madeline Hunter's *Eight Components of an Effective Lesson*

I. Outcomes of the Lesson	
General Principle:	**Knowledge Outcomes of the Lesson:**
State what the students are expected to know and/or to be able to do as a result of the lesson.	• The natural environment is a source of toxins threatening to life • Adaptation has given species' the tools to cope with challenges such as salt stress • A naturally occurring mineral may be toxic to life • Plants defend themselves against salt stress • Field techniques such as soil sampling and sketching
II. Elements of Lesson Design	
Definition of the Element:	**Plan:**
Anticipatory Set: Something at the beginning of the lesson that focuses the students' attention on the subject of the lesson.	1. Group discussion of Elodea lab results with teacher-provided prompts
Statement of Objective and Purpose: Communication of the intended outcome(s) of the lesson and why it is important for the student to know the information or be able to perform the skills.	2. Essential Question: How and why is salt stressful to plants?
Checking for Understanding: An activity that allows teacher to determine if students have understood the instructional input and modeling before proceeding to practice.	3. In groups, students will compete to recall (from a previous unit) all plant cell structures and functions. Each student creates own plant cell drawing (sample at Appendix 2a)
Guided Practice: An in-class activity in which students practice the skills or information just learned. Teacher is present to monitor and give feedback.	4. In different groups, students create a Cell Analogy, displaying knowledge of organelle function (sample at Appendix 2b) and present to class
Instructional Input	5. Osmosis mini-lecture on board. Topics to include: Balance and homeostasis, balance vs entropy, constant motion across boundary, movement of solvent (water) rather than solute
Modeling: Presentation of appropriate examples or a demonstration by the teacher of the behavior the student is expected to emulate.	6. Teacher answers, 'Which way will water move?' using diagrams on board
Checking for Understanding	7. Text poll quiz on osmosis concepts and application to plant cells (sample at Appendix 2c) http://www.polleverywhere.com/

Instructional Input	8. Mini-lecture: What does salt stress look like in plants? (ppt Day 2)
Modeling	9. Teacher How-to: field techniques of sketching and soil sampling
Checking for Understanding *Guided Practice*	10. Field trip outdoors to search for stressed plants and collect soil samples 11. Ticket Out the Door: A field sketch of a stressed plant 12. Soil salinity lab (Appendix 2d). Students will report findings to a spreadsheet that the teacher will evaluate. Note: Lab requires a salinity meter. Samples might also be sent for testing at a state or university lab.
Artful Ending: An act to adjourn the class, summarize today's learning, and/or preview the next lesson in the sequence.	13. Bubble demonstration examining movement across a cell membrane to emphasize osmosis concept and importance of salinity (Appendix 2e)

III. Assess Learning to Determine If Outcomes Have Been Met

General Principle:	**Assessments:**
Assessment may be formal or informal but should let the teacher know which students have mastered which outcomes (and therefore serve as a basis for the next sequence of lessons).	• Cell drawing • Text poll results • Soil salinity result • Ticket out door sketch

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Day 3 Lesson Design

Template adapted from Madeline Hunter's *Eight Components of an Effective Lesson*

I. Outcomes of the Lesson	
General Principle:	**Knowledge Outcomes of the Lesson:**
State what the students are expected to know and/or to be able to do as a result of the lesson.	• Adaptation has given species' the tools to cope with challenges such as salt stress • Repeated stress on human systems has long term detrimental health effects • The role salts and other electrolytes play in the human body • Compare plant and animal cellular function
II. Elements of Lesson Design	
Definition of the Element:	**Plan:**
Anticipatory Set: Something at the beginning of the lesson that focuses the students' attention on the subject of the lesson.	1. Show images of hyponatremic athletes and have students hypothesize what has occurred and why. 2. Teacher briefly introduces hyponatremia and explains who is danger of suffering from electrolyte deficiency
Statement of Objective and Purpose: Communication of the intended outcome(s) of the lesson and why it is important for the student to know the information or be able to perform the skills.	3. Essential Question: What is the role of salt in the human body?
Instructional Input: Presentation of the information or skills to be learned.	4. Electrolytes and Salt in the Body mini-lecture (ppt Day 3)
Instructional Input	5. Teacher guides students through web video and interactive: How does the kidney regulate salt in the bloodstream? http://www.kidneypatientguide.org.uk/site/HKWanim.php (Flash required)
Modeling: Presentation of appropriate examples or a demonstration by the teacher of the behavior the student is expected to emulate.	6. Teacher reinforces concepts of kidney functioning and homeostasis by creating diagram on board, focusing on major functions rather than parts (sample at Appendix 3a)
Guided Practice: An in-class activity in which students practice the skills or information just learned. Teacher is present to monitor and give feedback.	7. In groups, students create an Organ Analogy (similar to cell analogy, sample at Appendix 2b), displaying knowledge of major kidney functions. Groups will present to the class
Modeling	8. Teacher How-to: reading nutrition labels for portion sizes and sodium content
Independent Practice: Any practice activity which the student is capable of performing away from the class and without the teacher's supervision.	9. Students will track and log their sodium intake for 24 hours and report back for homework.
Artful Ending: An act to adjourn the class, summarize today's learning, and/or preview the next lesson in the sequence.	10. Electrolyte Testing: Evaluating different store-bought and made-in-class (sample at Appendix 3b) solutions, tablets, and gels for taste and nutritional value. Compare class results to results of scientists: http://www.cbsnews.com/stories/2006/02/24/health/webmd/main1342839.shtml

III. Assess Learning to Determine If Outcomes Have Been Met	
General Principle:	**Assessments:**
Assessment may be formal or informal but should let the teacher know which students have mastered which outcomes (and therefore serve as a basis for the next sequence of lessons).	• Kidney diagram • Homework sodium intake log • Electrolyte Test report

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Day 4 Lesson Design

Template adapted from Madeline Hunter's *Eight Components of an Effective Lesson*

I. Outcomes of the Lesson	
General Principle:	**Knowledge Outcomes of the Lesson:**
State what the students are expected to know and/or to be able to do as a result of the lesson.	• Repeated stress on human systems has long term detrimental health effects • Societies must defend themselves against a lack of natural resources and threats to human health • How humans define and maintain health • The impact natural resources have on societies • Devising healthy nutritional plans for themselves and others
II. Elements of Lesson Design	
Definition of the Element:	**Plan:**
Anticipatory Set: Something at the beginning of the lesson that focuses the students' attention on the subject of the lesson.	1. Watch excerpts from director José Padilha's *Secrets of the Tribe* on the Yanomami tribe of Brazil: http://youtu.be/JFON4N9dWo0
Statement of Objective and Purpose: Communication of the intended outcome(s) of the lesson and why it is important for the student to know the information or be able to perform the skills.	2. Essential Question: What role does salt play in human culture?
Modeling: Presentation of appropriate examples or a demonstration by the teacher of the behavior the student is expected to emulate.	3. Teacher How-to: Google Earth and basic user tools for searching and marking locations.
Checking for Understanding: An activity that allows teacher to determine if students have understood the instructional input and modeling before proceeding to practice.	4. Using a computer, each student will complete *Exploring Salt & Humans in Google Earth* to explore mineral resources of the earth, including salt mines, and locate the societies known for characteristically high and low salt consumptions (Appendix 4a) Extension note: Students might also download a USGS mineral resources layer for a certain region and explore individual salt mines http://www.gelib.com/world-mineral-resources.htm
Guided Practice: An in-class activity in which students practice the skills or information just learned. Teacher is present to monitor and give feedback.	
Instructional Input	5. In groups, students will read an excerpt from "The Man Who Ate Everything" by Jeffery Steingarten (Appendix 4b). From the reading, students will compile a vocabulary list of at least four unknown words and a list of questions for potential final research topics. 6. Mini-lecture on hypertension focusing on medical definition and risks (ppt Day 4)
Independent Practice: Any practice activity which the student is capable of performing away from the class and without the teacher's supervision.	7. Students will write a health questionnaire for hypertension sufferers. 8. Students will identify a friend, family member, or other person with hypertension and administer the health questionnaire. Results will be turned in as homework.

Instructional Input *Modeling*	9. Teacher will provide compiled salt consumption student data from the previous day and describe how to compare the results to federal guidelines.
Checking for Understanding *Guided Practice*	10. Students will create a chart showing federal recommendation for daily electrolyte consumption (Appendix 4c) compared to actual consumption of classmates. Federal guidelines found at: http://fnic.nal.usda.gov/nal_display/index.php?info_center=4&tax_level=1&tax_subject=256
Artful Ending: An act to adjourn the class, summarize today's learning, and/or preview the next lesson in the sequence.	11. Students use voting cards to respond to Sodium Smarts quiz (sample at Appendix 4d) with teacher. http://www.heart.org/HEARTORG/quizTemplate.jsp?pid=ahaweb.quiz.quizintro&quizId=100001 12. Ticket Out the Door: Students taste test certain low-sodium foods. Students fill out evaluation form (Appendix 4e) on each food.

III. Learning Assessments to Determine If Outcomes Have Been Met

General Principle:	Assessments:
Assessment may be formal or informal but should let the teacher know which students have mastered which outcomes (and therefore serve as a basis for the next sequence of lessons).	• *Exploring Salt & Humans in Google Earth* • Vocabulary list and research questions from reading • Salt consumption chart • Low-sodium taste test evaluation • Homework health questionnaire

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Day 5 Lesson Design

Template adapted from Madeline Hunter's *Eight Components of an Effective Lesson*

I. Outcomes of the Lesson	
General Principle:	**Knowledge Outcomes of the Lesson:**
State what the students are expected to know and/or to be able to do as a result of the lesson.	• Societies must defend themselves against a lack of natural resources and threats to human health • The impacts natural resources have on societies • Which species have adapted to survive in different environments and how • The motivations for genetic modification • Evaluation of ethical issues in human interaction with the earth's resources • Interpretation and analysis of data
II. Elements of Lesson Design	
Definition of the Element:	**Plan:**
Anticipatory Set: Something at the beginning of the lesson that focuses the students' attention on the subject of the lesson.	1. Students complete a journal response to the question, "What problem(s) originally began our study of salt?" 2. Students will share answers with class. Students will respond and identify the problem of saline soil contamination.
Statement of Objective and Purpose: Communication of the intended outcome(s) of the lesson and why it is important for the student to know the information or be able to perform the skills.	1. Essential Question: What species are able to tolerate high salinity and how? How have humans used this knowledge in genetic engineering?
Instructional Input: Presentation of the information or skills to be learned. *Modeling:* Presentation of appropriate examples or a demonstration by the teacher of the behavior the student is expected to emulate.	3. Teacher shows Salinity-Affected Soils world map (Appendix 5a) and guides students in initial data analysis and pattern recognition 4. Meanwhile, teacher reviews world geography, including placement of equator and identification of countries
Checking for Understanding: An activity that allows teacher to determine if students have understood the instructional input and modeling before proceeding to practice.	5. Map Analysis Activity: In groups, students analyze a series of maps (Appendix 5b) and develop three to five scientific inferences regarding soil quality, aridity, threats to soils, agriculture, and world hunger 6. Groups will present results and teacher will compile common inferences and other student responses for discussion. 7. Class will come together to identify major conclusions and issues that need attention.
Guided Practice: An in-class activity in which students practice the skills or information just learned. Teacher is present to monitor and give feedback.	8. Students are prompted to consider potential solutions to saline soil contamination (ppt Day 5a). Included is an introduction to genetic engineering as a potential solution.

Instructional Input *Checking for Understanding*	9. Teacher guides selected students through web interactive "Engineer A Crop." Class takes notes on the steps of transgenic manipulation http://www.pbs.org/wgbh/harvest/engineer/transgen.html (Flash required) 10. Teacher poses questions to class for discussion: What is the purpose of transgenic manipulation? What is the end goal?
Instructional Input *Checking for Understanding*	11. Mini-lecture: The Search for Favorable Traits (ppt Day 5b) Teacher guides students to thinking about how animal and plant species are adapted to saline environments and how to identify favorable traits for transgenic manipulation.
Instructional Input	12. Students watch two brief videos describing alternate viewpoints on genetic engineering: "GMOs To Benefit Hungry, Malnourished" http://youtu.be/EGDGbSLcfRQ Birke Baehr, "What's Wrong with Our Food System" http://youtu.be/F7Id9caYw-Y
Independent Practice: Any practice activity which the student is capable of performing away from the class and without the teacher's supervision.	13. For homework, students will write a one-page opinion piece on the genetic engineering of foods. Sources and citations are required.
Artful Ending: An act to adjourn the class, summarize today's learning, and/or preview the next lesson in the sequence.	14. Ticket Out the Door: Response to, What is the most pressing problem/issue that we discussed today and why?

III. Learning Assessments to Determine If Outcomes Have Been Met

General Principle:	Assessments:
Assessment may be formal or informal but should let the teacher know which students have mastered which outcomes (and therefore serve as a basis for the next sequence of lessons).	• Journal entry • Group map analysis • Ticket out door response • Homework: Genetic engineering opinion piece