**Michael Baer/SCIENCE 10-12 S.W.E.A.T.**

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**Name:** *Michael Baer*  **Unit Plan Title:** ***S.W.E.A.T.--S****ustainable* ***W****ater--****E****nergy* ***A****nd* ***T****ransport* **Course/Grade:** *Physics (grades 11-12); Integrated Chemistry-Physics (grades 10-12)* **Unit Plan Duration:** *3 weeks*

**Overview of Unit Plan:** *As a follow-up to the* ***dots in blue water*** *purifier project,* ***S.W.E.A.T.*** *is designed to help students further understand the global problems associated with clean drinking water, contrasting their own drinking water to that of a global culture. Upon completing the unit, students will investigate drinking water quality and delivery—assessing strengths and weaknesses in terms of sustainability—for both the global culture and their own.  The students will also examine the mechanisms of wind-powered and solar-powered electricity generation, and design an appropriate system that may improve the global culture’s water delivery. Students will also have an opportunity to propose a strategy for sustainable funding of their designed water delivery system.*

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| **Stage 1 Desired Results** | | |
| ESTABLISHED GOALS    *S.W.E.A.T. will provide students an opportunity to:*    *G1. Learn the interconnected impacts that man and environment have upon each other, and the consequences of mismanaging natural resources, in particular, fresh water*    *G2. Recognize how different cultures acquire, utilize, and manage systems of energy sources and drinking water*    *G3. Be able to collect, analyze, and communicate interpretations of scientific data*    *G4. Apply knowledge of mechanical energy as a sustainable source of power*    *G5. Apply knowledge of geophysical factors of wind strength, including coastal influences, temperature gradients, and mountain chains as a sustainable source of power*    *G6. Apply knowledge of PV (photovoltaic) solar energy as a sustainable source of power*    *G7. Apply knowledge of energy forms, electric circuits, and electromagnetic induction to the utilization & storage of generated electricity*    *G8 Mobilize a school community through heightened global awareness and personal involvement to produce ongoing and sustainable impact on the quality of life in a different culture* | ***Transfer*** | |
| *Students will be able to independently use their learning to…*    T1. Compare/contrast how different cultures acquire drinking water, and analyze the strengths and weaknesses of each system in terms of delivery rate, water quality, and feasibility and sustainability of power source used.    T2. Propose and design one improvement of a culture’" " " s water delivery system, taking into account delivery rate, water quality, and feasibility and sustainability of power source used.    T3. Determine what impacts such a system might have on that area, including social, environmental, public health, and economic concerns.    T4. Mobilize a school and community to help improve the water delivery system in one culture by designing and implementing programs to provide the necessary means to deliver and establish such a system. | |
| ***Meaning*** | |
| UNDERSTANDINGS    *Students will understand that*    *U1.Man and environment have an impact upon each other, and there are consequences of mismanaging natural resources*    *U2.* *Different cultures acquire, utilize, and manage systems of energy sources and drinking water through different mechanisms*    *U3. The scientific method is used to collect, analyze, and communicate interpretations of scientific data*    *U4. Mechanical energy can be used as a sustainable source of power*    *U5. Various* *physical factors affect wind strength as a sustainable source of power*    *U6. PV (photovoltaic) solar energy can be used as a sustainable source of power*    *U7. Energy forms, electric circuits, and electromagnetic induction are essential elements in the utilization & storage of generated electricity*    *U8. Heightened global awareness and*  *personal involvement are required to make a sustainable difference in a community of different culture* | ESSENTIAL QUESTIONS    *E1. What are some of the ways different cultures acquire their drinking water, and what health liabilities does this manner present to this culture?*    *E2. What are some sustainable forms of energy which can be used for water delivery in emerging countries?*    *E3. How do the feasibilities of mechanical, wind, and PV solar energies compare when powering a water delivery system?*    *E4. Can a sustainable water delivery system be designed, funded, and delivered to an emerging world community by a school community project?*    *E5. What impact might a sustainable water delivery system have on a community within an emerging country, including social, environmental, public health, and economic concerns?* |
| ***Acquisition*** | |
| *Students will know…*    *K1. Some technologies have unintended environmental consequences.*    *K2. Mechanical, wind, and PV solar energies can all be used for power, with differing feasibilities.*    *K3. Storage considerations in sustainable energy are as critical as the production aspects.*    *K4. How to create and interpret electrical schematic diagrams for assembling and operating the water delivery system.*    *K5. How to use the scientific method to collect and analyze data, formulate predictions, and communicate results in an investigation*    *K6. Differing global perspectives create certain critical considerations in the feasibility of replacing traditional patterns with technology*    *K7. Microfinance is a consideration in implementing and maintaining the sustainability of a global challenge* | *Students will be skilled at…*    *S1. Proposing, implementing, and evaluating a collaborative investigation using scientific method.*    *S2. Utilizing various equipment to data on collect wind speed and strength, temperature and therms, pump lifts and pressures, electrical transfer and storage, and water transfer and storage.*    *S3. Conveying a globally significant issue to the local school community informs that generate heightened global awareness and involvement.*    *S4. Assessing water quality to determine the potability of a water source.* |
| **Stage 2 - Evidence** | | |
| **Evaluative Criteria** | **Assessment Evidence** | |
| 1. The SAHS science department common lab grading rubric and Criterion Writing™ grading system will be used to evaluate the lab report submitted.    2. The SAHS science department common video/podcast rubric will be used to evaluate the podcast submitted.    3. Assessment of a student-produced working model of wind-generated and PV solar electricity will be used to evaluate student’s understanding of each.    4. The SAHS science department common oral presentation rubric will be used to evaluate the effectiveness of the student presentation regarding promotion and funding opportunity for the water system. | PERFORMANCE TASK(S):    1-2. Working collaboratively through written formal lab essay OR podcast OR YouTube™  video, students will be able to communicate the following: a) how a particular culture acquires drinking water, the students analyzing the strengths and weaknesses of each system in terms of delivery rate, water quality, and feasibility and sustainability of power source used; b) propose and design one improvement of a culture’s water delivery system, taking into account that culture’s geophysical features, as well as the culture’s water delivery rate, water quality, and feasibility and sustainability of power source for the system used; and c) determine what impacts such a system might have on that area, including social, environmental, public health, and economic concerns.     3. Working collaboratively, students will be able assemble and operate a working model of a) a wind-powered electricity generator and b) a PV solar-powered electricity generator, demonstrating their understanding of circuit electricity and mechanical energy sources.    4. Working collaboratively, students will create and activate one promotion and associated funding opportunity to support the financing of this sustainable water delivery project. ***All funding must be preapproved by Mr. Baer AND the high school principal, and fund collections MUST be handled by a supervising teacher, in accordance with school policy.*** Upon completion of the promotion, students must produce an essay describing the project and how the funds could be used to stimulate a water-related micro-economy in that selected culture. | |
| 5. The SAHS science department common scientific method rubric will be used to evaluate the student’s utilization of proper steps and sequence of the scientific method.    6. ETCAI™ ([www.etcai.com](http://www.etcai.com/)) electronics teaching software will be used to assess the student’s knowledge of electronic symbols and working electrical circuits involved in the PV and wind generated electricity.    7. Various commercially-available chemical test kits will be used to evaluate the water quality of a sample. | OTHER EVIDENCE:    5. Individually, students will be able to demonstrate a proper utilization of the steps and sequence of scientific method in developing their wind-powered and PV photovoltaic generation of electricity.    6. Individually, students will be able to interpret electrical symbols & circuits and design electrical circuits similar to those involved in the wind-powered and PV photovoltaic-powered systems.    7. Individually, students will be able to demonstrate a proper utilization of chemical test kits to determine the water quality of a sample. | |
| **Stage 3 – Learning Plan** | | |
| *Summary of Key Learning Events and Instruction*    **Lesson ONE: *“Water Washes Everything—But How Do You Wash the Water?”*** ***water quality***    Students working collaboratively should reflect on their own drinking water sources, and answer the essential question: *Do YOU Wash Your Water?*Students then use online research to read articles on a particular global culture and how that culture acquires drinking water, answering these questions: *Does this culture in any way wash its water? If so, how do they wash their water? What are they trying to rid from it?*Students should contrast their own drinking water to water from the global culture, and analyze the strengths and weaknesses of each system in terms of delivery, water quality, and sustainability. The students should propose and design one improvement of the global culture’s water delivery system, taking into account that culture’s geophysical features, as well as the culture’s water delivery rate, water quality, and feasibility and sustainability of power source for the system used. The student should determine what impacts such a system might have on that culture, including social, environmental, public health, and economic concerns. The presentation of this project should be reported through either written formal essay OR podcast OR YouTube™ video.  (G1, G2, G3, G5; U1, U2, U3, U8; E1, E2, E4, E5; K1, K2, K3, K5, K6; S1)        **Lesson TWO: *“I’ve Got the Power (Snap!)”: renewable energy***    After reading “Renewable Energy Basics” and “Other Clean Energy Technologies” from GreenLearning.ca, the students, working collaboratively, should prepare a presentation comparing renewable and nonrenewable resources available to the same culture selected in Lesson ONE. This presentation should include how that culture is implementing power generation, whether they are depending primarily on renewable or nonrenewable resources, and speculating on how sustainable that energy source will be over the next 50 years. In the presentation, students should address the questions posed at the end of each reading. The presentation of this project should be reported through either written formal essay OR podcast OR YouTube™ video.  (G2, G3, G4, G5, G6, G7; U2, U3, U4, U5, U6, U7, U8; E1, E2, E4, E5; K1, K2, K3, K4, K5, K6; S1, S2, S3)        **Lesson THREE: *“Here Comes the Sun (the Beatles) vs. Blowin’ In The Wind (Bob Dylan)”: researching wind and solar power***    Students working collaboratively will use online research wind and photovoltaic (PV) solar power. Based on their research, the students should then assemble and operate a working model of a wind-powered electricity generator and a PV solar-powered electricity generator, demonstrating their understanding of circuit electricity and mechanical energy sources. The student should determine what impacts such systems might have on the culture previously selected, including social, environmental, public health, and economic concerns. This project should be reported through either written formal essay OR podcast OR YouTube™ video.  (G2, G3, G4, G5, G6, G7; U2, U3, U4, U5, U6, U7, U8; E1, E2, E4, E5; K1, K2, K3, K4, K5, K6; S1, S2, S3)        **Lesson FOUR: *“Black Water (The Doobie Brothers)”: testing water quality***    Students working collaboratively will use the **Drinking Water Full Panel and Bacteria Tests Study Kit** (available from www.Sciencefaircenter.com)  to run various tests on these factors affecting water quality: pH, Alkalinity, Water Hardness, Nitrate, Nitrite, Free Chlorine, Total Chlorine, Total Dissolved Solids (TDS), Dissolved Metals (Combined Metals Cu+2, Co+2, Zn+2, Cd+2,Ni+2) and Bacterial Growth Indicator. Students should determine what impacts such contaminants might have on the culture previously selected, as referenced by online research, personal interviews, and other public health resources, such as the Indiana Environmental Health Association, the Environmental Protection Agency, and the World Health Organization, among others. At least one resource must be a videotaped interview with a professional in the field of medicine or public health. This project should be reported through podcast OR YouTube™ video.  (G3, G8; U1, U2, U3, U8; E3; K1, K5, K6, K7; S1, S3, S4)        **Lesson FIVE: *“Money for Nothing (Dire Straits)”: researching microeconomics***    Read this Sarah Lacy’s *Brilliant, Crazy, Cocky: How the Top 1% of Entrepreneurs Profit from Global Chaos* excerpt about creating a local economy from a small idea. <http://www.fastcompany.com/1725661/indias-mighty-microeconomy> Using this model and additional research, students working collaboratively should design a scheme for a given culture that could provide a sustainable income to fund the availability of drinking water. This project should be reported as a TV-ready 60-second “infomercial” (delivered as a .mov or .wmv or .avi video OR podcast OR YouTube™ video) or as a promotional T shirt design (some ideas at <http://www.sciencewear.net/>, <http://www.snorgtees.com/>, <http://www.cafepress.com/>)  (G3, G8; U1, U3, U8; E1, E2, E3; K5, K6, K7; S1, S2, S3, S4) | | |