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| Title | Developing Global Thinkers through Water Contamination |
| Introduction | The framework for 21st Century Learning is foundational on developing global leaders and thinkers. Water Contamination is a problem that plagues so many cultures around the world. Students rarely recognize how lucky they are to be able to turn on a faucet or drink out of a fountain with clean water. Using this issue with students learning, creates a cross-curricular learning experience that is rooted in rigor and relevant instruction. Students will be exposed to a genuine Science, Technology, Engineering and Math (STEM) learning experience as they try to come up with logical solutions to the problem of water contamination. |
| Learning Outcomes | Students will be able:   1. To use a multimedia technology to present their solution to the problem. 2. To effectively use the engineering design process. 3. Make informed judgments/solutions to a problem using observations made. 4. Understand cost per unit and per box for their shipment of their solution. |
| Curriculum Alignment | 4th Grade NCSCOS  Science  \*Activities are based on understanding and applying observations made. Lessons will link with ecosystems taught in 5th grade.  Technology  2.10 Storyboard and modify multimedia projects with menus, branching and/or multiple outcomes for content areas, citing sources as a group activity.  2.11 Recognize, discuss, and use rubrics to evaluate elements (e.g., content, organization, appropriateness of materials, citations) of multimedia projects/products.  3.01 Select and use technology tools (e.g., probe ware, digital camera, scanners) to collect, analyze, and display information for content assignments.  Math  Goal 1 Number and Operations  1.02 Develop fluency with multiplication and division  1.05 Develop flexibility in solving problems by selecting strategies and using mental computation, estimation, calculators or computers, and paper and pencil  Goal 4 Data Analysis and Probability  4.03Solve problems by comparing two sets of related data  Engineering Connection  Materials Engineering: students will understand how packaging it involved with product research and development (costs, restrictions, etc.)  Environmental Engineering: students will be looking into designing systems that could help the humans interact with the environment in a better and safer way  Framework for 21st Century Thinking   1. Core Subjects: mathematics, science, economics, geography 2. 21st Century Themes: global awareness, health and wellness literacy 3. Learning and Innovation Skills: creativity and innovation skills, critical thinking and problem solving, communication and collaboration skills 4. Information, Media, & Technology Skills: information and communication technology skills (ICT) 5. Life and Career Skills: Flexibility and adaptability, initiative and self direction, leadership and responsibility 6. 21st Century Support Systems: standards and assessments, curriculum and instruction, learning environments |
| Classroom Time Needed | 5-7 class periods (45 minutes to 1 hour each) |
| Materials Needed | STEM notebook pages  Assessment pages  Rubrics for presentations  3-4 Petri dishes per group of students  Vinegar  Milk  Bleach  Coffee Filters  Contaminated water sample (one used in this lesson comes from a classroom frog habitat)  1-2 eye droppers per group  Safety goggles for each student  Magnifying glasses for each student |
| Technology Resources | 2 powered microscopes  2 microscope cameras with USB connection  SMART Board with LCD projector  Document Camera  Toothbrush (UV) cleaner  SAM Animation software installed on laptops  1 laptop per group of students  1 webcam per group of students  SMART Board lesson document provided |
| Pre-Activities | 1. Students should already be familiar and have worked through the engineering design process from Boston Museum of Science (ask, imagine, plan, create, improve) 2. Students should understand how to take still pictures using a webcam and be able to manipulate the SAM Animation software 3. Connect microscope camera to microscope and make sure it runs and can be viewed through your computer on the SMART Board 4. Make sure your sample has active living organisms in it. Sometimes fish tanks have good and bad samples, before the lesson, be sure to check that there are active organisms in the water |
| Activities | Day 1   1. Play the water contamination video from [www.youtube.com](http://www.youtube.com) found on the SMART Board document provided 2. After video, have students sit in a circle. Create a discussion about the video they just watched. (Focus on the global element to the video, compare the problems we face and problems that others face everyday. Remember a strong element of this lesson is for students to develop global awareness) 3. Have students get back into their groups. Poise the question: “What is an observation and why is it so important in our learning?” (focus on bringing out the point of an observation is found using your senses and how they are foundational to so many curricular areas (math/science/engineering/literacy, etc)) 4. Hand out the STEM notebook pages 5. Pass out one sample of the contaminated water (in Petri dish) to each group of students and a magnifying glass to each student 6. Have the students draw and complete Day 1 Part 1 section of the notebook entry 7. Place a sample under the document camera and discuss and model what a good drawing would be. Show students why it is important to make good drawing and written observations. Explain even if they are not a good drawer: that writing small notes could help describe and allow you to remember what you saw 8. Have a discussion about what they thought was in the water (dirty, bugs, bacteria, etc) 9. After a brief discussion, show the students what it looks like under a microscope using the microscope camera through the USB on the Smart Board. It should be obvious now to students that are things living and moving around in the water that they previously didn’t see before. 10. Have students complete Day 1 Part 2 of their notebook, they will be drawing what they see on the microscope camera. 11. Students need to complete Day 1 Part 3 of their notebook   Day 2  \*Before this lesson, break the students into 6-7 groups. The room needs to have 6-7 stations depending o the number of groups and 2 central stations. The two central stations need to be where the two microscopes with USB cameras attached are placed where groups can bring their samples to further investigate. The other 6-7 stations are as follows: 1. Diluted Bleach Solution 2. Milk 3. Vinegar 4. Coffee Filters 5. UV Light (toothbrush cleaner) 6. Heat 7. Placebo or optional. Each station needs one sample of contaminated water in Petri dish, eye dropper, safety goggles and magnifying glasses   1. Go through the different stations for the students. When explaining them, have them look at Day 2 Part 1 page that corresponds to them. Reinforce that they will be drawing 3 times and making a prediction for each station (prediction, initial drawing, drawing after test without microscope, drawing after test with microscope). Be sure to reinforce safety measures (eye glasses, hot plate, etc.) 2. Students rotate through the six stations completing their notebook as they work. (As a facilitator, might be safe to stay near the hot plate and possibly have another adult in the room to monitor the microscopes and walk around) 3. Students complete Day 2 Part 2 4. Finish by asking each group to explain what happened at each station (ensure group consensus)   Day 3   1. Introduce “Ask” step of the design process: “Students have to create a way to help clean the contaminated water from \_\_\_\_ country. In addition to creating a process or method, you have to package it and ship it to them with instructions for usage.” 2. Explain to students that they will be using SAM Animation to create a presentation for the class to evaluate your product, process, method, etc. 3. Pass out the rubrics for the presentation: go through it with the students so they understand how they will be evaluated before staring to work. (Create your rubric using Rubistar website below, recommend creating it with your students to personalize it to each classes unique needs) 4. Remind students that there is not any one right solution to this problem. The solution can be a process, method or a product or a combination of these. But, they have to explain how to use this without being there, possibly these people do not know our language. 5. Students move into the “Imagine” step of the process then into the “Plan” step of the process. Do not pass out the STEM notebook pages for this day until that have got through the Imagine step completely. This will not limit their thinking. Before they move into “plan”, they can get their pages to complete.   Day 4-5   1. These days are used for the “create” step. Depending on the students, this might be shortened or extended. During the “create” step they will also be making the SAM Animation videos.   Day 6   1. Discussion on packaging of materials. This is relevant to the work of material engineers. For example, why using plastic parts can be cheaper than using glass. Explain why potato chip bags are never sold completely full (because chips would be crushed without the air pocket inside) 2. Discuss about how weight affects shipping cost. Show students how to find price per unit. 3. Provide an example of instructions in a foreign language. Discuss with the group what would make it able for you to understand without knowing the language (pictures, diagrams, video) 4. Students finish their solutions and presentations   Day 7   1. Group presentations, followed by students completing an evaluation using the rubric for each group 2. Using the packaging costs, have students complete the assessment provided 3. Students finish by completing “Improve” step in their notebooks |
| Assessment | 1. STEM notebook pages are used for an informal assessment. They can be used for an assessment on students’ ability to make predictions then evaluate their predictions.  2. Day 1 STEM Notebook pages, math 4.03, comparing two sets of related data. Their conclusion of day 1 will serve a basis if they can compare these two sets.  3. During the creation of their solution, Math 1.02 and 1.05 will be assessed during their presentation on their cost of their solution. Comparing the different groups ‘costs in the conclusion could serve as a secondary assessment of 4.03.  4. Technology 2.01, 2.11, 3.01 are all assessed through their SAM Animation presentation.  5. Create a rubric through Rubistar (website found below) to meet the needs for your presentation assessment |
| Modifications | 1. Creating heterogeneous groupings would provide modifications for students who need additional support.  2. Each of these activities is based in team settings. This provides preset modifications for all students.  3. If struggling with SAM Animation, Photostory 3 from Microsoft works as well. It is also a free download. |
| Alternative Assessments | 1. Having students help create the rubric would provide an optional assessment of technology 2.11  2. Having students create a video science notebook entry rather than writing each of their STEM conclusions would provide and alternative to a written assessment. |
| Supplemental Information | Engineering Without Borders website, multiple projects on improving living conditions worldwide <http://www.ewb-usa.org/index.php>  Website on health effects of water contamination: <http://www.healthynewage.com/water-contamination.htm>  Wikipedia on water contamination: <http://en.wikipedia.org/wiki/Water_pollution>  Siemens website on water treatment: <http://www.usa.siemens.com/entry/en/water.htm?stc=usccc021754>  National Ground Water Association lessons for water contamination: <http://www.ngwa.org/programs/educator/lesson.aspx> |
| Critical Vocabulary | Contamination  Observation  Materials Engineering  Environmental Engineering  Cost per unit  SAM Animation |
| Websites | 1. Boston Museum of Science EiE website <http://www.mos.org/eie/index.php> 2. Teach Engineering multiple excellent resources <http://teachengineering.org/> 3. SAM Animation software and information on usage <http://www.samanimation.com/> 4. Rubric creation tool: http://rubistar.4teachers.org/ |
| Comments | Completing this lesson with 14 different classes in the past 2 years has allowed me to understand that it truly works perfectly with this age group. The use of technology and applying relevant material allows students on all levels to be engaged and produce grade level work. The use of SAM Animation is an excellent resource for students to create a presentation. |
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