Transformation 2013 Design Challenge Planning Form

Design Challenge Title: __How Safe Is Our Drinking Water_

Teacher(s):_Chad Springer_____

School: _Taylor High School_____

Subject:__Chemistry_____

Abstract: Students will design and conduct quantitative experiments that will test the amount of dissolved solids in the drinking water from the City of Taylor.

MEETING THE NEEDS
OF STEM EDUCATION
THROUGH DESIGN CHALLENGES

REGION XIII EDUCATION SERVICE CENTER
ESC 20 Serving the Educational Community
A collaborative effort between Region XIII and Region 20 and their partners

Begin with the End in Mind

- ***Does this design challenge meet the criteria for STEM student needs (21st century skills, TEKS, TAKS)?***

Summarize the theme or "big ideas" for this design challenge
Students will design and conduct quantitative experiments that will test the amount of dissolved solids in the drinking water from the City of Taylor.

Identify the TEKS/SEs that students will learn in the design challenge (two or three).
2A-plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology
2C-express and manipulate chemical quantities using scientific conventions and mathematical procedures such as dimensional analysis, scientific notation, and significant figures
12B develop general rules for solubility through investigations with aqueous solutions
13A compare unsaturated, saturated, and supersaturated solutions

Identify key skills students will develop in this design challenge.
Manipulate quantities of concentration such as molarity, molality, and ppm.
Predict the products of a chemical reaction.
Use stoichiometry to identify the amount of a reactant.
Use net ionic reactions to.
Identify spectator ions.
Construct graphs to represent data.
Use stoichiometry to identify the amount of a reactant.

Identify the 21st century skills that students will practice in this design challenge (one or two).
www.21stcenturyskills.org
Communication
Critical Thinking and Problem Solving

Identify STEM outcomes to be included in this design challenge.
To enable students to assist and evaluate resources in their community using science and mathematics concepts.

Craft the Driving Question

- ***Have you posed an authentic problem or significant question that engages students and requires STEM knowledge to solve or answer?***

State the essential question or problem statement for the design challenge. The statement should encompass all design challenge content and outcomes, and provide a central focus for student inquiry.

Is the City of Taylor's drinking water safe?

Design experiments that will test the concentration of dissolved solids in the drinking water from the City of Taylor. Test the public drinking water of Taylor. Compare the results to World Health Organization standards. Compare the results to those reported by the City of Taylor. Present your findings to the City of Taylor Public Works. Cite possible solutions to problems that arise from your findings.

Plan the Assessment

STEP 1: Define the products and artifacts for the design challenge.

Early in the challenge:

Students will design 3 experiments that can be conducted within classroom settings. The experimental design must contain detailed instructions, needed materials, required chemicals, and steps for quantitative analysis.

-The experimental design must be able to be repeated by others.

During the challenge:

Students will have data that shows the amount of dissolved solids such as chlorides, sulfates, magnesium, calcium, phosphates, and carbonates. Students will compare their results graphically with reported values of TDS from the City of Taylor. Students will compare their results to published accepted values reported from the World Health Organization.

End of the challenge:

Students will complete a 10-15 minute Powerpoint presentation to be presented to the City of Taylor explaining their results. The students will detail each finding and offer accepted solutions to potential problems that have arisen from their study.

Plan the Assessment

STEP 2: State the criteria for exemplary performance for each product.

- ***Do the products and criteria align with the standards and outcomes for the design challenge?***

Product: Experimental Design (1 Test Grade)

Criteria: The students must design three experiments that will test for at least TDS composed of calcium, phosphates, and magnesium. The tests must be scientifically valid, and must be able to be reproduced. Each experiment is submitted in Microsoft word format. Each experiment contains the following:

1) Background theory detailing the chemistry principles behind each experiment.
2) Step-by-step instructions to allow others to replicate the experiment.
3) Step-by-step data analysis instructions that detail how the students will calculate their results.
4) List of needed chemicals and supplies.

Product: Graphical Analysis and Journal (3x Lab Grades)

Criteria: Students will submit lab journals that explain their findings. Each journal should contain a day-to-day detailing of their findings/accomplishments, a lab write-up* from each experiment that they performed, and graphs that allow students to find the average concentration of each dissolved solid.

*Lab rubric is attached on the last page.

Product: Presentation (1 Test Grade)

Criteria: -In PPT™ Format, Students must be able to explain what they have discovered, how it was discovered, what their findings mean, and possible resolutions to discrepancies between reported values from the City of Taylor and their findings.

Map the Design Challenge

Look at the major product for the design challenge and analyze the tasks necessary to produce a high-quality product. What do students need to know and be able to do to complete the tasks successfully? How and when will they learn the necessary knowledge and skills?

- ***Do the products and tasks give all students the opportunity to demonstrate what they have***

Product:	**(check appropriate box)**		
Knowledge and Skills Needed ***Elaborate on the knowledge and skills (TEKS student expectations) required to accomplish each step of the task.***	**Already Learned**	**Taught before the project**	**Taught during the project**
1. Use stoichiometry to identify the amount of a reactant		X	
2. Predict the products of a chemical reaction.		X	
3. Manipulate quantities of concentration such as molarity, molality, and ppm.		X	X
4. Use stoichiometry to identify the amount of a reactant.		X	
5. Use net ionic reactions to.			X
6. Identify spectator ions.			X
7. Construct graphs to represent data.	X	X	

What PBL tools will you use? **(check appropriate box)**

X Know/need to know lists ☐ _____
X Daily goal sheets ☐ _____
X Journals ☐ _____
☐ Briefs ☐ _____
☐ Task lists ☐ _____
☐ Problem logs ☐ _____
X Project flow charts ☐ _____

Title: **Is the City of Taylor's drinking water safe?**	
TEKS: Chemistry 2AC, 12B, 13A	
Entrance Activity: Students will conduct inspection on five different samples of potable water using the five senses.	
Engage Activity (Time: 1 Class) Identify/focus on instructional task, connect between past & present learning experiences, lay groundwork for activities (ex. Ask a question, define a problem, show a surprising event, act out a problematic situation)	Students will pick up one of five samples of water. Each sample of water will contain some dissolved material(salt, acetic acid/vinegar, sugar, etc.) The students will be asked to identify criteria that will rate the drinking water from best to worst. The students will use their five senses to rate the drinking water. Their results will be displayed. The results will have to be realigned with the standards issued by the World Health Organization.
Exploration Activity (Time: 1-3 classes) Students get involved with phenomena and materials, students work in teams to explore through inquiry	1) Student teams will be given the design challenge: Acting as environmental chemists, your team must design and execute experiments that will test the concentration of dissolved solids in the drinking water from the City of Taylor. Then, compare the results to the World Health Organization standards and to the results reported by the City of Taylor. Your final task is to present your findings to the City of Taylor Public Works. Cite possible solutions to problems that arise from your findings. 2) Student teams will research known examples of experiments that identify dissolved solids in drinking water, as well as local, national, and international drinking water standards.. 3) Student teams will collaborate to create a list of experiments that can be conducted to identify total dissolved solids. 4) Student teams will design their three experiments. 5) Student teams will conduct their experiments.
Explanation (Time: 1 class) Students discuss observations, ideas, questions and hypotheses with peers, facilitators, groups. Learners apply labels to their experiences – thus developing common language, clarification/explanation of key	Students will manipulate their data to identify average concentrations of TDS from their experiments. They will compare their results to published concentrations of TDS from City of Taylor Water.

concepts (ex. Writing, drawing, video/tape recordings)	
Elaboration (Time:1-2 classes) Expand on concepts learned, make connections to other related concepts, and apply understandings to the world. (ex. Extend & apply knowledge) Leads to more inquiry and new understandings.	Students will create their power-point presentations. Each presentation must be 10-15minutes long. They must detail each result/discovery from experimentation. They must offer explanations to any discrepancies between published results from the City of Taylor and their own experimental results. Students will need to compare their findings to published TDS values of local communities. These will give students the opportunities to discover commonalities in TDS based on geographic location.
Evaluation (Time: 1class) Ongoing diagnostic process to determine if the learner has attained understanding of concepts & knowledge (ex. Rubrics, teacher observation with checklist, student interviews, portfolios, project products, problem-based learning products, assessments) Leads to opportunities for enrichment through further inquiry and investigation.	Students will present their results to a panel from the City of Taylor. Students will turn in their journals and lab write-ups. -Lab rubric attached.
Materials/Equipment: beakers, burettes, graduated cylinders, magnetic stir plates, journals, paper, pencils, computers with internet access	
Resources: http://www.epa.gov/safewater/contaminants/index.html http://en.wikipedia.org/wiki/Drinking_water http://www.waterfiltersonline.com/water-tests.asp http://www.rapiddiscovery.biz/diagnostics/Environmental-water-tests.html	

Lab Grading Rubric

Chemistry

I. **Name** – Write your name. (5pts)

II. **Date**- Include complete date and day of the week (2pts)

III. **Investigator(s)**- Include first and last name(s) (3pts)

IV. **Title**- Reflects your purpose, Check for capitalization (5pts)

V. **Purpose**- Accurately reflects the reason for the experiment (10pts)

VI. **Background Theory**- Explains the chemistry topics behind your experiment (15pts)

VII. **Materials**- Lists all materials used to conduct the experiment (10pts)

VIII. **Procedure-** Give detailed step-by-step analysis of what was completed in the lab. (10pts)

IX. **Data Table and Graph**- (20pts)

Use Excel Spreadsheet

a. Use a ruler to display the graph accurately
b. Include axis labels, title, and units

X. **Conclusions**- (20pts)

a. Write at lease two paragraphs that accomplish, at minimum, the following
    - Restate the purpose
    - Restate the hypothesis (if applicable)
    - State whether the hypothesis was or was not supported (if applicable)
    - Restate the data (don't forget units)
    - State at least two sources of error that could have occurred
    - Answer assigned questions pertaining to the lab activity