Summer 2019

The Reduction Of Stormwater Runoff Pollution Through Community Service Efforts

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Adopt A Drain Unit Plan

"*Can community service efforts be implemented to reduce river pollution caused by stormwater runoff?"*

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Unit Setting:

- Classroom of no more than 24 learners
- Lab benches and stools, desks
- Age : Junior High Earth Science· Time of day: flexible
- Average length of lessons: 1 class period of 47 minutes
- Major Supplies Needed: Chromebooks, 2 liter bottle, sand, gravel, hot glue, drinking straws, aluminum baking sheet, water, sidewalk chalk, various art supplies, hot plate, food coloring, cling wrap, beakers, ice cubes, dilute acid, pH strips, ring stands

Unit Rationale:

This unit plan is designed to engage the student learner in community service and educate them to understand the importance of watershed preservation, runoff and community service.

Understanding By Design Outline

- What overarching understandings are desired?
    - Scientific Method
    - Inquiry
    - Community Service
    - Pollution
- What will students understand as a result of this unit?
    - Students will understand that the water cycle is the driving force that allows water to move throughout our planet.
    - Students will understand that their actions can impact the environment in positive and negative ways.
- What are overarching essential questions?
    - How does the water cycle work?
    - How do cities manage stormwater runoff?
    - How is community service valuable?
- What essential and unit questions will focus this unit?
    - Why does runoff happen?
    - Where does the water go?
    - How can community service help the rivers?
- What evidence will show that students understand?
    - Effective mastering of the vocabulary
    - Successful completion of laboratory exercises
    - Accurate modeling of a drain system
    - Willingness to volunteer
- Performance tasks, projects
    - Water cycle lab report

    - Percolation lab report
    - Storm Drain Model
- Quizzes, tests, academic prompts
    - CK 12 Curriculum Assessment
- Other evidence
    - Exit Cards
    - Journals
    - Participation level
- Student Self Assessment
    - Journals
- Given the targeted understandings, other unit goals, and the assessment evidence identified, what knowledge and skills are needed
    - Students will need to know: Key terms including: solid, liquid, gas, percolation, evaporation, condensation, infiltration, runoff, precipitation, groundwater, urban, impervious, watershed. Laboratory practices, laboratory safety, scientific method
    - Students will need to be able to: Follow a graphic, Model the water cycle, Follow a procedure, Process and analyze observational data, Develop higher level thinking conclusions.
- What teaching and learning experiences will equip students to demonstrate the targeted understandings?
    - Traditional instruction and reading allows for foundational concepts to be communicated.
    - Laboratory experiences enhance the level of conceptual understanding and elevate learning to the next level.
    - 3D modeling projects will foster group cooperation and artistic design as they work to meet requirements.
    - Field Trip(s) provide students an opportunity to interact with professionals while also promoting valuable interpersonal skills, social skills and manners.
    - Community Service activities will promote physical activity and aid in retention of key concepts.

Formal Unit Objectives: Upon successful participation in this unit, the learner will:

1. Be aware of the different components of the hydrologic (water) cycle
2. Understand the concept of stormwater runoff
3. Have a basic understanding of their local utilities infastructure that manages rainwater
4. Understand the impact of pollution on a watershed
5. Understand the value and importance of civic engagement / community service

Background Information:

1. Students should have a basic knowledge of the scientific method
2. Student should be able to conduct basic lab procedures
3. Student should be aware of all lab safety and field trip safety expectations

Timeline

This unit is broken into lesson plans that work within a 45 minute class period. They could easily expand up to an hour. Realistically, parts of the unit plan require multiple days. Part of the unit establishes a long term commitment too so I recommend undertaking this in the early spring and revisiting it throughout the final term of the school year.

Summary:

The Master's degree required me to complete a course offered by Tracey Fredin titled "Environment and Society". This course illustrated the positive and negative impacts of mankind on nature. While on the campus of Hamline University over the summer for that course, we learned of a metro based program called *Adopt a Drain*. The guest speaker shared with the class about the successes and struggles of this program. To briefly summarize the program, I will say that they are encouraging citizens to take ownership of a storm drain on the street and keep it clear of trash and debris to protect the Mississippi River. The motive is similar to that of the Adopt-A-Highway Program that is far more prevalent. The Mississippi is the ultimate end location of runoff that goes down storm drains. Therefore, anything that goes down the drain goes into the river, including pollution, fertilizer runoff, grass clippings, oil, and so on. The program coordinator shared that the project is struggling because of the shear number of drains in the metro and large amount of resident turnover. As I sat in on this lecture, my country boy mind questioned if this program could be implemented into rural Minnesota. Would this program work better in Henning compared to Burnsville? That curiosity has led me

to the question: *"How can community service efforts be integrated into student learning to reduce river pollution caused by stormwater runoff?"*

As an educator and environmentalist, I have no choice but to approach issues from a goal-oriented point of view. I have to ask myself if my goals are really attainable and realistic. As an informed citizen, I have to understand the struggles that come with municipalities and the fact that any time you deal with a city government, things can be difficult. All of these reasons have brought me back to the safety and security of my classroom. I cannot effectively implement an AAD program in my community unless I run it through my classroom.

My first goal is to educate students. I am professionally and ethically bound to teach within the guidelines and subject areas set forth by our state standards. Luckily, the science standards adopted by the state of Minnesota allow for a broad range of topics to be covered. The figure below is a snip of the most-closely related standards from the 8th Science Standards.

III EARTH AND SPACE SCIENCE	A. Earth Structure and Processes	The student will investigate the impact humans have on the environment.	1. The student will identify and research an environmental issue and evaluate its impact.

Regardless of your experience level, I feel that all educators can agree that the best way to increase student learning is to increase the level of engagement and ownership in the learning process. I believe that students innately want to do well and help take care of the environment and their community. I feel especially confident that community pride is high among small rural communities and that is the best motivator for this unit. Students, even as young as 8th grade,

understand how fragile their small rural area can be. They will want to help and this unit plan is designed to foster that.

The unit plan begins with very traditional and logical topics presented in an organized manner. Once the foundation is established, the learning becomes quite novice in its approach as it brings students on multiple adventures outside the classroom into the community. It fosters a relationship between the school, citizens and city government. It allows for flexibility with learners of all different abilities and has natural break points for scheduling. My district offers an 8 period day with 47 minute class periods so you will see that the lessons quickly get to the point. I believer that will little adjusting, these lessons will fit a longer class period easily.

It is my sincere hope as an experienced educator and avid outdoorsman that this unit plan provides a wealth of opportunities to your students. Feel free to beg, borrow, steal and modify these materials to best suit your needs.

Lesson 1:

Phase 1: Gather (5 min)

1. As students enter the classroom, you should have liquid water, boiling water and ice cubes on display. The Question of the Day on display as students enter is "If H20 is the chemical formula for water, what is the formula for ice and steam? Allow an appropriate amount of time for this not to exceed 5 minutes.

Phase 2: Introductory Lesson (15 min)

2. Review the 3 states of matter using ice, water and steam. The online curriculum link below will provide a basis for this review. https://flexbooks.ck12.org/cbook/ck-12-middle-school-earth-science-flexbook-2.0/section/8.2
3. Provide graphics at the molecular level to illustrate the molecular properties of water in each of the 3 states of matter. Emphasize the shape and volume. Review importance of 0 and 100 degrees Celsius. Have students explore the vaporizing and condensing portion of the curriculum from the link above.
4. Quick Card Game to assess basic understanding. Students should begin playing with a peer and then you could elevate to in front of the class depending on your classroom culture.
    a. Here, each card will have a set of conditions on it. The student would need to draw a card and be prepared to answer "Solid , Liquid or Gas" based on the conditions listed on the card.
        i. Example: Card 1 says " flexible shape, fixed volume"
        ii. Student should answer " liquid"

Phase 3: Water Cycle Reading (15 min)

1. Students should be given an opportunity to read the water cycle section in the text. https://flexbooks.ck12.org/cbook/ck-12-middle-school-earth-science-flexbook-2.0/section/8.3

Phase 4: Lab Prep (Remaining time)

1. The remaining class time should be used to prepare for the lab exercise to be completed on day 2.
    a. Hand out lab guides. The link is the google doc for the lab guide.
        i. https://docs.google.com/document/d/1NpVmZN6nspxfNTgyw1aJ4CO3ZtrVEJQZ-ph2TyvHzdA/edit?usp=sharing
    b. Use student volunteers to read through up to the procedure section.
    c. Have students read the proecudure part on their own, upon completion they can go to their lab station and start setting up glassware and other items as needed so that they can begin lab as soon as they enter on day 2.

Precautions:

1. Make sure lab is clean and ready for students
2. Make sure the curriculum links are intact and functioning
3. Do not allow students near the demonstration setup as they enter class because they will not have safety gear on

Adaptations / Modifications for special learners:

1. Provide paraprofessional for students who are identified as special needs
2. Provide extra instruction to students who are safety risks
3. Consider having handouts ready for those students who may struggle with technology

Conclusion:

Monitor the clock and guide students so they have time to get organized prior to the bell. Assist students as needed with struggles. Encourage students who need more time to consider coming in during free time to set up lab. Reassure students that they have plenty of time.

Assessment:

No formal assessment on day 1. Lab reports will be assessed after day 2 lab.

Lesson 2

Phase 1: Gather (5 minutes)

1. As students enter the room, have a youtube video playing showing various video clips of rain. The videos should have a variety of rains including a deluge, light mist and everything in between. Find video clips of streets flooding and storm drains working.
2. Have students do a "Think-Pair-Share" about the video clips.
    a. Think about some different rain events in your life
    b. Pair up with a peer and hear about their stories
    c. Share one notable rain experience with the class

Phase 2: Lesson on groundwater focusing on Percolation versus Runoff (10 min)

1. Allow students time to explore the curriculum by reading the text
    a. https://flexbooks.ck12.org/cbook/ck-12-middle-school-earth-science-flexbook-2.0/section/8.12
    b. Have students partner up and work through the groundwater study guide
    c. Demonstrate capillary action by handing out beakers, water and drinking straws. You could also use paper towels cleaning up spills for a faster demonstration.

Phase 3: Outdoor Lab (20 minutes)

1. Provide students with the handout.
    a. https://docs.google.com/document/d/1C439MRtbiTJMrezATHM1CMBOVImEDvIyNDOf9gWCoFM/edit?usp=sharing
2. Use student volunteers to read through the beginning of the lab handout
3. Move as a class to safe outdoor space where the lab activity can occur

Phase 4: Wrap Up (remaining time)

1. Have students gather materials and return to classroom
2. Students should clean lab toosl and return to storage
3. Any remaining time is to be used working on lab reports
4. Establish a due date for lab reports.

Precautions:

1. Make sure the outdoor space is close, safe and accessible
2. Make sure the curriculum links are intact and functioning
3. Do not allow students to wander outside.
4. Be sure to monitor outdoor weather conditions

Adaptations / Modifications for special learners:

- Provide paraprofessional for students who are identified as special needs
- Provide extra instruction to students who are safety risks
- Consider having handouts ready for those students who may struggle with technology

Conclusion:

Monitor the clock and guide students so they have time to get organized prior to the bell. Assist students as needed with struggles. Encourage students who need more time to consider coming in during free time to set up lab. Reassure students that they have plenty of time.

Assessment:

Lab reports will be assessed

Lesson 3:

Phase 1: Gather (5 min)

1. As students enter the classroom, have a teenage mutant ninja turtles theme song playing via youtube. Ask students what they know about storm sewers. Discussion should develop and try to guide the conversation to the fact that there are 3 underground systems in a community. One system brings freshwater in via pipes, a second system brings wastewater out of the building to a sanitation station and a third system is a series of pipes that mitigates stormwater and rain runoff.

Phase 2: Walking Tour (remaining)

*Permission slips may be required by your district

1. Bring students on a short walking tour down some side streets and find storm drains. Explain what they are and how they work
2. Coordinate with the city to rendevous with a utility worker to speak to the students
3. If possible, get into some city utility buildings and see the behind the scenes pipes, pumps etc.

Precautions:

1. Make sure the storm drains and city facilities are close, safe and accessible
2. Permission slips and/or extra help such as a para may be needed
3. Do not allow students to wander outside.
4. Be sure to monitor outdoor weather conditions
5. Consider a bus or van if distances are too far to walk or unsafe

Adaptations / Modifications for special learners:

- Provide paraprofessional for students who are identified as special needs
- Provide extra instruction to students who are safety risks
- Consider having handouts ready for those students who may struggle with technology

Conclusion:

Here are some possible suggestions for conclusion activities

1. The teacher could use exit cards to assess learning from the day.
2. The teacher could engage the students in a journaling exercise
3. The teacher could challenge the students to make a flow chart of where the water goes.
4. The teacher could have students draft Thank You letters to the guest speakers.

Lesson 4

Phase 1: (3 min)

1. As students enter the classroom, have a map of the city of Henning (your town) on display. This map should have the storm drains marked. Allow students to view the map and then ask "Where does the water go?"
    a. Students should recall information from the previous day's field trip and be able to share that stormwater goes down the drains on each street and flows undergound, downhill to the outlet. In Henning, one side of town drains to Brandborg Creek by the school and the other drains into Willow Creek by the nursing home.

Phase 2: (8 min)

1. Introduce the city drain modeling project using the attached project guide
    a. https://docs.google.com/document/d/1X2SeYRxDq6MdZSwUUd3aM2xf5QYi487ZtC9OT7z1iFU/edit?usp=sharing

Phase 3: (Remaining)

1. Allow students to work in pairs to design and build their model

Precautions:

1. Monitor lab safety protocol
2. Monitor the use of hot glue guns and exacto knives
3. Be careful of slips, trips and falls with possible wet floors

Adaptations / Modifications for special learners:

1. Provide paraprofessional for students who are identified as special needs
2. Provide extra instruction to students who are safety risks
3. Consider having open lab time for students who need extra time
4. Consider special grouping of partners depending on needs

Conclusion:

The teacher should evaluate lab reports and provide honest feedback on the student models. One could consider using the following rubric to assess the model: https://docs.google.com/document/d/1UgFrNycti7dGSO0QSdb-JOBV2EzYmrPokD04H030B24/edit?usp=sharing

Lesson 5

Phase 1: Gather (2 min)

1. Students should be given time to reflect and share their experience from the storm drain model lab. Allow them time to group up and use the prompt to develop conversation.
    a. What was one peak (positive/success) and one pit (failure/negative) from your model building experience?

Phase 2: Journaling (10 min)

1. Students should continue their reflection exercise by engaging in a journal activity. They should consider the following questions when journaling:
    a. How is your model similar to real life and how is it different?
    b. How could your model be improved?
    c. What about your model project makes you proud ?
2. After the students complete their journaling, I would encourage them to trade journal entries so that they get a good idea of how the project has impacted their classmates.

Phase 3: Adopt a Drain (AAD) webcrawl (10 min)

1. Have the students visit any one of the following websites and read about various AAD programs currently being facilitated by cities around the state.
    a. https://www.adopt-a-drain.org/
    b. https://www.stpaul.gov/departments/public-works/sewer-utility/stormwater/adopt-drain
    c. http://www.minneapolismn.gov/publicworks/stormwater/adoptadrain
    d. https://www.hamline.edu/news/2019/adopt-a-drain/
    e. https://www.cleanwatermn.org/announcing-adopt-a-drain/
    f. There are thousands of other websites students may find on their own

Phase 4: How Drains Contribute to Watershed Pollution (Remaining time)

1. Have students retrieve their storm drain models created in an earlier lesson.
    a. Could consider using the best student model if time is short
2. Instruct them to apply cooking oil, grease, food coloring, pepper flakes, glitter or any other traceable material on the roadway of their model.
3. Use the rain simulator to illustrate how rainwater rinses pollutants down the drain.
4. The student should be able to identify the tracer (oil, pepper, glitter, etc) as it comes out their drain outlet underneath their model
5. I really like using Koolaid sugar because that can represent fertilizer pellets from lawn fertilizer applications.
6. Have students orally discuss the following questions:
    a. How do pollutants get from the street to the watershed?
    b. How could you help protect the watershed?
    c. If you put a filter on the outlet before it gets to the river, how would that help?

d. What pollutants cannot be removed using a filter?
e. How does the fertilizer harm the river?
f. What is the best way to help the watershed so that this doesn't happen?
g. How would AAD help?

Precautions:

1. Ensure proper use of technology
2. Monitor journaling and discussions to make sure students are on task
3. Monitor the AAD pollution samples so they do not create a mess

Adaptations / Modifications for special learners:

1. Provide paraprofessional for students who are identified as special needs
2. Provide extra instruction to students who are safety risks
3. Consider having new groups for illustrating the runoff pollution so that way if a student did not have a model or an effective one, they could still be involved
4. Consider providing a skeleton handout for the journaling phase

Conclusion:

1. Teacher will provide feedback during oral conversation during the runoff pollution simulation.
2. Teacher will collect journal entries and check for understanding and proper reflection

Lesson 6:

Phase 1 : Gather (5 min)

1. Students should provide permission slips (if necessary)
2. Students should be dressed appropriately for outdoor activities
3. Students should have gloves, brooms, bags and dustpans or shovels along with safety googles and perhaps a mask
4. Students should be placed into pods or groups, each with an adult supervisor
5. Students should be instructed where their drain is located

Phase 2: Adopt a Drain Day

1. Students should be provided with the AAD Day handout to guide them.
2. https://docs.google.com/document/d/12fT9KwXf87dxdYDur6_ItG23vDf2U71CtDsZPf_Onks/edit?usp=sharing

Precautions:

1. Ensure proper use of safety gear by students and supervisors
2. Make sure students and supervisors know where to go
3. Monitor traffic, consider help from street department or law enforcement
4. Be aware of neighborhood dynamics
5. When possible, have students working on their own street if they live in the area

Adaptations / Modifications for special learners:

1. Consider physical limitations of all learners
2. Consider how added stimuli will impact student performance
3. If students cannot handle the physical component, they could help by designing chalk art or signs ahead of time

Conclusion:

Here are some possible suggestions for conclusion activities

1. The teacher could use exit cards to assess learning from the day.The teacher could engage the students in a journaling exercise
2. The teacher could challenge the students to make a map indicating which drains were adopted.
3. The teacher could have students draft letters to residents asking for help

Lesson 7

Phase 1: Gather (15 minutes)

1. Have students contribute words to a word wall visual that describe their thoughts, feelings, emotions, reactions and struggles from the AAD day.

2. The following link can be used to create this visual
    a. https://www.wordclouds.com/

Phase 2: Mapping the Drains (15 min)

1. Have a map of the city streets enlarged and on display
    a. This could be done electronically or with a printout
2. Have each student pair come mark on the map the location of the drain they maintained in the previous lab activity.
3. Assess the map and look for goals, shortcomings and accomplishments
    a. Ex. Every drain on "Montana Avenue" was adopted
    b. Ex. We got every drain on this side of the RxR tracks
    c. Ex. We missed this area of town

Phase 3: Recruiting Community Service (remaining)

1. Distribute the AAD enrollment form to students
    a. https://docs.google.com/document/d/1I-JQsCxUd1QeP7FyFv4eyXJRzHaqTK6ny9T3npnnMLw/edit?usp=sharing
2. Students must sign up for one drain.
    a. Students could be paired up to if there are students who live rurally or whatever the reason
3. Students are expected to recruit and adult resident to takeover the AAD program at their drain.
4. Establish a timeline and revisit as needed

Precautions:

1. Ensure proper navigation using the map
2. Be aware of neighborhood dynamics when students sign up

3. Be realistic about expectations with students claming a drain
4. Encourage students to claim a drain near their home or relatives home
5. Review safety precautions about AAD

Adaptations / Modifications for special learners:

1. Consider physical limitations of all learners
2. Consider home location of students. Are they rural? Split betwee homes? Transient?
3. If students cannot handle the physical component, they could propose other ways to help

Conclusion:

Here are some possible suggestions for conclusion activities

1. The teacher could use exit cards to assess learning from the program.
2. The teacher could engage the students in a journaling exercise.
3. The teacher could challenge the students to make a map goal and establish a reward.
4. The teacher could arrange for correspondance with the local newspaper and other media sources to promote the student project.
5. The Teacher could arrange for interactions between the city and students.