A collaborative activity set for grades 6-12 to examine:
- oil spills and their impact on the environment
- containment processes and concerns
- human impact on the environment through pollutants

This guide utilizes **The SPILL**, a board game published by Smirk and Dagger Games. Available April 2022 at your local game store or at https://www.smirkandlaughter.com/

Common Core Science Standards

These activities address the following standards:

CCSS.ELA-LITERACY.RST.1 - Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

CCSS.ELA-LITERACY.RST.3 - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CCSS.ELA-LITERACY.RST.7 - Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CCSS.ELA-LITERACY.RST.9 - Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

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Part 1: A Drop in the Water

Oil spills are often appropriately causes of major concern when they occur in major bodies of water. This activity will simulate the progression of an oil spill, as well as the impact that environmental concerns may have on human response to oil spills..

Materials

- A digital copy of the Oil Spill Grid (or a drawn copy of the Grid on a whiteboard)
- 4 six-sided dice (with faces 1-6)
- A "boat" (an object that can stick to whichever surface you will be presenting the Oil Spill Grid)
- For each student or group, a copy of the Oil Spill Grid, 15 six-sided dice, 1 boat token, and 9 Marine Animal tokens (a copy of The Spill will provide enough components for 4 sets)

Preparation

Display the Oil Spill Grid for the class with a projector or other digital means, or create a replication of the grid on a whiteboard.

Have a copy of the Oil Spill Grid, 15 six-sided dice, 1 boat token, and 9 Marine Animal tokens collected for each student or group. *Note: a copy of The Spill will be able to support 4 individual students or groups in terms of six-sided dice and* Marine Animal *tokens.*

Introduction for Students/Class

Today, we will examine how we respond to oil spills. Oil spills are natural disasters, in that they are events that have the potential to cause massive damage to the environment. However, these events are primarily created by humans - either through mistakes or unexpected circumstances. Thus, it is our responsibility to address oil spills as quickly and effectively as possible to mitigate the impact they can have on the environment!

Whole-Class Activity: How does oil react in the water?

1. Begin by asking the class "How do we think oil will move and react when it gets into water?" and record student suggestions. Then show a brief video (such as Pop Up Science: Oil and Water https://www.youtube.com/watch?v=F5HEDgzWQXE) to demonstrate exactly the relationship that oils have with water.
2. Ask the class to consider a large quantity of oil introduced to a body of water, and ensure that they understand that oil will act in a similar way, regardless of the amount of oil and the quantity of water.

3. Direct the class to look at the Oil Spill Grid, either projected or drawn on a whiteboard. Set the scene for the class that a ship has begun to spill oil into the ocean, with the ship at the top of the grid.
4. Have a student volunteer roll 4 dice, and mark an "X" at the top of each numbered column whose number the student rolls. If a student rolls more than 3 of any number, have the student re-roll those numbers. Explain that each "X" on the grid represents oil that has leaked from the ship and is moving out and away from the ship.
5. Roll 1 of the dice and place your "boat" at the base of the corresponding column. Explain that this is our ship, which we can use to push back and contain the oil in the water.
6. Explain that the class will have 3 actions as they work to contain the oil spill. They must keep each column from overflowing (reaching the fourth spot on the column), and more oil will spill after they have used 3 actions. Their actions are to **move** the "boat" 1 space to the left or right, or **contain** the oil (erase the lowest "X" in the column their boat is currently located).
7. Have students take turns as the leader, dictating which 3 actions they would like to perform. After each student performs 3 actions, roll 2 dice to continue simulating the active oil spill (write an "X" in the lowest open spot in the appropriate column that was rolled).
8. Complete this process until each student has had at least 1 chance to act as the leader, or until the oil has completely filled a column and a newly rolled die would place another "X" in that column. If the class manages to keep a column from overflowing, congratulate them on their containment efforts; if a column does overflow, let them know that unfortunately their containment efforts were not successful.
9. Complete the activity by asking students "How did you feel as you worked to contain the oil spill?" and have a brief discussion to unpack their thoughts and ensure that they grasp the concept of difficulties in oil spill containment efforts.

Group/Individual Activity: What might complicate oil spill containment efforts?

1. Begin by asking the class "What made our efforts to contain the oil spill complicated in the previous activity?" and allow for group discussion as they analyze their previous efforts. Then introduce the following open-ended question: "What other factors might impact efforts to contain an oil spill?" Gauge student answers and encourage discussion, being sure to either introduce or emphasize how marine animals might affect containment efforts.
2. Break the class up into groups or individuals, and provide each group or individual with the following: a copy of the Oil Spill Grid, 15 six-sided dice, 1 boat token, and 9 Marine Animal tokens.
3. Have the class place their Marine Animal tokens on their oil spill grid as follows: place 1 token in the lowest open cell of the columns for the numbers 1, 3, and 5, and place 2 tokens in the lowest 2 open cells (1 token per cell) of the columns for the numbers 2, 4, and 6. Let them know that each token has a clean and oiled side, and that tokens will become oiled when an oil die is placed into a column with it. All tokens should be placed on their clean side to start.
4. Ask each group to roll 4 of their dice, and place each die in the top-most cell of the matching column. Advise them to place 1 die per cell, and that dice can be placed in cells where there are Marine Animal tokens. If any die would cause a column to overflow, advise the group to re-roll such dice until they can be placed. After all dice have been placed, advise them to flip any Marine Animal tokens that have an oil die in their cell should be flipped to the oiled side.
5. Ensure that they understand the following about oiled tokens: If a token is oiled, players can **contain** the oil to remove it from the cell with the token, then **treat** the token and place it in front of them. If an oiled token still has an oil die in the same space after their 3 actions, that token is removed from the game (to the "sick bay").

6. Inform the groups that they still have 3 actions before more oil is spilled, and can perform any combination of the following:
    a. **move** the boat token 1 space to the left or right
    b. **contain** the oil (remove the lowest die in the column their boat is currently located)
    c. **treat** a Marine Animal token that has become oiled.
7. Encourage students to look at the grid and decide where they would like to place their boat. Ensure that they understand that moving their boat will cost an action, and that the oil will grow after each set of 3 actions.
8. Have each group take their first set of 3 actions, and ensure that students are completing them correctly. Once all groups have taken their first 3 actions, ask each group to report the actions to the class and explain why they took those actions. Optionally, keep a running tally where all students can see to determine which actions are most popular.
9. Each group will then check for oiled tokens that share a cell with an oil die, removing any as appropriate. Then groups will then roll 2 additional dice and add them to their grid. Groups will continue to take their 3 actions, check for oiled tokens, and add 2 additional dice until each group hits one of the following states:
    a. If a die is rolled and cannot be placed in an open cell, the oil containment has failed.
    b. If a fourth Marine Animal token is removed to the "sick bay," the environmental impact is too great and the containment has failed.
    c. If a group has saved 4 Marine Animal tokens that were oiled and has not had a column overflow, they have successfully contained the spill.
10. Optionally, you can discuss the actions taken with the class to determine which actions were most popular, and have the class analyze what the trends in actions might suggest about difficulties in containing an oil spill.
11. When each group has finished, complete the activity by asking students to compare the experience without Marine Animal tokens to their experience with the tokens added to the activity. Have them analyze how the presence of the Marine Animal tokens made the process of containment more complicated, and how this might translate to real-world instances of containing oil spills.

Conclusion

After students have completed each activity, ask them to recount their efforts to contain the oil spills in a brief narrative piece. The following questions will help to guide them and ensure that they consider the entirety of the activities that they have performed:
● Before you started the activity, what did you think you would have to do to contain the oil?
● When you were just concerned about the oil, what were your priorities? What made these priorities for you?
● After marine animals were brought up as an additional concern, how did your priorities change? What do you think caused this change?
● Were you successful in your efforts to contain the oil spills? What do you think led to your success of failure in the oil containment?
● Aside from marine animals, what are other concerns that may arise while trying to contain an oil spill?

Part 2: An Ocean of Concern

Armed with a deeper understanding of oil spills and how to (abstractly) respond to them, students will be tasked with two incredibly important tasks: collaborate to handle a much larger spill with even more unexpected impacts on containment efforts and to help spread the word to others about the real-world impact that oil and other pollutants can have on the environment.

Materials

A copy of The Spill board game
Examples of environmental awareness images for social media

Preparation

Have the board and materials for The Spill set up in a central location, either at the front of the classroom or at a larger table.

Decide the level to which you would like to modify the game experience based on the grade level and ability of the class. Some potential modifications:

To reduce complexity, consider removing the Specialist character cards. These abilities can be useful, but can also cause deviation from the typical actions of a student or group. You can also remove Resource cards, but bear in mind that this will likely make for a more difficult game. Alternatively, use the recommended Resource cards for one's first game: "Dredge," "Weather Radar," "Multi-Task," and "Call a Specialist."

To speed up the game, consider modifying one of the Winning Condition cards by reducing the requirements necessary to win. Also consider setting a reasonable time for each turn, utilizing a stopwatch if it will help keep students moving and on-task.

The end game triggers can also be modified, such as losing after more Marine Animal tokens are placed in the Sick Bay or allowing more Spill Outs before the game is lost, based on complexity or speed concerns.

To avoid potential emotional triggers, be sure to refer to removed Marine Animal tokens as having gone "to the sick bay" and redirect students that may imply that the animals have died.

Introduction for Students/Class

Today, we will further examine responses to oil spills. We have proven ourselves capable (or, at the very least, experienced) in handling containment efforts for spilled water. A much more difficult opportunity has

presented itself, as an offshore oil rig has begun to spill oil into the ocean! We will have to work together and weather even more difficulties (such as the weather itself) to save the environment!

Whole-Class Activity: Disaster at DeepWell 4!

1. Begin by asking the class to recount their previous experience with oil spill containment in the last activity. Guide discussion to ensure that limited time/actions, marine life, and the movement of the oil itself are brought up and discussed.
2. Break the class up into 4 groups, and assign each group a boat color. Offer a brief explanation of the rules, emphasizing that the play will be similar to the activity that they completed previously. Be sure to introduce the additional game concepts that will be in play, including the weather dice, Specialist card powers, Resource cards, and the Winning Conditions that the groups will all be working towards.
3. Inform the class about the expanded actions that they have available to them, as well as how many action points each move will use, and offer them reference handouts so that they understand exactly what they can do during their turns.
4. Allow the class to play out a game of The Spill, being sure to answer any student questions as they come up by referencing the game's rulebook. Also be mindful of the time that each group takes, to ensure that the class will be able to complete a game within a class period.
5. If the class reaches one of the losing conditions and it cannot be corrected by the end of the next group's actions, namely if one of each Marine Animal type is contaminated in the Sick Bay, if 3 of a single type of Marine animal is contaminated in the Sick Bay, or if the board contains 6 or more Spill Outs (a Spill Out is a column of 3 dice filling a Sector), inform the class that disaster has ended their efforts to contain the oil spill, and they can no longer work to contain the spill.
6. If the bag no longer has dice, explain that the well has been capped and that they have just one final turn to try to contain the spill. If one or more losing conditions is met after the next group's actions, the spill has stopped but the damage to the environment is immense. If there are no losing conditions, however, the class has successfully contained the spill and protected the environment!
7. If the class fulfills all of the Winning Conditions, inform them that their efforts have helped to proactively contain the oil spill, and that they have saved the environment from further damage!
8. Complete the activity by asking students "How was addressing this larger situation different from your previous efforts in oil spill containment?" Allow for discussion on how each different element (the weather dice, the Specialist abilities, the increased area of the spill, etc.) helped or hindered their efforts. Students should be commended for their efforts, regardless of the outcome of their game, as the game design can prove quite challenging for players. Finally, offer suggestions for how this simulation works to abstract what a response to such an environmental disaster would look like - and how it may differ from what actually happens in the world.

Group/Individual Activity: What impact do we have on the environment?

1. Have students consider and answer the following pre-activity questions: How do humans impact the environment? How do humans impact the water, the air, and the land? Allow students about 5 minutes to work with their group (or individually) to come up with as many impacts as possible for each category. Have students write their ideas on the class whiteboard or work on a whole-class collaborative document online.
2. Lead a class discussion to compare and contrast their ideas. Push students to consider additional impacts that each of the ideas may have, including if the idea impacts multiple parts of the

environment. Be sure to help students to identify different pollutants that are directly responsible for negatively impacting the environment.

3. Groups/individuals will be asked to pick one type of pollution brought up in the discussion to investigate and create a shareable. This sharable can be a flyer, an infographic, or another medium (as discussed and approved by you). Canva (https://www.canva.com/) and Google Docs/Slides can be valuable tools to help your students present their ideas.

4. Allow students class time to begin their research, and set clear markers for them to demonstrate their understanding of the pollution:
   a. Define a source of pollution: What exactly is the pollution? Is it point or nonpoint pollution? (refer them back to the oil spill activities as a demonstration of point pollution if they are unsure about the concept.)
   b. How does this pollutant affect the Earth & life (humans, animals, and/or plants), either directly or indirectly?
   c. What is the cause of this pollution? Consider that there can be more than one cause!
   d. How can this pollution be prevented and/or cleaned?
   e. What visuals or images can help to quickly convey your information to others?
   f. Sources - Where did you find this information? Give credit where credit is due!

5. Allow students to complete their shareable for homework, providing feedback and allowing for changes and revisions as necessary.

6. Consider different ways that these shareables can be distributed and posted. The classroom is likely the easiest, but look for other potentially impactful ways in which student work can be shared - school hallways, school social media presences, and student-produced publications like newspapers and news programs could all be avenues to help spread awareness about pollution concerns!

Conclusion

After completing these activities, students should have a better understanding of concerns about and reactions to pollution. Some future topics to consider for further student investigation and lesson planning include the following:
- Further exploration on point vs. nonpoint pollution
- Additional sources of pollution in coastal areas
- Remediation processes for polluted areas

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