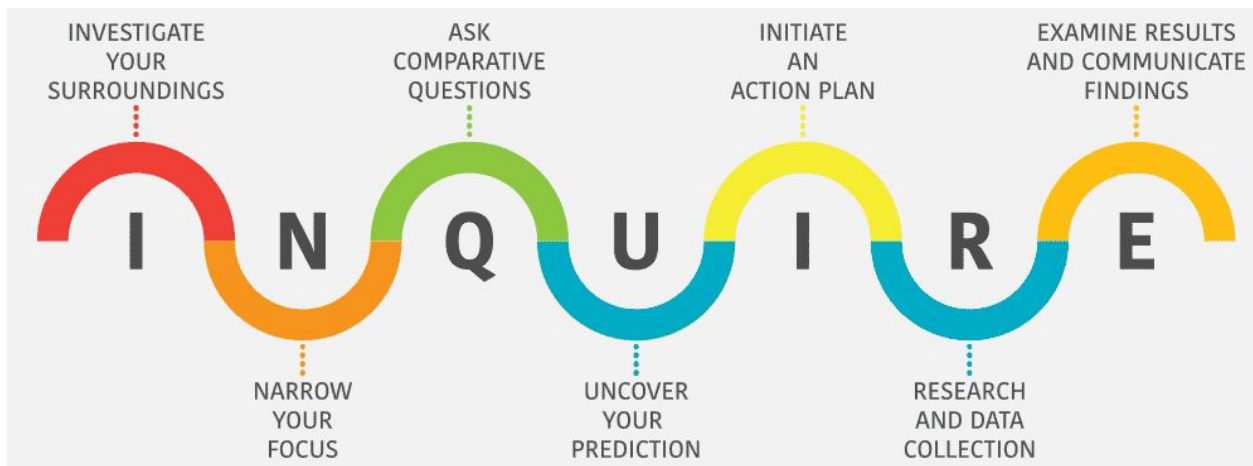


Exploring the Aftermath of Oil Spills

An inquiry-based lesson plan designed to promote critical thinking by integrating content with traditional and inquiry-based learning.



All Hands-On Learning is NOT Inquiry-Based Learning

Inquiry based learning is process-oriented and does not focus on a single correct answer, but rather emphasizes the process of gathering information and forming a conclusion. Traditional hands-on learning tends to be product-oriented and has students follow a pre-planned procedure to come to a single, specified answer.

Key Terms

Process Skills (PS)

Skills that students will engage in while thinking critically. These include observing, questioning, predicting, planning, investigating, interpreting, and communicating. These skills are found in each step of the inquiry process.

Investigating Surroundings

Observing the overall surroundings. What do I see? What is understood about the topic? What still needs to be understood?

Narrowing Focus

Observing student needs and interests, as well as academic content. Find the balance between natural curiosity and standards-based concepts. What area can be concentrated on to best promote growth and learning?

Questioning

Forming questions about what is not fully understood. Comparative questions can be investigated. They need to be able to lead into an action plan. What can be found out?

Uncover Prediction

Logically thinking to form a prediction about what could happen. What do I expect to happen based on my experiences and knowledge?

Initiate Plan

Figure out the action plan. Design an experiment which will answer the comparative question. What can I do to answer this question? How can I find this out?

Research and Collect Data

Investigating the elements of the experiment. Researching and collecting data that applies to the action plan.

Examine Results

Interpreting the data collected. What does this data mean? What else do I want to find out?

Communicating

Communicating the information that was found to someone else. The way the data is presented. What will the audience want to know? What will the audience be able to understand about this?

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Overview

This is an inquiry-based learning lesson in which students learn about the negative effects oil spills have on the ecosystem and discover some of the challenges that occur when cleaning up an oil spill. They will analyze their findings and present to the class. The project will link IBL with traditional teaching by giving teachers options to best suit the class needs. More questions will emerge to continue scientific investigations and further the learning process.

Practical Application

This experiment allows students to understand the importance of taking precautions to prevent oil spills. Each student will have practice with the scientific process, including documenting and interpreting data.

Lesson Plan

Grade Level: 2nd- 5th

Class:

Teacher:

Time Required/Duration: 3 days, approximately 30 minutes each day

Objectives

1. Incorporate the process of inquiry-based learning into a traditional direct instruction classroom setting.
2. Students will be able to use multiple means to find answers to their questions, including but not limited to participating in the inquiry experience, reading information from primary and secondary sources, watching videos, and talking with more knowledgeable individuals in their community.
3. Students will be able to identify ways humans use oil to sustain their way of life.
4. Students will be able to identify problems that occur after an oil spill.
5. Students will be able to collect data answering their comparative questions.
6. Students will be able to present scientific data as well as journal their process.
7. Students will be able to uncover additional questions and think critically about the data found.

Educational Standards

Scientific Inquiry, Practices and Applications

- Apply knowledge of science content to real-world challenges.
- Plan and conduct simple scientific investigations using appropriate safety techniques based on explorations, observations and questions.
- Employ simple equipment and tools to gather data and extend the senses.
- Use data and mathematical thinking to construct reasonable explanations.
- Communicate with others about investigations and data.
- The world is discovered through exploration.
- Exploration leads to observation. Observation leads to questions.

2.LS.1: Living things cause changes on Earth.

3.ESS.1: Earth's nonliving resources have specific properties.

3.ESS. 2: Earth's resources can be used for energy.

4.LS.1: Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

5.LS.1: Organisms perform a variety of roles in an ecosystem.

Materials

Needed:

1. Water
2. Rocks
3. Sticks
4. Moss (pieces of lettuce work as well)
5. Paper Towels

~~IBL Institute Provided at No Charge (Shipping and handling fees will apply):~~

- ~~1. Plastic Tubs (1 per team of 4-5 students)~~
- ~~2. Pipette~~
- ~~3. Furry Fabric~~
- ~~4. Faux Feathers~~
- ~~5. Cups~~
- ~~6. Vegetable Oil~~
- ~~7. Cocoa Powder~~
- ~~8. Sponges~~
- ~~9. String~~
- ~~10. Cotton Balls~~
- ~~11. Spoons~~
- ~~12. Dawn Dish Detergent~~

~~To order the IBL Institute provided supplies, please contact Jessica Begonia at 419-223-1362 with how many students and groups you will have in your classroom. Supplies will be scheduled for delivery two days before the experiment starts.~~

Vocabulary

Comparative Questions
Prediction
Observe
Action Plan
Communicate Findings

Renewable Resources
Nonrenewable Resources
Oil
Contained
Pollution
Extract

Instructional Plan

Day 1

1. Have a class discussion about the natural mineral, oil.
2. Discuss with students what oil is used for in our daily lives. Discuss how oil is used to help fuel cars, trucks, and planes. It is also used to help heat homes, provide electricity, and create synthetic materials and plastics that we use almost everyday. **(Investigate Surroundings)**
3. Think-pair-share about whether they would be able to continue their current lifestyle without oil. Pose the question: “Is it alright for humans to use oil?”
4. Discuss that some many companies drill for oil in the oceans. Let students know that we are going to investigate a simulation environment where oil might be drilled.
5. Have students brainstorm the different living and nonliving items that would be located in the ocean. Write these ideas down on chart paper or an interactive whiteboard.
6. Create a model of the ecosystem using a plastic tub and materials you have prepared (if there is an item that students mentioned that would be located in the ecosystem but you do not have prepared, feel free to have students bring in that item for their group ecosystem the following day.)
7. Talk to students about how sometimes when companies are drilling for oil, some of the oil might leak out into the environment. Model this by using a dropper to add a small amount of the cocoa powder/ oil mixture into the model ocean ecosystem.
8. Ask students how that little amount of oil affected the ecosystem.
9. Talk to students about how sometimes there are bigger spills that occur where pipelines might bust or an accident allows large amounts of oil to spill into the ocean. Model this by dumping a part of the mixture in the tub.
10. Think-pair-share about how this amount of oil affected the ecosystem. What happens if there are waves?. **(Investigate surroundings)**
11. Read the background science about oil spills in groups of 4-5 students then discuss the impact. What happens to wildlife? How is the ecosystem impacted? How can this be cleaned up? **(Narrow Focus)**
12. In small groups, discuss how they think different materials can be cleaned? What method would be best for each? How can certain materials be cleaned without excess oil being put back into the ocean?
13. Create comparative questions in small groups. Examples of comparative questions could be, “Would scrubbing with dish soap or pouring water over feathers rid them of oil easier?” “Will using cotton balls or sponges be more effective at removing oil from rocks?” **(Ask Comparative Questions)**
14. Each student should make their own predictions and document these in their Investigation Books. **(Uncover Prediction)**
15. As a group, students should create a plan as to how they will work to investigate their comparative question. **(Initiate Action Plan)**

Day 2

1. Re-engage students by sharing each the comparative question/s each group will be investigating.
2. Each group of students will need to create their own model ecosystem with the materials provided.
3. Once the ecosystem is set up, students will simulate an oil spill in their ecosystem.
4. Students will then be able to investigate their comparative question. **(Research and Collect Data)**
5. Students should document their findings in their Investigation Books.
6. Once students have finished collecting their data, they can discard non-reusable materials, clean their area, and begin discussing their results.

Day 3

1. Think-pair-share how the investigation went with a peer.
2. Split back into the groups they have been working with and discuss their investigation from yesterday. What went well? What did not go well? What was the answer to the comparative question? **(Examine Results)**
3. Students will complete the post-assessment explaining their findings.
4. Students will prepare as a group what they found and present these findings to their peers. **(Communicate Findings)**
5. Have students complete Student Evaluation Sheet.

Instructional Overview

1. The teacher will introduce the topic oil.
2. Students will discuss the everyday uses for oil.
3. The class will observe a mock oil spill and discuss the potential implications.
4. Each student will receive background science about oil spills.
5. Groups will create comparative questions, make predictions, and create an action plan.
6. Groups will work together to create a model of an ocean ecosystem.
7. Each group will simulate an oil spill to answer their comparative question.
8. Groups will record their data.
9. Students will write in their Investigation Books.
10. Students will complete the post assessment worksheet.
11. Groups will create a presentation and communicate their findings to their peers.
12. The teacher will administer the student feedback form.

Post-Assessment

1. Have each student answer the questions on the worksheet.
 - a. Discussion about the material during this time should be encouraged, the answers should also be in their own words and what they individually think.
2. Each group will prepare an explanation to the class about their findings. It should cover the data they collected during their investigation and any other relevant information.

Background Science-Teacher Information

An oil spill refers to liquid petroleum hydrocarbon (oil) spilling out into the environment, and is considered a type of pollution. This can be caused by accidents involving drilling rigs (such as this lesson refers to), wells, tankers, or other oil-containing machinery.

Oil and water have key differences down to the molecules. Oil does not dissolve into water, and instead spreads out over its surface. This is because the water molecules have a polar charge, which means that to bond with them, the other molecules need to have a polar charge as well. Oil molecules are nonpolar, so they can only bond with other nonpolar molecules. This makes the water molecules stay together, and the oil molecules stay together, keeping them separate from each other.

Soaps are emulsifiers, meaning they have one end of the molecule as polar and the other as nonpolar. This allows the soap molecules to attach to both the water and oil molecules, making it easy to remove them from the area. Soaps like Dawn have been known to be beneficial in cleaning oil from animals because it can remove the oil with relative ease, is safe for skin and eyes, and is easily attained.

Oil Spills have a large impact on the ecosystem they occupy. Animals that live in the area affected can be coated in the oil, which can weigh them down, making it hard for them to float or swim in the water. It can have more severe effects on the animals, causing them to lack the ability to breath, eat, or properly function, which can lead to their deaths. Other animals can eat these oil-coated animals, which can cause a variety of health problems for those animals. Oil can also be harmful to plants, which prohibits their natural impact on the surrounding environment and the animals that eat them. Loss of shelter for animals can occur due to the oil's effects on the habitat, or the clean-up efforts.

The Audubon website has an article “FAQ: How Oil Covered Birds Are Cleaned” which answers several questions about cleaning birds who have been affected by an oil spill. It gives an insight into the real life practice of taking care of these animals, and provides information about the specifics of the work. The web address for this article is provided below.

<https://www.audubon.org/news/faq-how-oil-covered-birds-are-cleaned>

Your Carbon Footprint is the environmental impact you have on the Earth, measured by the amount of Carbon that is released into the air. Many things can help reduce your carbon footprint, such as turning off the lights when they're not being used, eating less meat, using reusable bags, and turning off the water while brushing your teeth.

Journaling

Students will document their thoughts and questions each day for the duration of this lesson. Students will be writing in their investigation books, which they will add on to each day. Writing should be done each day, that way students can document what they have learned each day and add any new questions that come to their minds. If the students already regularly engage in a journaling activity, the teacher can choose to use that method instead of the investigation book. The goal of journaling is for students to reflect on their knowledge and how it has grown, as well as to think about and record the questions they have about this topic.

About Inquiry-Based Learning As It Applies To This Lesson Plan

This is a project that works best when students work in small groups (4-5 students). Inquiry is collaborative in nature. The process takes advantage of students' strengths to contribute to the project. Some are great communicators, some are problem-solvers, and some have well-developed technical skills. In the workplace, we also work in groups. We work as part of a team. The inquiry process develops skills necessary to solve complex problems in the world.

Investigate your surroundings and narrow your focus: Encourage each group to think about the everyday uses of natural oil. What happens to the ecosystem if natural oil spills into the environment? This is a good time for students to write down questions. We suggest having them write individual questions on individual pieces of paper so the questions can later be sorted. It's not important to sort those now, but this can be revisited once the students are more in tune with the inquiry process.

Ask comparative questions: At the heart of inquiry is the comparative question. Comparative questions are ones that can be investigated. Some questions are very good questions, but they are very difficult to investigate. For example: Why are butterflies attracted to my flower garden? Good question, but difficult to investigate. However, we can take that question and change it to: Are butterflies attracted more to red flowers or white flowers? Do you see where we are going with this? You can now design an experiment to count how many butterflies visited each of the colors and compare the results. More questions will come of this process. Do the findings hold up for different kinds of butterflies? Another experiment can be designed. In the case of cleaning up an oil spill, the comparative question, at least somewhat, can be provided by you. This makes the lesson plan a guided inquiry. An open inquiry is one in which the students pick the topic, create the questions, create the action plan, etc. For this guided inquiry, examples of comparative questions include: What technique will help remove more oil from the environment, _____ or _____? Will using a _____ or _____ remove more oil from _____? Later, we will revisit the questions the students asked above and have them separate those questions that can be investigated and those that cannot. Often, questions that would be difficult to investigate can be made investigable by turning them into comparative questions.

Uncover your prediction: We are not talking about group-think here. What do you individually think? Each group will be collecting data from their simulation of an oil spill. Will the data show that one technique was better than another? Each student will have a prediction and they should record that prediction. A prediction is not the same thing as a hypothesis. A hypothesis might be: All swans are white. A prediction would be: I think the next swan I see will be white. A prediction is based upon the individual's experiences, observations, opinions, knowledge, and instincts.

Initiate an action plan: The experiment has been provided. The action plan was designed to help students answer the comparative question. Students will create an ocean ecosystem, simulate an ocean spill, and investigate their comparative questions. It's not one of those "do the experiment and I will let you know the right answer." There is no right answer. Ask the students to record their data on the data sheet provided. To make future lesson plans or repeats of this one more inquiry-based, simply ask them to make a data sheet and record their findings. Perhaps have half the groups use the data sheet provided and then let the other half come up with their own. Part of inquiry requires you to give up some control to allow your students to figure it out.

Examine results and communicate findings: Each group will present their findings to the class. Typically, each group would prepare a graph, data table, chart, pictures or whatever they want to communicate their findings to the class. A poster or section of white board is helpful. The group goes to the front and each member usually participates. As a group, they share the data found with the class. They share their individual predictions. They share their analysis of the measurements and how they came to their conclusion. How do they answer the comparative question? What did they learn from the experience? Classmates then have an opportunity to ask questions to the presenting group.

Student/Teacher Roles for Each Step:

Investigate your surroundings:	The students are doing this
Narrow your focus:	The students are doing this
Ask comparative question:	The students are doing this
Uncover your prediction:	Each student is doing this
Initiate an action plan:	The teacher and the students are doing this
Research and data collection:	The students are doing this*
Examine results and communicate findings:	The students are doing this

*You may use the data sheet provided or the student may create their own

Group Procedures

Day 1:

1. Investigate the model oil spill ecosystem with the class.
2. Synergize with your group to create a comparative question.
3. Write your own prediction.
4. Create an action plan as a group.

Day 2

1. Create your own model ecosystem in your bin using water, rocks, sticks, and other materials you find.
2. Create the oil spill in the ecosystem by mixing 1/2 cup vegetable oil with 2 tbsp. of cocoa powder.
3. Pour mixture into your model ecosystem.
4. Observe the spill and use the action plan to answer the comparative question.
5. Record your findings.

Day 3

1. Work on writing your findings neatly on your post-assessment.
2. As a group discuss what information is important to share.
3. Decide what you will say to the class.
4. Practice what each person will say during the presentation.
5. Present your findings to the class.

Extensions

1. Students can research different ways to clean up oil spills.
 - a. There are several products that have come out that advertise their benefit to cleaning up oil spills. Some scientists have also suggested bacteria and other natural methods could be a good way to get the oil out of the water.
 - b. Have students research these different methods and compare them. What are the benefits to this method? What are negative effects this method might have?
 - c. Make a pros and cons list for each method, or choose two different methods and make a venn diagram about the impact each one will have.

2. Students can explore pollution in their own environment.
 - a. Explain that pollution occurs in many different ways, not just large oil spills.
 - b. Have each student think about and research one way that pollution is occurring in their daily life.
 - c. Discuss carbon footprints as a class, and how each person has an impact on the environment, which can be both good and bad.
 - d. Students can research ways they can reduce their carbon footprint using computers. Help them look for lists online, such as the one on Columbia University's website State Of the Planet, and their article "35 Easiest Ways to Reduce your Carbon Footprint" at the URL provided below:
<https://blogs.ei.columbia.edu/2018/12/27/35-ways-reduce-carbon-footprint/>
 - e. Students will use a piece of paper to split into two sections. On one section they will draw a picture (or depict however they would like) the pollution they see happening in their life. On the other side, they will depict how they can personally help reduce their carbon footprint to do their part in helping the environment.
 - f. Collect and hang these in the room or in the hall.

Word Wall: Bridges



**Comparative Questions-
questions we can
investigate**



**Prediction- what you
think before you
investigate**



**Observe- to watch
carefully and notice
important details**



Action Plan- the steps you will take during your investigation



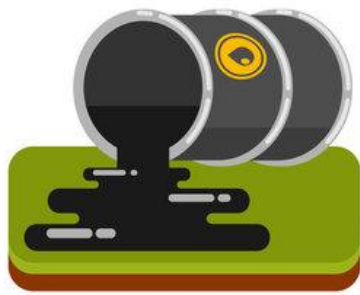
Communicate Findings- explaining what you found to your peers



Renewable Resources- supplies that can be replenished or sustained



Nonrenewable Resources- supplies that are finite and do not replenish as quickly as we use them



 publicdomainvectors.org

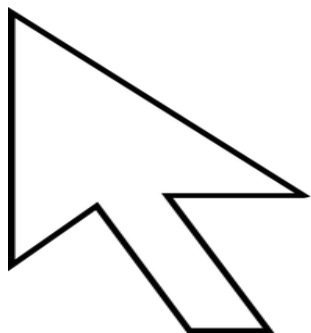
Oil: a nonrenewable resource that is used to create gas, plastics, and other materials



Contained: when a material is not spread to other areas



Pollution- happens when harmful materials are let go into the environment



Extract- to remove or take out

Background Science- Student Information

Pollution is when harmful materials are let go into the environment. It is harmful when it has negative effects on the world, which includes animals, plants, soil, and the air. Pollution is happening everywhere, including big cities, small towns, countrysides, lakes, ponds, and the ocean. It can be caused by many things, even things that are in your daily life!

Some pollution is natural, like volcanic eruptions, which send ash into the air and can cover the sky for months. This harms the environment by not letting sunlight to get to Earth's surface, making plants unable to grow normally. Pollution is also caused by humans, like when pesticides used for crops run off into water and soil. This puts harmful chemicals into the food and water that many animals use to survive.

Oil is a nonrenewable resource that is used to create gas, plastics, and other materials. It is made from dead plants and animals who have been buried for millions of years. The soil piled up on top of them, and over time it caused the plant and animal matter to have a lot of heat and pressure put on them. This created the oil that we use in our daily lives.

Areas with oil close to the surface are often underwater. Companies drill into the ocean floor, then extract the oil to sell and use. Sometimes, a mistake is made which causes the oil to spill out into the ocean. This can cause harm to the environment that it is in. The oil cannot mix with the water, so it goes to the surface of the water and spreads out.

Plants and animals can die or get hurt from this, especially if humans are not able to help them in time. Oil can get stuck in birds feathers, and weigh them down. This makes them unable to fly, and can make it hard for them to find food. Animals also use their feathers or fur to keep warm, but when they are coated in oil they cannot do that. It can also get stuck in whale and dolphin blowholes, making them not be able to breath.



Investigation Book

Investigator: _____



Institute

Inquiry-Based Learning
Educational Consultants

KWL Chart

Oil Spills

K Things I Know	• • •
W Things I Wonder	• • •
L Things I Learned	• • •

Things I Want to Investigate

The factors I am investigating are:

My comparative question is:

I think that :

What made you excited about today's lesson?

What is one thing you learned about today?

My findings:

What I am taking away from this inquiry:

Vocabulary



Comparative Questions-
questions we can investigate



Prediction- what you think
before you investigate



Observe- to watch carefully and
notice important details



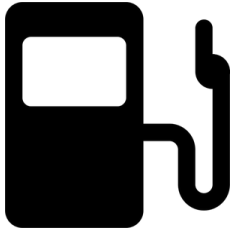
Action Plan- the steps you will
take during your investigation



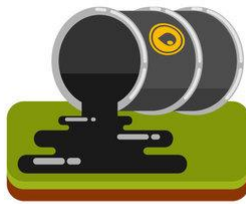
Communicate Findings-
explaining what you found to
your peers



Renewable Resources- supplies that can be replenished or sustained



Nonrenewable Resources- supplies that are finite and do not replenish as quickly as we use them



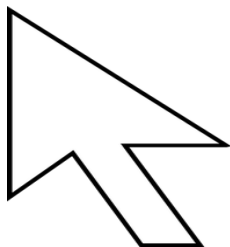
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Contained: when a material is not spread to other areas



Pollution- happens when harmful materials are let go into the environment



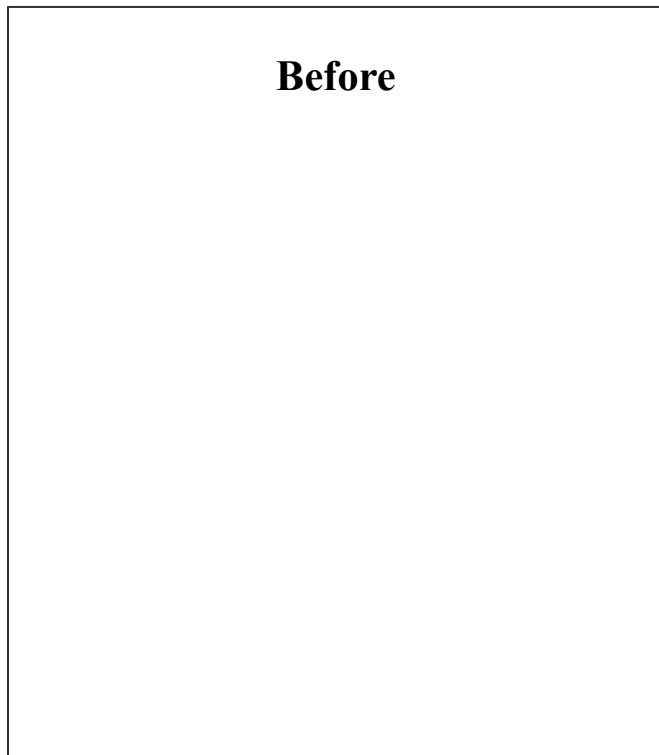
Extract- to remove or take out

Name: _____

What was your comparative question?

Draw or insert pictures of your investigation.

Before



After



What were your results?

Thinking about oil spills, what would you like to investigate further?

1. What did you learn from this?

2. What additional questions come to mind after having done the experiment?

3. Was it fun and/or interesting?

1. What evidence suggests students grasped the major themes of the experiment?

2. Do you anticipate other guided or open inquiry projects arising from this project? What questions did the students ask that suggest understanding and interest in the subject?

3. To what extent did this project fit into your curriculum and teaching agenda?

4. Would you consider doing this again?

5. What would improve this experience?