**DEP Environmental Education Curricula**

**Lesson Plan**

**GRADE/LEVEL: Middle School**

**LESSON TITLE: Ocean Acidification**

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| **Next Generation Science Standards** |  |  |
| **MS-ESS3-4** |  **MS-ESS3-4** | Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems. |
|  | **Science and Engineering Practices** | [**Engaging in Argument from Evidence**](http://www.nap.edu/openbook.php?record_id=13165&page=71)[Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).](http://www.nap.edu/openbook.php?record_id=13165&page=71)[Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.](http://www.nap.edu/openbook.php?record_id=13165&page=71) |
|  | **Disciplinary Core Ideas** | [**ESS3.C: Human Impacts on Earth Systems**](http://www.nap.edu/openbook.php?record_id=13165&page=194)[Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.](http://www.nap.edu/openbook.php?record_id=13165&page=194) |
|  | **Crosscutting Concepts** | [**Cause and Effect**](http://www.nap.edu/openbook.php?record_id=13165&page=87)[Cause and effect relationships may be used to predict phenomena in natural or designed systems.](http://www.nap.edu/openbook.php?record_id=13165&page=87) |
| **Objectives** |
|  |  | **Objective 1:** Promote student understanding of ocean acidification.**Objective 2:** Learn the causes of ocean acidification and actions that can be taken to reduce ocean acidification.**Objective 3:** Discuss why scientists are concerned about ocean acidification and lowering pH levels in our oceans. |
| **Vocabulary** |  |  |
|  | **Calcareous** | Meaning mostly or partially formed of calcium carbonate. |
|  | **Carbonate** | A salt of carbonic acid. |
|  | **Carbon Dioxide** | A colorless, typically odorless, gas – a carbon atom covalently bonded to two oxygen atoms. |
|  | **Chemosensory** | Perceptive to chemical sensory input. |
|  | **Larval** | An immature form of animal or insect.  |
|  | **pH** | A figure expressing the acidity or alkalinity of a solution on a logarithmic scale. |
|  | **Photosynthetic** | The process by which plants and some other organisms use sunlight to synthesize nutrients from carbon dioxide and water. |
| **Background** |  |  |
| **Teacher Version**Selected Materials from …**Ocean Acidification**  | **Source:** http://www.noaa.gov/resource-collections/ocean-acidification |
| **Introduction**For more than 200 years, or since the industrial revolution began, the concentration of **carbon dioxide** (CO2) in the atmosphere has increased due to the burning of fossil fuels and land use change (e.g. increased car emissions and deforestation). During this time, the **pH** of surface ocean waters has fallen by 0.1 pH units. The pH scale, like the Richter scale, is logarithmic, so this change represents approximately a 30% in acidity.Ocean acidification changes ocean chemistry and affects marine life.The ocean absorbs about 30% of the CO2 that is released in the atmosphere, and as levels of atmospheric CO2 increase, so do the levels in the ocean. When CO2 is absorbed by seawater, a series of chemical reactions occur resulting in the increased concentration of hydrogen ions. This increase causes the seawater to become more acidic and causes **carbonate** ions to be relatively less abundant.Carbonate ions are an important building block of structures such as sea shells and coral skeletons. Decreases in carbonate ions can make building and maintaining shells and other calcium carbonate structures difficult for calcifying organisms such as oysters, clams, sea urchins, shallow water corals, deep sea corals, and **calcareous** plankton. The pteropod, or "sea butterfly," is a tiny sea creature about the size of a small pea. Pteropod: noaanews.noaa.govPteropods are eaten by organisms ranging in size from tiny krill to whales and are a major food source for North Pacific juvenile salmon. When pteropod shells were placed in sea water with pH and carbonate levels projected for the year 2100, the shells slowly dissolved after 45 days. Researchers have already discovered severe levels of pteropod shell in the Southern Ocean, which encircles Antarctica. Pteropods are small organisms, but imagine the impact if they were to disappear from the marine ecosystem!Changes in ocean chemistry can affect the behavior of non-calcifying organisms as well. The ability of certain fish, like pollock, to detect predators is decreased in more acidic waters. Recent studies have shown that decreased pH levels also affect the ability of **larval** clownfish to locate suitable habitat. When subjected to lower pH levels, the larval clownfish lost their **chemosensory** ability to distinguish between their favored and protective anemone habitat among the reefs and unfavorable habitats like mangroves. Additionally, greater acidity impairs their ability to distinguish between the "smell" of their own species and that of predators. These two factors create an increased risk of predation. When these organisms are at risk, the entire food web may also be at risk. Ocean acidification is expected to impact many ocean species to varying degrees. While some species will be harmed by ocean acidification, **photosynthetic** algae and seagrasses may benefit from higher CO2 conditions in the ocean, as they require CO2 to live just like plants on land.Estimates of future carbon dioxide levels, based on business as usual emission scenarios, indicate that by the end of this century the surface waters of the ocean could be nearly 150% more acidic, resulting in a pH that the oceans haven’t experienced for more than 20 million years.Ocean acidification is currently affecting the entire world’s oceans, including coastal estuaries and waterways. Today, more than a billion people worldwide rely on food from the ocean as their primary source of protein. Approximately 20% of the world’s population derives at least 1/5 of its animal protein intake from fish. Many jobs and economies in the U.S. and around the world depend on the fish and shellfish that live in the ocean.Over the last decade, there has been much focus in the ocean science community on studying the potential impacts of ocean acidification. NOAA's Ocean Acidification Program serves to build relationships between scientists, resource managers, policy makers, and the public in order to research and monitor the effects of changing ocean chemistry on economically and ecologically important ecosystems such as fisheries and coral reefs.Because sustained efforts to monitor ocean acidification worldwide are only beginning, it is currently impossible to predict exactly how ocean acidification impacts will cascade throughout the marine food chain and affect the overall structure of marine ecosystems. With the pace of ocean acidification accelerating, scientists, resource managers, and policymakers recognize the urgent need to strengthen the science as a basis for sound decision making and action.**Crosscutting Concept: Cause and Effect**The concentration of **carbon dioxide** (CO2) in the atmosphere has increased due to the burning of fossil fuels and land use change (e.g. increased car emissions and deforestation). Consider how using renewable energy sources rather than burning fossil fuels may change the amount of CO2 in the atmosphere, and thus the ocean. This topic can be discussed again after the demonstration procedure has been performed, and the effects of pH are reinforced. |
| **2nd topic source** **Ocean Acidification** | Source Material taken from http://www.whoi.edu/OCB-OA/page.do?pid=112076 |
| **Questions for Discussion****What is ocean acidification?**International experts define **ocean acidification** (OA) as a decrease in ocean pH over decades or more that is caused primarily by uptake of CO2 from the atmosphere. Because human activities are releasing CO2 into the atmosphere very quickly, the ocean is taking up CO2 faster today than it has in the past. This is causing global ocean chemistry to change more quickly than ocean systems can handle.**What is the difference between pH and acidity?**pH is the scale on which acidity is measured, and so it describes how much acid is in a liquid. This is similar to how degrees Celsius are used to measure temperature. The amount of hydrogen ions in a liquid determines how acidic the liquid is. But hydrogen ions can be present in a range from 1 down to extremely small numbers (0.00000000000001). To avoid error from writing down all the zeros, scientists use a **logarithmic scale** and call this scale pH. Because it is logarithmic, one step up or down on the pH scale is the same as multiplying or dividing by ten on the hydrogen ion scale. **Why are scientists concerned about such a seemingly small change in ocean pH?**Many organisms on land and in the oceans are very sensitive to small changes in pH. Marine organisms that are used to stable seawater chemistry will experience changing conditions because of ocean acidification. Research shows that this change could harm certain species.**Misunderstanding: Because natural pH variability is greater than long-term pH change, ocean acidification is nothing to worry about.**Many scientists have observed that natural variability in seawater acidity (and thus pH) over days, weeks, and months is strong. This short-term variability can be much larger than the recent and forecasted changes in acidity that will take place over decades to centuries because of ocean acidification.  The reason that scientists are concerned about this slow, long-term change is that it changes the environmental baseline. This means that the natural variability in acidity due to photosynthesis, respiration, upwelling, and many other processes will be overlaid on an ever-increasing average concentration of H+.Even though this change in the baseline is slow and steady relative to human time scales, this change is very fast relative to geological time scales. Ocean acidification is more rapid than any change in ocean acidity documented over the last 300 million years, so organisms that tolerate a certain narrow range of conditions may encounter increasingly stressful, or even lethal, conditions in the coming decades. **Ocean acidification chemistry 101**Carbon dioxide (CO2) naturally exchanges between the atmosphere and the surface of the ocean.  The CO2 content of the upper ocean has been increasing in parallel with the CO2 in the atmosphere since the Industrial Revolution, with the rate of increase becoming more rapid over the last half century as human-caused CO2 emissions have accelerated.When CO2 dissolves in seawater, it has several consequences for the chemistry of the seawater.  Some of the CO2 that dissolves in seawater will remain in the form of a dissolved gas that can freely exchange with the atmosphere and be taken up directly by marine plants and phytoplankton.  This fraction is usually referred to as dissolved or aqueous carbon dioxide, and it is typically expressed as the partial pressure of CO2 [abbreviated pCO2, in units of microatmospheres (µatm)].Some of the molecules of CO2 dissolved in seawater combine with molecules of water (H2O) to form a weak acid, called carbonic acid (H2CO3), the same acid that is in carbonated beverages like seltzer water.   This reaction can be depicted as:CO2      +          H2O      ↔       H2CO3**carbon             water                carbonic****dioxide                                     acid**When acids are dissolved in water, they “dissociate,” which means that they break apart into their constituent ions, in this case a hydrogen ion (H+) and a bicarbonate ion (HCO3-, as is found in baking soda).H2CO3   ↔     H+        +          HCO3-**carbonic         hydrogen         bicarbonate****acid                  ion                   ion**At typical seawater pH values, some of the hydrogen ions will remain as hydrogen ions, thus increasing the acidity and lowering the pH of the seawater.  However, most of the hydrogen ions created through the previous reaction will subsequently combine with carbonate ions (CO32-) to form additional bicarbonate ions, thereby reducing the pool of carbonate ions. H+        +          CO32-   ↔     HCO3-**hydrogen     carbonate         bicarbonate****ion                   ion                   ion**In summary, the chemical changes in seawater resulting from increased atmospheric CO2 concentrations include ***increases***in the concentrations of dissolved (or aqueous) carbon dioxide, hydrogen ions, and bicarbonate ions, and ***decreases*** in the carbonate ion concentration and pH. |
| **Demonstration Project**  | **Materials taken from Source:** **http://www.cisanctuary.org/ocean-acidification/PDFs-WorkshopPage/Hands\_on\_acivities/OA\_Shells.pdf** |
| **Background** Shells serve as a protective structure for both marine and **terrestrial** organisms. Marine ecosystems that depend upon calcium-carbonate to make shells, such as coral reefs or oyster beds, can be impacted by changes in ocean pH due to increased carbon dioxide. In experimental conditions under very high levels of CO2, shells of clams, oysters, corals, snails and urchin shells dissolve. If these organisms are unable to build or repair shells, due to increased acidification caused by industrial emissions, deforestation and other human activities, they will likely cease to exist in these environments. These results do not occur for all organisms. In experimental conditions, extreme increases in carbon dioxide result in crabs, lobsters, temperate sea urchins, limpets, and calcifying algae all building thicker shells with the more acidic conditions. Some organisms are able to adapt more rapidly than others, some will leave an environment if they cannot adapt and others may cease to exist in that environment. Nutrient levels, water temperature, food availability and habitat changes also can have an impact. Efforts to reduce that impact have the greatest chance of preserving some of these habitats. This activity allows you to see firsthand the effects ocean acidification can have on calcifying organisms. When exposed to vinegar, which is an acid, the calcified eggshell produces CO2 bubbles as it dissolves. The shells and skeletons of live calcifying organisms can be similarly affected as the ocean acidifies. If shell-building organisms are affected, then all of the organisms that depend on them will also be impacted.Related image***Always follow the safety instructions of your teacher. Use safety equipment as directed. Do not drink or inhale vapors of the fluids. If you spill any liquids confirm with your teacher the proper clean up procedure. Read the entire procedure for your upcoming project and ask any questions for clarification before you start your work.***Have a student look up the approximate pH of distilled white vinegar, cola, ammonia, and fresh water. Note: Distilled white vinegar (5%) has a pH of ~2.4. Cola pH ~ 2.5. pH of ammonia ~ 11.6. Fresh water pH ~ 7.5 – 8.5. **Materials (for each group performing the demonstration)*** pieces of empty clean chicken eggshell (these are abundant, calcified shells and serve as a proxy for marine shells)
* distilled vinegar, cola, ammonia, fresh water
* pH test strips or pH probe
* a small dish for each sample
* medicine dropper or plastic pipette for each liquid
* magnifying lens
* safety gloves and goggles (one set per group)

**Procedures** 1. Designate a student to look up the approximate pH of distilled white vinegar, cola, ammonia, and fresh water. Have this student share the data with the class to record on their worksheets.
2. Have students predict and record the effect of the solutions on the pieces of shell. What will happen if they put a piece of egg shell in vinegar, cola, water, etc? Which solution will have the greatest effect on the shell?
3. Designate a student to label each dish with the type of liquid they will use on the shell.
4. Put a separate piece of shell into each small dish. Keep one piece in a dish on its own as a control.
5. Use a dropper to place a few drops of selected liquid on a shell piece. (Use a different piece of shell for each liquid).
6. Watch what happens. What do you observe? Which liquids react with the shell first? Record your observations.
7. From your observation of the eggshells, what might be some consequences of ocean acidification for animals with shells? How might you test this hypothesis? Record your thoughts.
8. If possible, leave your test samples overnight and check and record the results on the following day.
9. Did the results match your expectations? If no, why do you think this is?
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| **Teacher Prep**  |  |  |
|  | **Advanced Preparation Steps &****Duration** | 1. Read and consider associated background material, demonstration procedures, and questions for discussion. (1 hour)

Review Video Clip A Climate Calamity in the Gulf of Maine Part 2 – https://www.youtube.com/watch?v=ZimEBFw1Q7c(4:26 minutes)1. Review Ocean Acidification PowerPoint (20 minutes)
2. Assemble Demonstration Materials & Practice Demonstration (2 hours)
3. Print out student worksheets for demonstration day.
4. Assign the Student Background Information Sheet for students to read prior to the lecture/demonstration day.
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| **Needed Materials**  |  |  |
|  |  | Video Clip A Climate Calamity in the Gulf of Maine Part 2 – embedded in powerpoint - https://www.youtube.com/watch?v=ZimEBFw1Q7c(4:26 minutes)1. Ocean Acidification Power Point
2. pieces of empty clean chicken eggshell (these are abundant, calcified shells and serve as a proxy for marine shells) (per group)
3. vinegar, cola, ammonia, water (less than ½ a cup of each liquid per group)
4. 4 pH test strips, pH probe (per group)
5. a small dish for each sample (per group)
6. medicine droppers or plastic pipette (per group)
7. magnifying lens (per group)
8. safety gloves and goggles (one set per group)
9. internet Access
 |
|  | **Duration of activities** | 60 minutes |
|  | **Safety notes** | Always follow the safety instructions of liquids as listed on their containers. Use safety equipment as directed. Do not drink or inhale vapors of the fluids. If you spill any liquids confirm the proper clean up procedure. Read the entire procedure for your upcoming project before you start your work. |
|  | **Additional Information Sources for Enrichment** | <http://www.necan.org> – The Northeast Coastal Acidification Network<http://www.seargant.umaine.edu/extension/maine-ocean-and-coastal-acidification-partnership> - Maine Ocean and Coastal Acidification Partnership (MOCA) |
| **Procedures for Instruction** |  |  |
|  |  | Assign the Student Background Information Sheet for students to read prior to the lecture/demonstration day. |  |
|  |  | Introduce the class to the idea of Ocean Acidification.  | ~ 2 minutes |
|  |  | Ocean Acidification with associated film  | ~25 minutes(PowerPoint) |
|  |  | Ocean Acidification Demonstration & Worksheet | ~20 minutes |
|  |  | Discussion  | ~10 minutes |
| **Student Materials** |  |  |
|  | Student Background Information | Reading assignment prior to the demonstration day. |
|  | Vocabulary List | Available for clarification of terminology as students read their Background Informational Sheet and Demonstration Procedure |
|  | Student Worksheet | Use this worksheet for students to record their thoughts and observations during the project. |

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| **Student Background Information Sheet – Ocean Acidification** |
| **Source:** http://www.noaa.gov/resource-collections/ocean-acidification**Introduction**For more than 200 years, or since the industrial revolution began, the concentration of **carbon dioxide** (CO2) in the atmosphere has increased due to the burning of fossil fuels and land use change (e.g. increased car emissions and deforestation). During this time, the **pH** of surface ocean waters has fallen by 0.1 pH units. The pH scale, like the Richter scale, is logarithmic, so this change represents approximately a 30% in acidity.The ocean absorbs about 30% of the CO2 that is released in the atmosphere, and as levels of atmospheric CO2 increase, so do the levels in the ocean. When CO2 is absorbed by seawater, a series of chemical reactions occur resulting in the increased concentration of hydrogen ions. This increase causes the seawater to become more acidic and causes **carbonate** ions to be relatively less abundant.Carbonate ions are an important building block of structures such as sea shells and coral skeletons. Decreases in carbonate ions can make building and maintaining shells and other calcium carbonate structures difficult for calcifying organisms such as oysters, clams, sea urchins, shallow water corals, deep sea corals, and plankton. Changes in ocean chemistry can affect the behavior of non-calcifying organisms as well. The ability of certain fish, like pollock, to detect predators is decreased in more acidic waters. Recent studies have shown that decreased pH levels also affect the ability of **larval** clownfish to locate suitable habitat. When subjected to lower pH levels, the larval clownfish lost their **chemosensory** ability to distinguish between their favored and protective anemone habitat among the reefs and unfavorable habitats like mangroves. Additionally, greater acidity impairs their ability to distinguish between the "smell" of their own species and that of predators. These two factors create an increased risk of predation. When these organisms are at risk, the entire food web may also be at risk. Ocean acidification is expected to impact many ocean species to varying degrees. While some species will be harmed by ocean acidification, **photosynthetic** algae and seagrasses may benefit from higher CO2 conditions in the ocean, as they require CO2 to live just like plants on land.Estimates of future carbon dioxide levels, based on business as usual emission scenarios, indicate that by the end of this century the surface waters of the ocean could be nearly 150% more acidic, resulting in a pH that the oceans haven’t experienced for more than 20 million years.Ocean acidification is currently affecting the entire world’s oceans, including coastal estuaries and waterways. Today, more than a billion people worldwide rely on food from the ocean as their primary source of protein. Approximately 20% of the world’s population derives at least 1/5 of its animal protein intake from fish. Many jobs and economies in the U.S. and around the world depend on the fish and shellfish that live in the ocean.Over the last decade, there has been much focus in the ocean science community on studying the potential impacts of ocean acidification. NOAA's Ocean Acidification Program serves to build relationships between scientists, resource managers, policy makers, and the public in order to research and monitor the effects of changing ocean chemistry on economically and ecologically important ecosystems such as fisheries and coral reefs.Because sustained efforts to monitor ocean acidification worldwide are only beginning, it is currently impossible to predict exactly how ocean acidification impacts will cascade throughout the marine food chain and affect the overall structure of marine ecosystems. With the pace of ocean acidification accelerating, scientists, resource managers, and policymakers recognize the urgent need to strengthen the science as a basis for sound decision making and action. |

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| **Student Vocabulary List – Ocean Acidification** |
| **Vocabulary** | **Carbonate** | A salt of carbonic acid. |
|  | **Carbon Dioxide** | A colorless, typically odorless, gas – a carbon atom covalently bonded to two oxygen atoms. |
|  | **Chemosensory** | Perceptive to chemical sensory input. |
|  | **Larval** | An immature form of animal or insect.  |
|  | **pH** | A figure expressing the acidity or alkalinity of a solution on a logarithmic scale. |
|  | **Photosynthetic** | The process by which plants and some other organisms use sunlight to synthesize nutrients from carbon dioxide and water. |

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| **Ocean Acidification Demonstration Student Worksheet** |
| **Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**Related image***Always follow the safety instructions of your teacher. Use safety equipment as directed. Do not drink or inhale vapors of the fluids. If you spill any liquids confirm with your teacher the proper clean up procedure. Read the entire procedure for your upcoming project and ask any questions for clarification before you start your work.*****Before starting your work have the student that will be handling eggshells and liquids put on his or her safety gear. Confirm your group has the following materials for your demonstration.*** safety gear (gloves, safety goggles) for the student handling the liquids and shells.
* pieces of empty clean chicken eggshell (these are abundant, calcified shells and serve as a proxy for marine shells)
* distilled vinegar, cola, ammonia, fresh water
* 4 pH test strips (or pH probe)
* a small dish for each sample
* medicine dropper or plastic pipette for each liquid
* magnifying lens
1. **Record the approximate pH of the following liquid.**

|  |  |  |
| --- | --- | --- |
| **Liquid** | **pH value****(Measured with test strips)** | **pH value****(Reference value from internet)** |
| Distilled White Vinegar |  |  |
| Cola |  |  |
| Ammonia |  |  |
| Fresh Water |  |  |

1. **Prediction of Actions**

What are the suspected effects of the liquids on the eggshells?What liquid do you suspect will cause the greatest effect, and why?1. **Label each dish with the name of the liquid to be applied to the eggshell, and label one dish as “control”.**
2. **Have the student in safety gear place a piece of eggshell in each dish.**
3. **Have the student in safety gear apply each liquid to each eggshell piece. Observe the reaction between the liquid and the shell.**
4. **Which liquids react with the shell first? Record your observations below\*.**
5. **From your observation of the eggshells, what might be some consequences of ocean acidification for animals with shells? How might you test this hypothesis? Record your thoughts.**
6. **Share your thoughts with your teacher and the class. Is there general agreement in the class?**

 **\***If possible, leave your samples overnight and check and record your results. |

**Project Assessment**

**Project Title:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Instructor/School/Grade: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_/\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_/\_\_\_\_\_\_\_\_**

**Instructor Contact Information: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Date you assigned this project to your class: \_\_\_\_\_\_\_ Number of Students Participating \_\_\_\_\_\_**

The following questions are intended to help us understand your feelings regarding the presentation and materials. Your sincerity in answering these questions is appreciated. Please feel free to use the space at the end of the form for any additional comments that you may have. *This form has been left in Microsoft Word format so that you may fill it in electronically. Please fill out the form completely and email your assessment to* david.madore@maine.gov.

**Ranking System**

 1 ~ Excellent / Strongly agree

 2 ~ Good – Above average / Moderately agree

 3 ~ Average – ok / Neutral in agree or disagree

 4 ~ Poor – below average / Moderately disagree

 4 ~ Very poor – not acceptable / Strongly disagree

 NA / not applicable

*Please continue on the second pagee…*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **NA** | **Questions** |
|  |  |  |  |  |  | **Course Content** |
|  |  |  |  |  |  | 1. Value of course content to you.
 |
|  |  |  |  |  |  | 1. Importance of course content given your teaching topic.
 |
|  |  |  |  |  |  | 1. Overall rating of course content.
 |
|  |  |  |  |  |  | 1. Ease of implementing materials into daily lessons.
 |
|  |  |  |  |  |  | **Materials/Project** |
|  |  |  |  |  |  | 1. Movie (if applicable) was easy to present.
 |
|  |  |  |  |  |  | 1. Student worksheet was useful and easy to follow.
 |
|  |  |  |  |  |  | 1. Student project stimulated thinking & conversation.
 |
|  |  |  |  |  |  | 1. The project put ideas across effectively.
 |
|  |  |  |  |  |  | 1. Teacher materials were useful and easy to follow.
 |
|  |  |  |  |  |  | 1. The method of material presentation encouraged students feel free to ask questions, disagree, express ideas, etc.
 |
|  |  |  |  |  |  | **Self-Evaluation (Instructor)** |
|  |  |  |  |  |  | 1. What was your level of knowledge concerning this topic prior to this presentation?
 |
| **Please share any recommendations you feel would be helpful.** |

**Thank you for providing your feedback!**

Please email your assessment to david.madore@maine.gov.