

Introduction to the Teacher

Timeline and Discipline	Big Idea and Essential Questions	Lesson Overview	Eliciting and Engaging the Student	Developing the Ideas	Checking for Understanding
<p><u>Timeline:</u> ~1 day <u>Discipline:</u> Any</p>	<p>BIG IDEA 1: How the case study may be different than what students are used to, and what the expectations are.</p> <p><u>Essential Questions:</u> 1. How does the case study differ from what I (a student) may be used to in the classroom? 2. What will I (a student) be expected to do? 3. How and why do people work in teams?</p>	<p>In these three lessons students are introduced to the case study approach.</p> <p>Lesson 1-1 asks students to discuss how they prefer to learn. Lesson 1-2 is a description of the what the students should expect. Lesson 1-3 is a discussion the challenges, strategies, and benefits of working in teams.</p>	<p>Lesson 1-1: Introduction to learning styles</p> <p>Lesson 1-2: Expectations for the case study</p> <p>Lesson 1-3: Working in teams</p>		<p>Ask the Questions:</p> <p>1. What concerns do you have about the upcoming case study? What are you excited about?</p> <p>2. Have you worked in teams before? What was it like?</p>
<p><u>Timeline:</u> ~1 day <u>Discipline:</u> Science, Environmental Studies</p>	<p>Inception BIG IDEA 2: Oil spills have a significant impact on marine life and on communities close to the spill.</p> <p><u>Essential Questions:</u> 1. What did you know</p>	<p>In these lessons, students are introduced to the topic of the case study and become invested in it.</p> <p>Students are polled on oil spills and</p>	<p>Lesson 2-1: Polling the students</p> <p>Lesson 2-2: Inception video</p>		<p>Ask the question:</p> <p>1. What have you learned about the BP oil spill?</p>

	<p>about the BP oil spill? 2. What are the lasting effects of the BP oil spill? 3. What are the possible biases from this video?</p>	<p>watch an inception video on the BP oil spill in 2010.</p>			
<p><u>Timeline:</u> ~2 days <u>Discipline:</u> Environmental Studies, Science</p>	<p>Engagement <u>BIG IDEA 3:</u> Understanding cleanup methods for oil spills.</p> <p><u>Essential Questions:</u> 1. How do dispersants work? 2. What would you have done during the BP oil spill?</p>	<p>Through these lessons students become engaged in the topic of oil spills.</p> <p>Students will discuss the engagement question of “if dispersants were the best course of action during the BP oil spill,” and will gain a deeper understanding about the cleanup options for an oil spill. Each team will pick a cleanup method.</p>		<p>Lesson 3-1: Engagement Question Lesson 3-2: Topic Exploration</p>	<p>Ask the question: 1. What are the options for cleanup after an oil spill?</p>
<p><u>Timeline:</u> ~1 week <u>Discipline:</u></p>	<p>Research <u>BIG IDEA 4:</u> Scientific inquiry skills can be</p>	<p>In these lessons, students collect background</p>	<p>Lesson 4-1: Topic diagram</p>	<p>Lesson 4-2: Writing a research question</p>	<p>Discuss with each team whether they have gathered</p>

<p>Science</p>	<p>used to address oil spill cleanup</p> <p><u>Essential Questions:</u></p> <ol style="list-style-type: none"> 1. What is known about this topic? What is not known? 2. How do you write a research question? 3. How should I collect my information? 4. Which sources are reliable and reputable? 	<p>information on their topic, write a research question, and collect data and information to answer their research question.</p>	<p>Lesson 4-3: Form a hypothesis</p> <p>Lesson 4-4: Designing the study</p>	<p>Lesson 4-5: Conducting the research</p>	<p>enough information to answer their research question. Do they have the evidence to support their position? Are they missing a piece of information?</p>
<p><u>Time:</u> ~1-2 days <u>Discipline:</u> Science</p>	<p>Create</p> <p><u>BIG IDEA 5:</u> Scientific communication can be used to address oil spill cleanup</p> <p><u>Essential Questions:</u></p> <ol style="list-style-type: none"> 1. How do you draw conclusions from research and data? 2. Who would benefit most from hearing your conclusion? 3. How do you articulate your conclusion clearly and scientifically? 4. Could your research lead to a change in the treatment of oil spills? 	<p>In these lessons, students will draw a conclusion based on their research, communicate their conclusion to an audience outside the classroom, and present their team's project to the class.</p>	<p>Lesson 5-1: Drawing a conclusion</p>	<p>Lesson 5-2: Communicating your findings</p> <p>Lesson 5-3: Peer-editing</p> <p>Lesson 5-4: Presenting</p>	<p>Ask the following questions:</p> <p>Compare and contrast yours and your classmates communication pieces. What do you think these communication pieces will accomplish?</p>

<p><u>Time:</u> ~1 day <u>Discipline:</u> Any</p>	<p>Reflect <u>BIG IDEA 6:</u> Reflection is a tool for improving your scientific inquiry skills and for identifying the next steps for addressing oil spills.</p> <p><u>Essential Questions:</u> 1. What have I learned? 2. What have I done well? 3. How can I improve?</p>	<p>In this lesson students will reflect on their process recognize their strengths, their opportunities for growth, and what they have learned and accomplished.</p>	<p>Lesson 6-1: Reflect</p>		<p>N/A</p>
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Introduction to Teacher

Case studies are a student-driven, situation-based approach to learning science. Students investigate a societal problem through asking questions, researching, drawing conclusions, and communicating their findings. This case study addresses Oil Spills both on land and in marine areas, their causes and their effects. Students are introduced to this topic through a video on the impacts of the BP oil spill on residents of New Orleans five years after and a debate on the effectiveness of dispersants as a clean-up method. Later, student teams choose a solution addressing oil spills to research further. By the end of the case study each team will have moved the needle forward on addressing oil spill impacts through cleanup strategies.

This high-school level case study is adapted from a college-level science program called the Integrated Concentration in Science (iCons) Program at University of Massachusetts Amherst. Students in this program bring their expertise from a variety of science and engineering majors and work together on interdisciplinary societal problems in the fields of renewable energy and biomedicine. To learn more about the iCons program, you can visit our [website](#).

The case study method, which hopes to engage scientific curiosity and inquiry, works in conjunction with lecture style learning in which students focus mainly on basic scientific principles and their significance. The goals of the case study method are focused just as much on the skills students develop from the experience of self-driven learning as they are on the facts they learn. This may be a shift from the students' normal experiences, so it is important to emphasize the value of the learning process before you begin. Then you may proceed through the five steps of the iCons Case Study learning process: inception, engagement, research, create, and reflect.

Inception is the first step in the iCons case study method. The purpose of this step is to introduce the topic of the case study and get the students invested in it. An effective inception material draws attention to a particular time and place, brings relevancy to the societal issue, and leads students into the engagement step.

The **Engagement** step allows students to “buy in” to the case study curriculum before they begin the highly student-driven Research step. The Engagement step is when students become aware of how scientific inquiry will help them address the societal issue. They will gain confidence and motivation to address this societal problem and become curious about the scientific phenomena underlying the societal issue.

The **Research** step requires students to narrow their topic. Teams are challenged to understand one topic completely in order to answer a specific research question and to eventually draw original conclusions. Students have the freedom to conduct an experiment, compile information from other scientists' findings, survey other's understanding and habits,

calculate a cost-benefit analysis of a certain object/practice, etc. or a combination of these in order to answer their research question. It is important to give students freedom and to push them to do their best work so that they can exceed their own expectations of what they can accomplish.

In the **Create** step, the students communicate the conclusions they have drawn from their research to an audience outside the classroom and to their peers. This grounds the students' work in reality and reinforces the idea that their work is important, valid, and applicable to a real issue. Students then present their whole research process and communication product to the class.

The **Reflection** step is for students to analyze, critique, and evaluate their process and product, and recognize how they have learned and grown through the case study. It is also a data-collection tool to inform improvements of your case study curriculum design. Students will incorporate feedback from others and draw from their own experiences to answer reflection questions. Reflection questions should cover personal growth, team dynamics, engagement, and societal impact of their research.

Journal Check-in: These optional check-ins are interspersed throughout the case study in places we feel students would benefit from collecting their thoughts and setting goals. They are meant to be 3-5 minute reflection periods during which students respond in journals to prompts related to the previous activity. The purpose of these journal activities is to help students prepare for the reflection step of the case study, process their experiences in this new and possibly uncomfortable learning style, and become self-reflective learners.

The following Next Generation Science Standards can be addressed in this case study:

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

*HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

*HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

*These standards may be addressed depending on what students choose to investigate for their research and create steps.

During case study days, students work in teams to address oil spill cleanup through scientific research. Students develop research and collaboration skills throughout the process; therefore, it is not just the final product that can be used as an assessment for learning, personal growth, and team collaboration. Student participation and cooperation are required throughout, and they may need periodic feedback to guide their level of efficiency. This is different from traditional-style curriculum, in which assessment tools like tests and exams are often used to measure individual growth.

In terms of timing, this case study could take a few different forms, depending on the format and schedule of your class. This could be done in a 2-3 week stretch where the case study is the only material being addressed during this time. Another option is for the case study to be interspersed with the regular curriculum two or three days a week for multiple weeks. This is up to your discretion concerning your class structure, student preference and curriculum layout. In addition, depending on the experience and academic level of your class, you may choose to add, edit, or remove activities to this lesson plan to meet the needs of your students. It is our hope that each teacher who uses these case studies makes them their own.

This curriculum was created by Dominique Kiki Carey, Rebecca Howard, Erica Light, Corrine Losch, and Stephanie Purington. We are members of the iCons community at the University of Massachusetts Amherst. This case study was developed based on our experiences teaching case studies in high-school classes. It has been revised to reflect all that we learned through our teaching, and we have incorporated suggestions into the teaching plans. From our experiences, we believe student-centered, case study-based education is an extremely effective and engaging way to learn. We hope to prepare students to be leaders in solving the world's challenges through research and critical thinking.

NGSS Lead States. (2013). *Next Generation Science Standards: For States, By States*. National Academies Press.