Where Did the Oil Go?
Following the Deepwater Horizon emissions

Case Study Objectives:

- Discover scientific principles and concepts in the context of real world problems facing society.
- Develop appreciation of the interdisciplinary nature of the scientific process and scientific solutions to problems.
- Master the quantitative basis of evaluation and quantitatively express the magnitudes and rates pertinent to a problem.
- Learn about technology and tools used to perform scientific investigations.

Inception.

- Read popular media from immediately after spill, speculating on outcomes. Every student team then finds an article from within the past month, first to illustrate the fact that it isn't big news any more, and second to provide a comparison.
- **Deliverable** - 1 paragraph about what changed.
- **Discussion**: Do these articles have a different tenor or outlook? Why? What changed?

Engagement.

- Teams work collaboratively to create list of things that can happen to an oil molecule.
  Hope to get such things as dilution/dispersion, bio- or other degradation, oxidation, accumulation somewhere, etc. As a topic of further discussion, this broadly asks the question of what happens to a molecule in the environment, be that a pharmaceutical or a polymer.
- Organize these by grid. Not meant to be mutually exclusive categories.

fast, natural process	fast, human process
slow, natural process	slow, human process

- **Engagement** Question: How fast are any of these? How would you measure the rate of disappearance of 'oil' (knowing it is a mixture) by any process?
- Questions we expect/hope to come up:
  - What is oil composed of?
  - What eats oil?
  - How volatile are the different components?
  - How do you measure the makeup of an oil sample?
  - How do you know how old a sample is?
- **Assign** each team a mechanism to investigate. By the next class period, create a 5-minute presentation to teach your classmates about that mechanism.
  *Allow 1-2 periods for presentations. After all presentations, discuss: were some better than others? Why? What would they do differently next time?

Research.

- Read primary literature article about composition of oil.
- Answer set of very direct questions about the content of the article (What type of kinetics did the authors assume? Why?) .

- Accumulate and understand presented data and supplemental data.

Create.

- Go beyond the conclusions of the article, which only suppose first order kinetics. Use the researcher's data to construct a graph that plots composition of a sample (as fractions, concentrations, or whatever) as a function of time. This is a tool that you would use to map the composition of an oil sample to its age, much like radiocarbon dating.
    a) Using that data, create your own tool that could determine the composition of an unknown sample if you could determine its composition. Let them work out what form that should take - table of numbers, graph, etc. Spend class time actually developing the tool. Some questions should come up:
        - How will you represent the fundamental data? Spreadsheet? Some other way?
        - How will you summarize the large data set? Average? Span? Other?
        - How will you *present* your tool, making its use visually apparent?
        - How will you *use* your tool, if you obtain composition information?
- Use the tool to answer a *different scientific question of your own devising.* You can learn more from this than what you designed it to provide. What more can you learn, and what *do* you learn, from this presentation of the data?
- **Deliverable**: Report of the data summary, instructions for using it to address the direct question, description of new opportunity that is enabled by their advance. Due two classes from now.

Reflect.

- Pose a couple of questions, then allow the students at least half of the class period to discuss.
- Possible questions:
    - How did you use something that you've learned in other classes to develop the tool you created?
    - How did different members of your team approach the problem differently? Why did someone else take a different approach?
    - What did you learn about reading and interpreting primary literature?