

Name:

Date:

Class:

Example Research Plan: Investigating Oil and Gas

Use the following template to plan your project. Feel free to edit and reformat as needed.

Group Members & Contact Info

Names, phone numbers, emails go here.

Research Question or Hypothesis

Our town has a lot of oil and gas development, including a well pad just outside one team member's backyard. We are interested to see if the VOC levels near a well pad are higher than they are in an area not near a well pad.

Hypothesis: The VOC levels will be higher near a well pad than at a similar site not near a well pad because it is possible for well pads to leak natural gas.

Research Question: How do the VOC levels compare between two sites that are similar, but one has a well pad nearby?

What larger theme does this relate to? (For example, climate change, public health, etc.)

This project relates to public health as some VOCs emitted during natural gas extraction are potential harmful to human health.

Who might be interested in this data? Why?

People living near well pads might be interested, as well as people working on well pads. Regulators might also be interested in the data for the purposes of crafting policy to keep people safe.

Background Information

List what you *already* know:

Oil and gas extraction can result in methane and other VOC emissions, particularly if there is a leak in the infrastructure. There is a well pad just outside of my backyard, we will use this as the well pad site.

List what you *need* to know:

For our comparison measurements, we need to find a site that is similar to the site with the well pad. We also need to check the wind direction/speed before sampling to either choose a calm day or make sure we place the air quality monitor downwind.

List your next steps:

We will find a similar "background" site, and reserve a time to use the monitors. If two monitors are available, we will conduct the measurements at the same time; if only one Pod is available, we will take one measurement after the other.

Method

What pollutants are you interested in?

VOCs, specifically methane and larger hydrocarbons.

What additional quantitative or qualitative data do you need?

We need to know if any farms or other industrial plants are nearby because they could affect our measurements at both sites by introducing other possible VOC sources. We also need additional data from each site: including temperature and humidity data, wind speed and direction data, and site elevation.

What are you comparing? (For example, two pollutants in different locations, or the same location at different times.)

We are comparing VOCs at two different sites at the same time of day (hopefully on the same day) that are similar with the exception of a well pad at one site.

Required Materials

 TeachEngineering.org

Study Design for Air Quality Research Activity—Example Research Plan: Investigating Oil and Gas

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- 1-2 air quality monitors (Pods)
- Charged batteries for the monitors
- Car (to get to the sites)
- Map of well pads and other potential VOC sources to ensure our background site is a background site
- Weather/wind data pulled from online
- Pencil and paper for field notes, to record usage times and other observations
- Cell phone to photograph sites and monitor setup

Procedure

How will you collect your data, step by step? This applies to groups using the Pods and groups using existing data.

- We will set the pod up in the backyard that backs up to a well pad. We will leave the pod on for five hours and record the temperature and weather as well as the start and stop times.
- We will set up the Pod across town at a friend's house who has a similar neighborhood size. Her house is located several miles away from the nearest fracking site. We will run this sampling period for the same five hours.
- We will record all variables that might affect the experiment in order to draw more conclusive data about VOC levels near fracking sites.
- If the schedule allows, we will repeat our measurements three times at each site.

Timeline

Project Phase	When will this happen?	What will we need?	Who will bring it? Or, how will we get it?	Questions?
Complete Project Plan	03/24/2016	Group to get together to finish writing plan	Group meeting after school on 03/23	
Prep Equipment	03/25/2016	Get Pod(s) from teacher and have car ready to use	Tori picks up Pod(s) after school 03/25	
Collect Data	03/26/2016-04/02/2016	Tori sets up Pod at house, then at friend's house	Tori brings Pod home to put in backyard; then we take it to Becky's house (or set up 2 Pods at once)	
Check Data	04/04/2016	*Request assistance	In class with teacher	
2 nd Data Collection (if necessary)	04/05/2016	TBD		
Data Analysis	04/20/2016	In class, use Excel to make VOC averages, charts and graphs	In class	How will we know what is "good" data? And, what days to use?
Make Poster	04/25/2016	Laptop, PowerPoint template and our data	In class	
Symposium	5/5/2016	Poster and prepared 2-5 minute talk	University student mentor prints and brings poster	How should we dress?

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Potential Sources of Error

List two potential sources of error and how you can minimize their effects on the data.

1. Error due to sensor malfunction: We will check our data immediately after collection to make sure the sensor is working and the Pod is recording data for the entire five-hour duration.
2. Weather could pose a threat to accurate comparisons: We will give ourselves enough time to make sure the weather is similar for most or hopefully all of the experiments. For example, if it rains during one sampling period and not the others, we will not use that data.

Data Analysis Plan

Describe two statistics that you will compute to help you evaluate your hypothesis.

- We will compare the average VOC levels between the two sites over the entire five-hour period.
- We will compare the standard deviation in the VOC levels for both sensors at each site, this will give us an idea of the spread of the data – we would expect greater spread at the site with the well pad because we expect higher VOC levels and more emissions.

Describe two plots that you will make to help you evaluate your hypothesis.

- We will plot time series of the VOC levels at each site to make a visual comparison and look for patterns.
- We can use a bar chart to visually compare the statistics listed in the previous section.