Activity Data Sheet Answer Key

The Monitors

Below are some reminders of how the air quality monitors work and how to use them. *(Note: Even though this activity is done as a class, you will need to know how to use the monitors for your later project.)*

- The raw data from the sensors is an electronic signal, but this signal directly relates to concentration. So, whether you examine the raw signal (voltage) or concentration data (ppm or ppb), the trends and relative amounts will be the same.
- To verify that the monitor is running, look for illuminated LED lights on the board and a running fan.
- Remember that the monitor is continually recording data when it is powered on.

CAUTION Keep your distance from the emissions and hot tailpipes of idling vehicles!

Procedure

Note: The air quality monitor requires a **30-minute warm-up** period, and following each emission test, the sensors need time (3-5 minutes) to "recover" (or re-equilibrate).

1. Outside in the testing area, run the monitor ~5 minutes to obtain a baseline measurement, which means measuring what is already in the air before the emission test source is introduced.
2. **Setup:** Place the monitor ~1 foot from the tailpipe, slightly above and straight out, with the inlet facing the tailpipe. Remember, hot air rises, so you could prop it on a box or container.
3. Idle vehicle #1 for 3-5 minutes. Then turn off the vehicle.
4. Repeat the baseline measurement for ~5 minutes.
5. Replicate the setup for vehicle #2.
6. Idle vehicle #2 for 3-5 minutes.
7. Repeat the setup and testing for the rest of the vehicles, always finishing with baseline measurements.

Before Data Collection

List three variables you need to consider as you set up the experiment (such as distance from tailpipe):

- Wind
- Rain
- Start engine temperature. How long have the cars have been off?

Explain how you will control for these variables:

Variable	How to Control
EXAMPLE sensor distance	EXAMPLE Make sure the air monitor is placed at the same distance away from the tailpipe for all tests. Measure the distance and replicate for each test.
wind	If it is a very gusty day, place the Pod closer to the tailpipe. Be sure to replicate the same conditions for each car.
rain	If it is raining, do the experiment under cover.
engine temperature	Ask to make sure that the cars have been off for similar amounts of time. (Do not use the car of one person who last drove it hours ago and the car of another who just drove up.)

Notes and Observations

Please record below the vehicle description, monitor placement and distance, and times for each test.

Run	Vehicle Description (make, model, fuel type, engine size, year, etc.)	Distance/position between monitor and tailpipe	Idle start time:	Idle stop time:
1	Chevrolet Blazer K, 1993, 6.5L V-8 Turbo diesel engine	10 inches away, placed Pod on box so it sat 3 inches above tailpipe	1:00	1:05
2	Volkswagen Jetta, 2010, 2.0L 4-cylinder diesel engine	10 inches away, new box so that Pod was 3 inches about tailpipe	1:10	1:15
3	Toyota Prius, 2016, 1.8L 4-cylinder engine, hybrid: gasoline, electric battery	10 inches away, 3 inches above tailpipe	1:20	1:25
4	Honda Accord, 2005, 3.0L V-6 engine, gasoline	10 inches away, 3 inches above tailpipe	1:30	1:35

Observations: Record any environmental conditions or nearby activities that might affect your results.

- Temperature: 60 ˚F, sunny
- Wind: calm day, winds out of the North
- Experiment is behind a building, near the highway, but it is 1pm so there is not much traffic

Hypothesis/Predictions

How do you predict the emissions will differ for each vehicle? Specifically, for CO_2, VOCs, and RH [relative humidity)] pollutants? In the graphs below, draw lines showing how you expect the emissions to look from before the vehicle is turned on until after, for each measured emission. Be sure to use a different color or line style for each vehicle so you can tell them apart when they are on the same plot.

Key:

Vehicle 1 ▮ (red)

Vehicle 2 ▮ (black)

CO₂ (ppm) graph — x-axis labeled **start idle** and **end idle**

VOC (ppm) graph — x-axis labeled **start idle** and **end idle**

RH (%) graph — x-axis labeled **start idle** and **end idle**