| Name: Leah Bandstra | Class/Period: High school environmental science or biology class |
| --- | --- |
| Time: three to four 90 minute lessons | Unit: Air Quality Index Exploration |
| **Central Focus/Big idea** (core concepts students will develop)**:**  What are the factors of air quality and what impacts air quality? | |

**Content Standards:** (Include the number and text of each standard. If only a portion of a standard is being addressed, only list the part(s) that are relevant.)

HS-ESS2-2 - Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

**What do you want students to know and be able to do at the end of this lesson? (Learning Objectives)**

SWBAT describe the factors that determine air quality, including their causes and the effects on people and the environment.

SWBAT formulate questions about large regional data sets.

SWBAT explain how Data Science allows us to manipulate a large data set to answer our specific scientific questions, specifically in our own community.

SWBAT pose a question related to AQI, develop a lab procedure, carry out the lab, and report on their findings.

**What evidence of learning will you collect at the end of the lesson? How will you know what students have learned? (Assessment)**

Summative Assessment: Lab report with CER. Students describe their self-designed lab, data collection procedures, and results. The report is written in a Claim, Evidence, Reasoning format.

Formative Assessments: Notes from gallery walk about AQI factors, group and class discussions about AQI factors, group and class discussions about regional AQI data, group and class discussions about data science process.

**PART 1: Introduction to Air Quality**

**Detailed Lesson Sequence**

Timing: 90 minutes, could be split into 2 lessons

| **Time** | | **The teacher will…** | **The student will…** | **Materials/Resources** |
| --- | --- | --- | --- | --- |
| 10 min | | - Introduce idea of AQI  - Ask students to discuss questions  - Record student ideas on board | - Discuss questions in groups  - Share out ideas and personal experiences | - [Factors of Air Quality Slides](https://docs.google.com/presentation/d/1qR-LbLxIXSMSNDAkMpA2Bypg0H92ARDVuZt7nwIPpXs/edit?usp=sharing) |
| 20-30 min | | - Split students into groups for the factors  - Assign a slide to each group or give access to whole slideshow for students to edit  - Circulate during student work time  [Break here for 45 minute classes] | - Form groups  - Use links on slide to research AQI factor in groups |  |
| 5 min | | - Determine a rotation pattern and draw on the board  - Set a timer for group rotations  - Ask students to discuss big ideas and decide who will stay to teach other groups | - Decide who will stay and present ideas  - Decide who will rotate around to other groups |  |
| 30 min | | - Circulate during rotations  - Announce when it’s time to rotate | - Travel to other groups based on rotation pattern  - Teach arriving groups  - Take notes on document during rotations (post in Google Classroom or make paper copy) | - [AQI Factors Graphic Organizer](https://docs.google.com/document/d/1gm3_wPXV2_9rL9rK86ZQ-T09kQMiNp8Nuy78v34cdog/edit?usp=drive_link) |
| 10-15 min | | - Direct students to return to original groups and share notes with members who stayed to teach | - Return to original groups and share notes with members who stayed to teach |  |

**PART 2: Using Data Science To Explore AQI Data**

**Detailed Lesson Sequence**

Timing: 90 minutes, could be split into 2 lessons

| **Time** | | **The teacher will…** | **The student will…** | **Materials/Resources** |
| --- | --- | --- | --- | --- |
| 10 min | | - Review from last time  - Ask student to open graphic organizer from last class and be ready share ideas  - Record student review ideas on board or slides | - Open graphic organizer and review  - Share ideas from research | - [Using Data Science to Explore AQI Data Slides](https://docs.google.com/presentation/d/1kKUY2JZuxGCgZr4n8Z2dJnuRFYCroQ9DsLlKvK_5W5Q/edit?usp=sharing) |
| 5-10 min | | - Ask students what is causing the air quality they see in the images (replace with relevant regional images for your location)  - Dive into PM2.5 info | - Share ideas |  |
| 20-30 min | | - Pass out AQI Tile Plots for Portland ([or your area](https://www.epa.gov/outdoor-air-quality-data/air-data-multiyear-tile-plot))  - Ask students to examine the data  - Ask students what they notice and wonder  - Pass out AQI Tile Plots for Los Angeles  - Ask students to examine the data  - Ask students what they notice and wonder  - Ask for student questions | - Examine data  - Share ideas  - Examine data  - Share ideas  - Share questions | - [AQI Tile Plots](https://docs.google.com/document/d/1HzMYg-YJU27HBA0hHPXMKhy8C3m43icc6YkGWjE4ssk/edit?usp=sharing) (color copies or post on Google Classroom so students can see colors)  - [EPA Air Data Multiyear Tile Plot](https://www.epa.gov/outdoor-air-quality-data/air-data-multiyear-tile-plot) (to create regional tile plots for your area) |
| 20-30 min | | - Introduce idea of Data Science  - Star Wars silly example  - Process of taking large data set and using R coding to answer a specific scientific question | - Listen to information on Data Science  - Watch demonstration of Star Wars example  - Watch demonstration of AQI data manipulation | - [AQI data science interactive tutorial](https://lewis-and-clark-data-science.github.io/6-12-Data-Science-Resources/tutorials/AQI_tutorial.html) |
| 20 min | | - Display Wrapping Up questions and facilitate class discussion (or use questions to create exit ticket or other assessment) | - Answer questions, share ideas, participate in class discussion |  |
| Extra time | | - Give students link to EPA Data or use Part 2 of interactive tutorial  - Ask the to explore a city they have visited or want to visit | - Explore EPA data | - [Part 2: AQI Interactive tutorial](https://lewis-and-clark-data-science.github.io/6-12-Data-Science-Resources/tutorials/AQI_tutorial_advanced.html) |

**PART 3: Air Quality Exploration Lab**

**Detailed Lesson Sequence**

Timing: Two-three 90 minute lessons

| **Time** | | **The teacher will…** | **The student will…** | **Materials/Resources** |
| --- | --- | --- | --- | --- |
| 10-15 min | | - Review what we have done  - Introduce Atmotubes  - Help students download app and connect to device | - Download Atmotube app and connect to devices | - [Air Quality Index Exploration Lab Slides](https://docs.google.com/presentation/d/12pu_TVCrGO2mNQfy6KlcVsDjKRNlh76NNdmzcfnV_7Y/edit?usp=sharing)  - 1 Atmotube for each group  - Device that can download app and connect by Bluetooth |
| 20-30 min | | - Direct students to Atmotube Exploration Graphic Organizer and ask them to play around with Atmotubes to answer the questions  - Circulate as students are working to troubleshoot | - Open graphic organizer and explore the features of Atmotubes  - Go to various stations around the room to test out how they change air quality  - Record ideas on graphic organizer | - Stations with: candle/matches, bunsen burner, cleaning spray, clorox bleach wipes, other ideas from you or students  - [Atmotube Exploration Graphic Organizer](https://docs.google.com/document/d/1AKg73LroeUM_wLSv5FnJj8HADKieX8mIYtRuQmLz1BI/edit?usp=sharing) |
| 10 min | | - Bring students back together  - Debrief with students about experience | - Share out what they noticed and what questions they have about sir quality |  |
| 30 min min  **End of Day 1** | | - Tell students about the next steps for Air Quality Exploration Lab  - Ask students to form groups and begin brainstorming question and procedure | - Form groups, formulate question and propose procedure  - Answer question #1 on the Formative assignment (proposal and procedure) | [- Template Air Quality Lab (Formative link)](https://app.formative.com/clone/C4QSZD?_rid=0x9mp1)  [- Template for Air Quality Lab (Google doc)](https://docs.google.com/document/d/1bDoDPmaU8BdKlKlXXgK5r9ILxpmxeTOV_3LyyMcdEFo/edit?usp=sharing) |
| *Before next class* | | *- Check procedures and give approval* |  |  |
| 90-180 minutes | | - Check procedures and give approval  - Circulate and facilitate | - Finish writing procedure and getting approval from teacher  - Conduct experiment and collect data  - Create graphs and write report | - [CER Writing Sentence Frames](https://docs.google.com/document/d/1zy2Ro2Smn6dAZ1KZkEjLkZo-oFyhhOHJtLHxpCA9XDw/edit?usp=sharing) |

**Adaptations/Modifications** (What adjustments will you make for students with special needs? This includes ELLs, students with IEPs, and any other special considerations you should use when planning and carrying out instruction. *Use italics in lesson sequence description to indicate where these supports will be implemented.*):

| **Emergent Bilingual** | Images and videos with subtitles will be used to help understanding. Sentence starters will be provided for the writing and speaking parts. |
| --- | --- |
| **TAG** | Students will design a lab procedure to test different variables, offering opportunities to add complexity. There will be opportunities for extension exploration and questions to prompt students to think about what other information they would want to find in order to answer another question. |
| **Special Needs** | Sentence starters and word banks will be provided for the writing and speaking parts. |
| **Other** |  |