**Lesson Planning Template**

**COSMOS EDUCATIONAL TOOLKIT: Measuring and Comparing Air Quality Using COSMOS Toolkit & Sensors**

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| **Grade/ Grade Band**: 7 | **Topic:** Measuring and Comparing Air Quality  | **Lesson #** 1  **in a series of** 1 **lessons** |
| **Brief Lesson Description**: Students will learn about the importance of good air quality and its effect on health. Students will use the sensors and the mobile node to collect data in different places inside and around the school. They will use this data to draw conclusions about air quality. They will brainstorm ways to improve the school’s and neighborhood’s air quality and communicate their findings to the community. |
| **Specific Learning Outcomes:**Students will be able to make claims about the indoor air quality in different parts of the school building by comparing data collected from different locations. They will also be able to compare indoor and outdoor air quality.Students will be able to compare air quality inside and outside the school building.

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| Possible inside locations: science classroom - room 420, 5th floor gym, cafeteria, indoor yard, unoccupied classroom | Possible outside locations: Broadway, Amsterdam, Central/Riverside Parks, Recess Yard, 110th St. stop on the 1 train) |

Students will develop an understanding of how air quality contributes to an individual’s health and well-being. Students will brainstorm solutions to improve air quality. |
| **Narrative / Background Information**  |
| **Prior Student Knowledge Required:** Students should have an understanding of the importance of indoor air quality on their health and learning in school.Students will understand that the mobile node and its sensors can be used to collect air quality data.Students should understand the difference between CO2, temperature, and humidity. They should understand that there [can be a relationship](https://www.chicagotribune.com/news/ct-xpm-2009-11-15-0910190209-story.html) between humidity and temperature. |
| **Problem Solving Practices (Ex: Standards for Mathematical Practice):** **Using Mathematics and Computational Thinking****Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.****Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1)** **Obtaining, Evaluating, and Communicating Information****Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods. Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3)** | **Main Content Ideas:** **PS4.C: Information Technologies and Instrumentation****Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)****PS3.D: Energy in Chemical Processes and Everyday Life****Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)** | **Possible Multidisciplinary Concepts:** **Influence of Science, Engineering, and Technology on Society and the Natural World****Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3)**  |
| **Possible Preconceptions/Misconceptions:** * carbon dioxide is a “bad” gas to have around
* plants make only carbon dioxide, plants do not make oxygen
* pollution causes carbon dioxide levels to increase
* the carbon dioxide levels will be the same (or will be different) when we compare different parts of the building
* humidity is related to the amount of moisture in the air
* lower dust (particulates) in the air indicate higher air quality
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| **LESSON PLAN – 5-E Model**  |
| [**ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:**](http://www.youtube.com/watch?v=PUB1GU_tvpI&safe=active) Students discuss - what is meant by “air quality”?Show [news segment](https://www.youtube.com/watch?v=UWFe4sPSXBE) from ABC 15 in Arizona (1:43)Show [clip](https://www.youtube.com/watch?v=5-J1NnwD2S0) from NEA ‘Indoor Air Quality Affects Student Success’ (3:43 - may need to trim this clip because it talks about other issues besides air quality)* Where do you spend most of your time? Inside, or outside?
* How can air quality affect your life?
* What are some differences between indoor air and outdoor air? Factors that affect indoor versus outdoor air quality?
* Why should we care about air quality?
* What are quantities we can measure to collect data about air quality?
* What can be done to improve air quality? What can happen to worsen it?
* What are the main takeaways of this video?

**Students brainstorm*** What factors that could affect the indoor air quality of our school?
* What factors that could affect the outdoor air quality of our school?
* Is there anything we can do to change the air quality at our school?
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| **EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:** **Students will need:*** **the mobile node**
* **sensors: O2, CO2, and humidity (particulates?)**
* **COSMOS node**
* **Chronograf**

**Make predictions*** **what areas in the school can we compare?**
	+ **gym**
	+ **6th grade science classroom**
	+ **7th grade science classroom**
	+ **8th grade science classroom**
	+ **Indoor Yard**
* **where will the best air quality be? where will the air quality be lower?**
* **what areas outside the school can we compare?**
	+ **Outdoor Yard**
	+ **Broadway @ 109**
	+ **Amsterdam @ 109**
	+ **Subway Station**
* **where will the best air quality be? where will the air quality be lower?**
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| **EXPLAIN: Concepts Explained and Vocabulary Defined:** Students bring the mobile node(s) and sensors to various locations around the building to measure the levels of CO2 (and, sensors permitting, particulate matter)Roles* Leader (keeps everyone on track)
* Timekeeper (makes sure the group takes measurements for at least 2-3 mins)
* Sensor Manager (holds/takes care of sensors)
* Mode Manager (holds/takes care of IoT node mobile node; makes sure it is collecting data)

Students record data and bring it back to the classroom to analyze/review using Chronograf**Key Vocabulary:** * air quality
	+ CO2
	+ humidity
	+ particulate matter
* sensor
* mobile node
* transmitter
* receiver
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| **ELABORATE: Applications and Extensions:** Analyze data - graph CO2, O2, particulate matter, humidity* What statistics can we use to compare this data?
* What is the mean?
* What is the range?

Analyze trends * what correlation do you see?
* What patterns/trends do you see in your data?
* Where in the school is the best/worst air quality? What evidence supports that claim?
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| **EVALUATE:** **Formative Monitoring (Questioning / Discussion):** * students’ predictions
* students’ use of evidence to support their predictions

**Summative Assessment (Quiz / Project / Report):** * **lab report**
	+ title (“the effect of [independent variable] on [dependent variable]” i.e. “the effect of location on air quality (CO2 levels, particulate matter, etc.)”)
	+ question
	+ background information/introduction
	+ experimental design: IV, DV, constants
	+ materials
	+ hypothesis
	+ data
	+ graph
	+ analysis
	+ conclusion
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| **Elaborate Further / Reflect: Enrichment:** Students explore: what could be causing their results * if they see differences - what features of the location/room could contribute to these results
* if they see similarities - what features of the location/room could contribute to these results
* what sources of error could have occured to affect your results?
* how would you extend this experiment? what would you try to do next?

If air quality is “poor”* what could be done to improve the air quality?
* could classroom plants (e.g. those in the 7th and 8th grade science classrooms) contribute to the air quality in those rooms?
* would you expect to see any changes based on the time of year? based on roof construction?

Connection to larger COSMOS project - when the testbed is fully installed, students can view air quality data from different locations in West Harlem and make comparisons to the data collected in and around the school. |