Spokane Clean Air Kids Making Sense Pilot Program Report

DEPARTMENT OF ECOLOGY State of Washington

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Hotstart THERMAL MANAGEMENT

Final Report Prepared for
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Spokane Clean Air Agency
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Spokane Clean Air Kids Making Sense Pilot Program Report

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Cover includes photos of (1) a Spokane Clean Air Agency meeting, and (2) the Kids Making Sense education kit.

Contents

1. Program Overview

1.1 Introduction to Kids Making Sense

Kids Making Sense (www.kidsmakingsense.org), developed by scientists and educators at Sonoma Technology (sonomatech.com), unites Science, Technology, Engineering, and Mathematics (STEM) education with a complete measurement and environmental education curriculum. Kids Making Sense teaches students in grades 6-12 about monitoring and improving air quality in their communities. In this unique program, students learn about particle pollution, its sources, and its health effects. An in-class lecture and discussion are followed by a lesson that uses handheld, low-cost air sensors paired with a smartphone app. Students measure air quality around schools and their local community, and develop an understanding about particle pollution sources and affected areas. Data collected is crowdsourced on a mapping website for discussion and interpretation, and students learn about pollution control actions and how to support them. With Kids Making Sense, students:

- Learn about air pollution and air quality basics.
- Experiment with a low-cost air quality particle sensor and learn how it works.
- Plan a sensing route for measuring air quality.
- Collect particle measurements.
- Analyze and discuss the resulting data.
- Learn how to identify, reduce, and avoid sources of air pollution.
- Learn how their actions and daily habits contribute to emissions and air quality.
- Share data and results with other schools.
- Learn how to engage public officials and promote clean air.

Kids Making Sense meets Next Generation Science Standards and Common Core standards, encourages project-based learning and deep understanding of applied science, and allows students to engage with science as if they were air quality professionals. In addition, the Kids Making Sense program helps students understand how their daily routines and actions can impact emissions and air quality at a time when they are developing life-long habits. Kids Making Sense has been successfully deployed in over 400 classrooms in the United States and abroad.

The Kids Making Sense program also strives to support teachers in their efforts to bring this topic to their classrooms. As such, the teacher's guide includes information to help instructors lead students through the modules. It also includes a table to assist with standards alignment, answers to questions posed in the student workbook, suggested class discussion questions, and cautions and adjustments. Additionally, it explains how to tailor the program for the amount of class time teachers have available and differentiate instruction per classroom level.

A major advantage of Kids Making Sense kits is that the kits are reusable for multiple classes, year after year. The AQ-go handheld air quality sensors are engineered in transparent casing, allowing students to see the electronic components inside of the sensor. This purposeful design removes some of the "black box" aspect of measurements away from the student experience and encourages conversations around electronics and design.

1.2 Program Logistics

The Spokane Regional Clean Air Agency (Spokane Clean Air) received grant funding from the **Washington State Department of Ecology** to implement the Kids Making Sense program at eight pilot schools in Spokane County. Spokane Clean Air also received financial support from **Avista Corp**, **Central PreMix/Inland Asphalt**, and **Hotstart Thermal Management**. These community-minded businesses sponsored a total of four classroom kits. Schools were recruited by the Spokane Clean Air Agency to participate. Each school was provided with a Kids Making Sense classroom kit and curriculum, and up to two teachers from each school were trained on how to use the curriculum and technology included in the kits. The training took place in two parts and multiple sessions of each part were offered to accommodate teacher schedules. The training sessions took place between October 26 and November 3, 2022. In total, 13 teachers participated in the training sessions either in person or virtually. Teachers were asked to fill out a pre-training survey, as well as a survey at the end of the school year when they had time to implement some aspects of the Kids Making Sense program in their classrooms.

Teachers were offered a chance to use "chat with a scientist" time, where air quality experts from Sonoma Technology make themselves available to virtually join a class of students to answer their questions about a specific air quality topic, discuss air quality-related career paths, help with their handheld air sensor project, and more.

Lastly, as part of this project, AQ-go sensors from one classroom kit were re-allocated to a library sensor loan program. For this effort, an Air Sensor Loan Program Guide was developed and will be distributed along with the sensors for loaning out at the Spokane Public Library.

This report starts with an overview of Kids Making Sense and the Library Loan Program Guide and then focuses on the responses obtained from teachers in the pre-training and post-program surveys. Finally, lessons learned are summarized at the end of the document.

1.3 Air Sensor Loan Program Development

To maximize community engagement, a sensor loan program was established to provide community members access to handheld particulate matter (PM) air sensors so they can measure and map air quality in their community. Community members will be able to go to the library branch and check out a sensor, a paired cell phone, and the newly developed Sensor Loan Guide. The sensors included are the AQ-go handheld PM sensors. These devices allow users to walk or move around their community and map the PM data in real-time. The data is displayed easily using an app that can be downloaded to a cell phone or tablet. Data is automatically uploaded to a crowdsourced website where users can view any data session contributed to the mapping platform.

The Sensor Loan Guide includes general and background information, including sections that cover:

- An overview of the Sensor Loan program.
- Background information on air pollution and specifically PM.
- How particle sensors differ from regulatory monitors and how each is used.
- A quick start guide for setting up and using the AQ-go sensor.
- Information on how to navigate the sensor app and view data in real-time on the provided cell phone.
- Information on how to view collected data on the crowdsourced mapping website after the session is complete.
- A list of helpful resources and links for more information about air quality or specific topics.
- A glossary of terms and abbreviations.

Additionally, the Sonoma Technology team developed three “activity modules” to offer users suggestions of ways they can use the sensors to understand more about the air they are breathing. Included in each of these modules are also suggestions for ways to mitigate exposure or ideas for ways to protect themselves from harmful effects of PM. These modules are:

- **Personal PM Exposure**: This module helps guide users through measuring and/or mapping PM levels on their commute to school or work, or on a typical path they travel. This is intended to help them understand more about their exposure to PM and where the highest exposure level occurs.

- **Exposure from Stationary Sources**: This module helps guide users through using the handheld AQ-go sensor to understand their exposure to PM from stationary sources. Sources could include a bonfire, BBQ, local restaurant, idling vehicle, or another source that is not moving. This module is intended to orient users to how high concentrations can reach from sources they may not have previously considered could be impacting them.

- **Explore Your Library's Sensor Data**: The Spokane Clean Air Agency has equipped the library with a PurpleAir sensor, which is mounted outside the building. This module is intended to help library patrons understand how to access the PurpleAir data, view historical data, and interpret the AirNow Fire and Smoke and Washington Smoke Information websites.

2. Pre-Training Survey Responses

Prior to the training, teachers were asked to complete a pre-training survey where background information was gathered relating to topics they currently teach, the grade levels they teach, and what they hope to gain by including the program in their curriculum. In total, 10 teachers responded to the pre-training survey.

2.1 School Characteristics and Demographics

The teachers who participated in the program were from the academic institutions in the Spokane region listed in Table 1. Most schools had two teachers that participated in the training, though some only had one (see Table 1, column 2). Though two teachers from a school may have participated in the training, this did not mean that both teachers used the kits in the 2022-23 school year.

Table 1. List of participating schools and the number of teachers who were trained as part of the program.

Participating Schools	Number of Teacher Participants
Yasuhara Middle School	2
Chase Middle School	2
The Community School	2
West Valley Outdoor Learning Center	1
Lewis & Clark High School	2
Medical Lake Middle School	1
Westwood Middle School	2
Shadle Park High School	1

In the pre-teacher survey, teachers were asked the type of community that their students live in to get an idea of the types of air pollution sources students might be used to. The chart in Figure 1 indicates that most teachers described their students' home environments as either 'mostly urban' (40%) or a 'combination of suburban and urban' (30%). Fewer were described as a 'combination of suburban and rural' (20%) or 'mostly suburban' (10%), and no one responded that their students were from primarily rural communities.

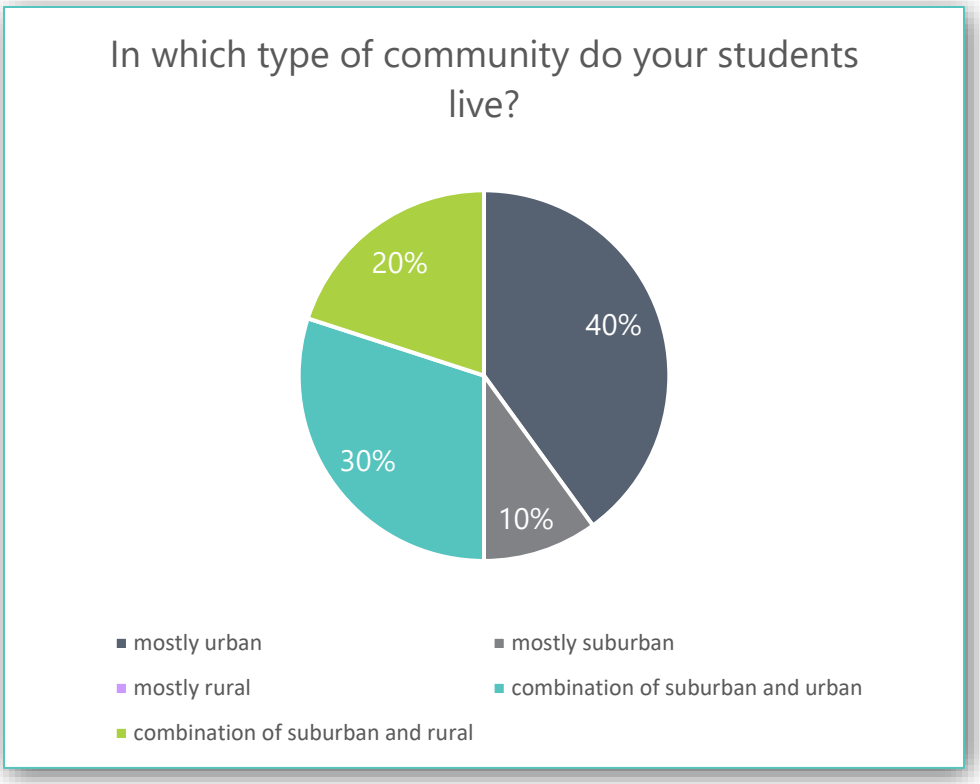

Figure 1. Responses to the pre-training survey question asking "In which type of community do your students live?"

To understand the demographics of students who would be served with the program, teachers were also asked to select an option that best describes the overall racial composition of their students. 40% of responses selected a 'combination of races,' and another 40% selected 'mostly white,' with 20% responding 'NA/unknown' (**Figure 2**).

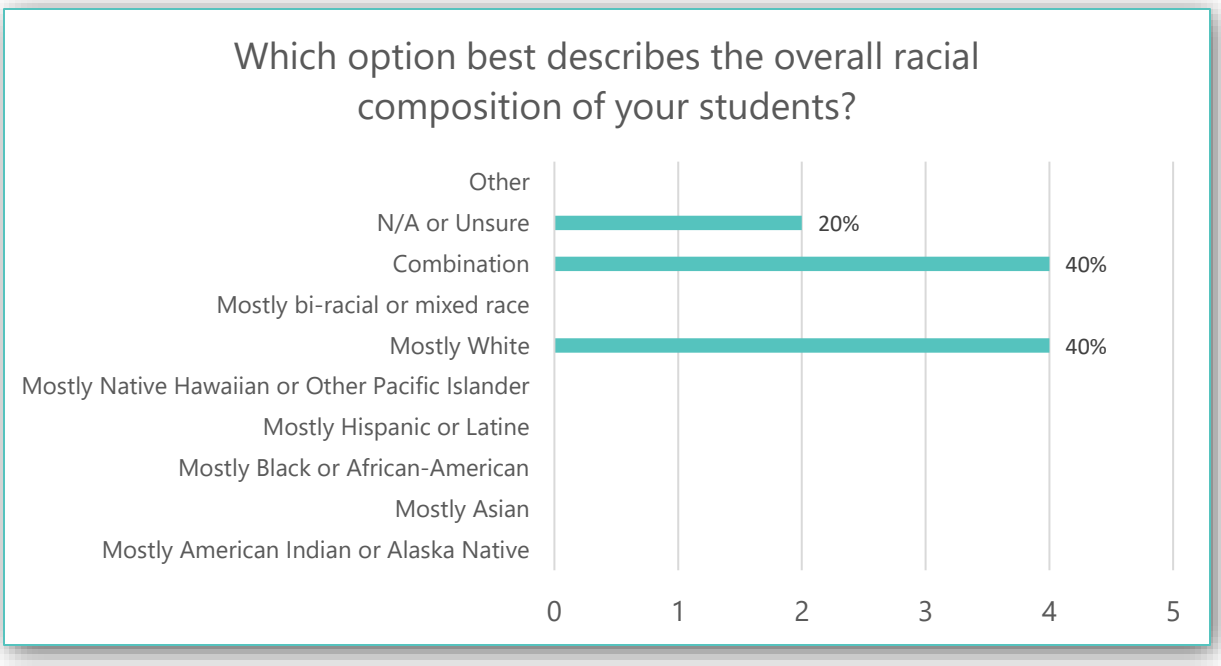

Figure 2. Responses to the pre-training survey question asking "Which option best describes the overall racial composition of your students?"

2.2 Teacher Knowledge and Current Curriculum

In order to (1) ascertain the familiarity that teachers would have for the material during the training, (2) know how in-depth to go with background information during the training, and (3) understand whether teachers might be able to immediately find ways to integrate the modules into their curriculum, teachers were asked, "Do you already teach air quality topics in your class." All ten teachers responded 'yes.'

Teachers were also asked to rate, on a scale, how familiar they felt they were with air quality and air pollution (**Figure 3**). The majority of teachers said they were 'somewhat familiar' (60%), with 20% of teachers feeling either 'very familiar,' or 'neutral.'

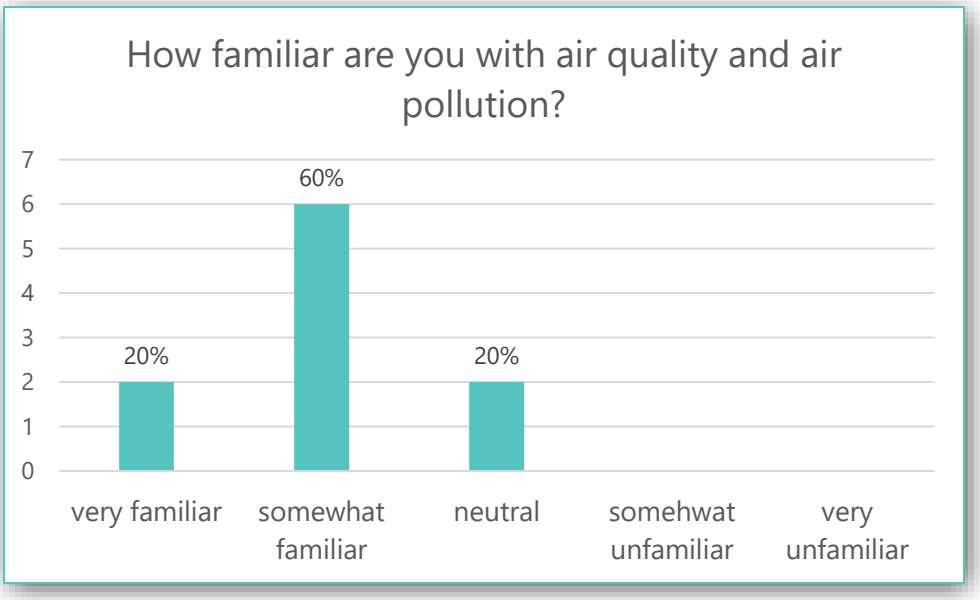

Figure 3. Responses to the pre-training survey question asking "How familiar are you with air quality and air pollution?"

To understand more about where the teachers receive their information regarding air quality, we asked "What resources do you typically use to find out about your local air quality?" Teachers were given space to fill in their own answers and list as many sources as necessary; these answers have been summarized in Table 2. The most popular sources were AirNow (either listed as AirNow or as AirNow Fire and Smoke map), and Spokanecleanair.org, followed by local news and media sources.

Table 2. Responses to the open question "What resources do you typically use to find out about your local air quality?", along with the number of people who cited the same source.

Source of Local Air Quality Information	Number of Responses
AirNow / AirNow Fire and Smoke map	4
Spokanecleanair.org	3
Local website and news/weather reports	2
iPhone Weather app	1
AirFire tools	1
The National Oceanic and Atmospheric Administration (NOAA)	1
Accuweather	1
WeatherBug	1
N/A	2

2.3 Program Expectations

Although the teachers did not have in-depth backgrounds concerning the topics covered in the Kids Making Sense curriculum at the time of this survey, they were asked to select the skills that they hoped their students would learn from the program. Asking this question provides insight into the types of skills teachers may be seeking additional materials for, and the skills they may think students need more help with. The results from this question are shown in **Figure 4**, and teachers could select more than one choice. The results show that teachers were very interested in all skills related to the program. All teachers were hoping students would lean more about interpreting and analyzing data (10 responses). They were also hoping students could learn more about air quality knowledge (9 responses) and how to design a scientific investigation (8 responses). Science communication and general science skills were also of interest (7 responses each). One teacher responded with 'other' and shared that they were hoping students would learn "*Air investigations for AP Environmental Science.*"

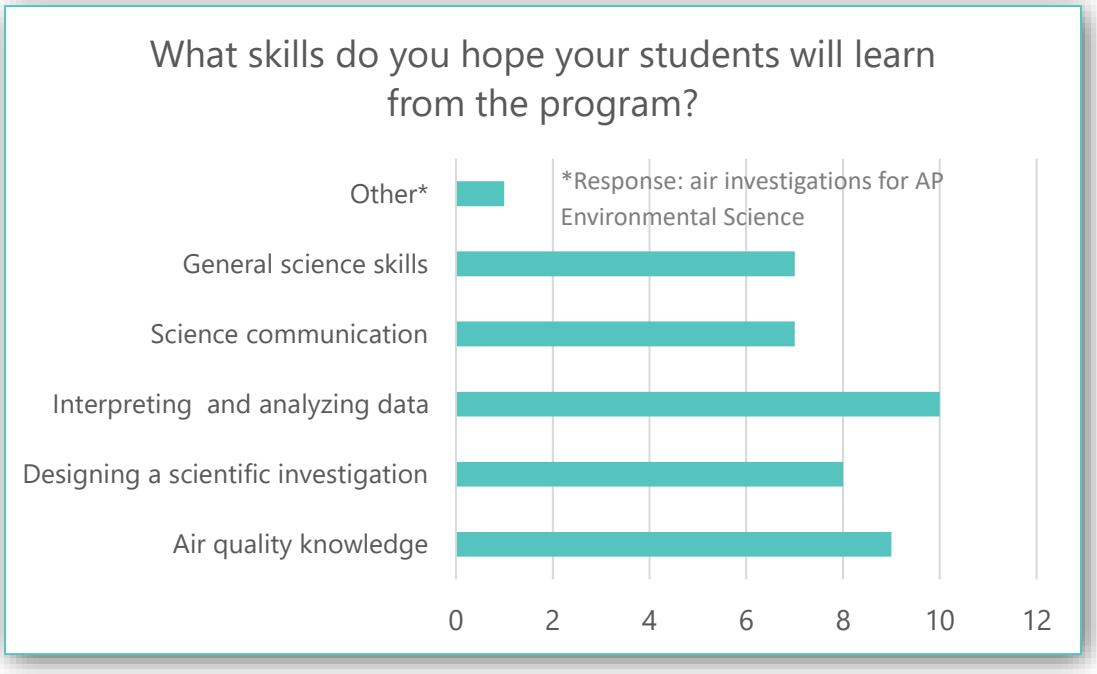

Figure 4. Responses to the pre-training survey question asking "What skills do you hope your students will learn from the program?"

Similarly, teachers were asked what they hoped their students will be able to gain by using the Kids Making Sense program and curriculum modules. Teachers were given space to fill out their own answers, which are recorded in **Table 3**. Overall, teachers were looking for engaging, authentic, real-world activities that could help their students understand air quality data that is relevant in their

region. They were also looking for ways to help students understand data collection, improve their overall science skills, and participate in something that might interest them outside of the classroom.

Table 3. Responses to the open-ended, pre-training survey question "What are you hoping to get out of the Kids Making Sense program?"

What are you Hoping to get Out of the Kids Making Sense Program?
"I am hoping to have students get real science knowledge. Looking at air quality data, analyzing it, noticing trends, is real-life stuff and I think that benefits kids. I want to give kids the opportunity to see science that they could potentially be interested in and be a part of after school."
"Data to pull in regarding air quality and tie it to climate change."
"A better understanding of how the purple air sensor system works and collects data. I hope we will have some good access to the data collected."
"Ideas for data collection and analysis."
"Community connected, authentic, science learning."
"I hoping to get some ideas for developing more science investigations and labs."
"Making it relative for students."
"I am hoping to provide a student lead scientific inquiry unit on air particulates and air quality."
"I am hoping to learn skills I can bring back to my students."
"I do not know enough about this program to know what I will get out of it. In general, I would like some engaging activities to use with my students. That center around good science skill."

Finally, when asked if they had any other comments or concerns about the program or training, two teachers responded:

- *"I appreciate the training and I am looking forward to figuring out how all of this can be worked into a future project at TCS."* – Teacher from The Community School
- *"None, excited to learn!"* – Teacher from Lewis and Clark High School

3. Post-Program Survey Responses

In May 2023, teachers were asked to fill out a post-program survey to inform on how they used the kit and curriculum in their classes over the 2022-2023 school year. In total, 11 teachers responded to the post-program survey. One teacher from Yasuhara Middle School responded separately that she had not had time to use the kits; however, the other teacher from the school who was trained was able to use them with his classes. At least one teacher from each school responded to this survey.

3.1 Training

The training covered all modules in the curriculum. During the training, teachers were guided through how to use the AQ-go sensors and how to connect the sensors to the phones included with the kits. Teachers need to feel comfortable with this technology in order to successfully guide students through Module 6 and 7 in the curriculum. Due to time limitations with the training, teachers had a chance to follow along on sensors during the training, but did not have a chance to go outside and test out the sensors (as would usually happen in longer training sessions). One teacher requested and received a follow up session to go over the technology in more detail via Zoom.

Question 1. In the post-program survey, teachers were asked, on a scale of 1 (not at all) to 5 (very much so), "How comfortable are you with the technology in the KMS kit following the training?". All teachers replied that they had some level of comfort, with 73% responding with a score of 4 or 5 (very comfortable); however, one teacher responded with a score of 3 and two responded with scores of 2 (**Figure 5**). Additional questions asked of teachers are described below that follow up on this topic.

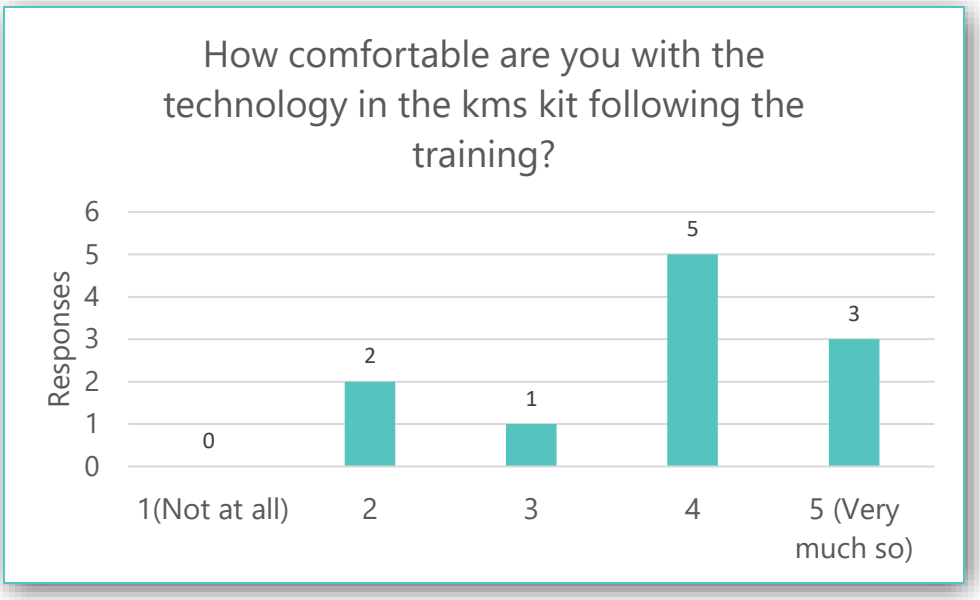

Figure 5. Responses to the post-program survey question asking "How comfortable are you with the technology in the kms kit following the training?"

Question 2. The next question specifically focused on the sensor portion of the training and whether teachers felt adequate time was allocated for the technology/sensors and phones during the training. The results for this question were split between 73% of teachers who agreed that adequate time was devoted to this, and 27% who felt they needed more support (**Figure 6**).

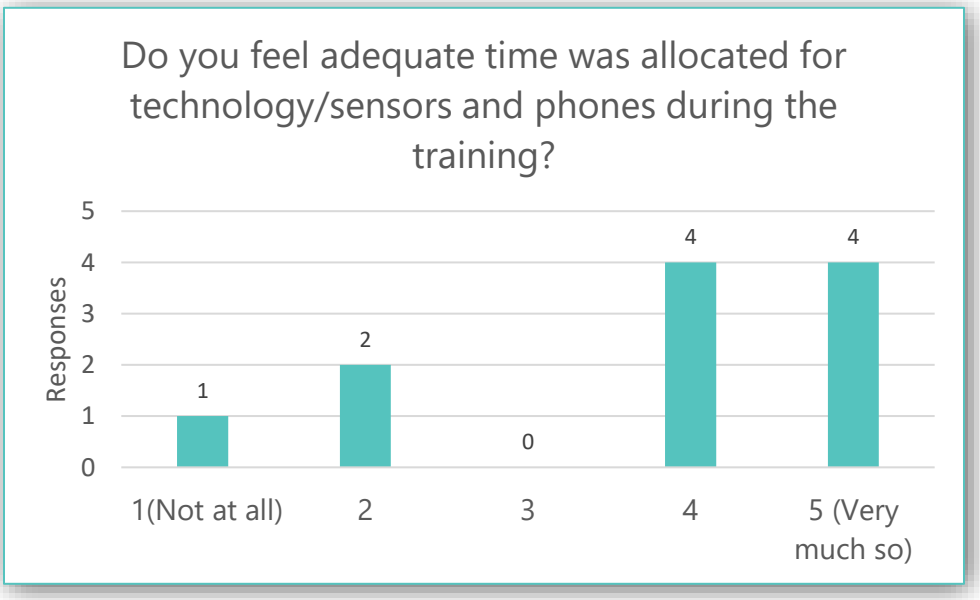

Figure 6. Responses to the post-program survey question asking "Do you feel adequate time was allocated for technology/sensors and phones during the training?"

Question 3 and 4. Next teachers were asked, on a scale of 1 (not at all) to 5 (very much so) to reflect on their opportunity to get questions answered during the training sessions (Figure 7). 91% of teachers responded with a score of 4 or 5 (very much so), and one teacher gave a score of 3.

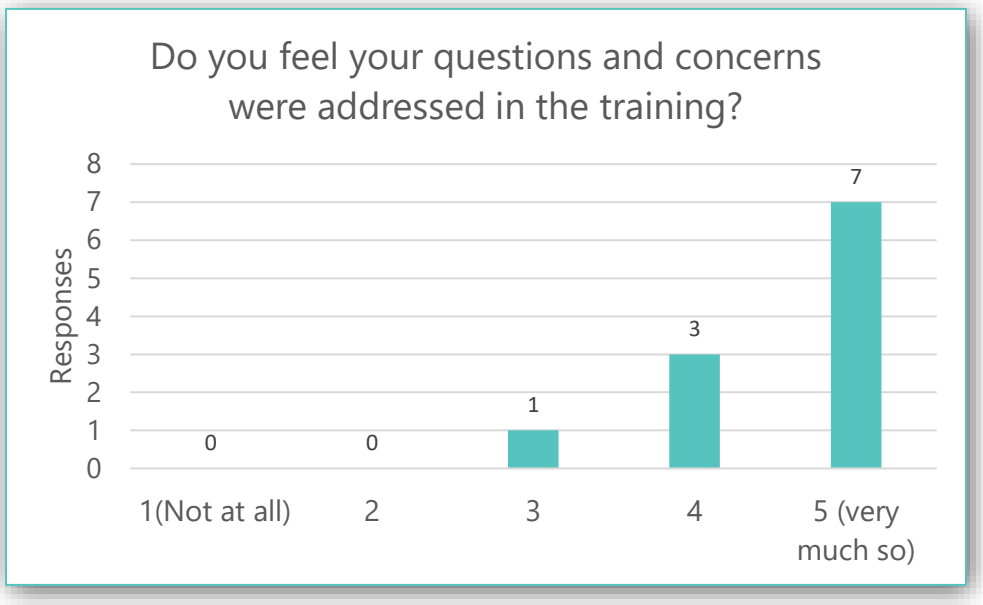

Figure 7. Responses to the post-program survey question asking "Do you feel your questions and concerns were addressed in the training?"

For those respondents who answered with a response of less than 5, they were asked the follow up questions, "[In] what way were your questions not addressed? What could be done to improve this in the future?" The responses are listed in Table 4 along with the numerical response they gave (for reference). Two teachers responded that they would have liked more help or time spent on the sensors, and one requested more time spent on the curriculum. One teacher responded that their questions were answered sufficiently during the training.

Table 4. Responses to the post-program survey question asking "In what way were your questions not addressed? what could be done to improve this in the future?" and the numerical response the teacher provided to whether they felt their questions were addressed during the training.

In what way were your questions not addressed? what could be done to improve this in the future?	Numerical response to whether they felt their questions were addressed in the training (prior question)
Just more time with the curriculum	3
I would have liked more time getting comfortable with the sensors! I did not feel comfortable enough to use them this year!	4
I did not have any questions that were not addressed in the training.	4
Setting up and getting the technology prepared for my classes and then spending time trouble shooting was a challenge.	4

From the results of **Questions 3 and 4**, we can conclude that some teachers may need additional support with sensors in future iterations of the program. It might be possible that there is no "one-size-fits all" training approach and that training should be supplemented with an additional Q&A session for teachers who still have questions.

Question 5. Teachers were asked on a scale of 1 (not at all) to 5 (very much so) whether they were able to incorporate some of the curriculum modules into their classes this school year. Responses (Figure 8) to this question spanned the scale, and considering the typed feedback to other questions, appear to have been based on the amount of time teachers had available in their schedules this school year. The results of this question indicate that teachers were able to incorporate some of the curriculum, but perhaps not as much as they would have liked due to time restrictions.

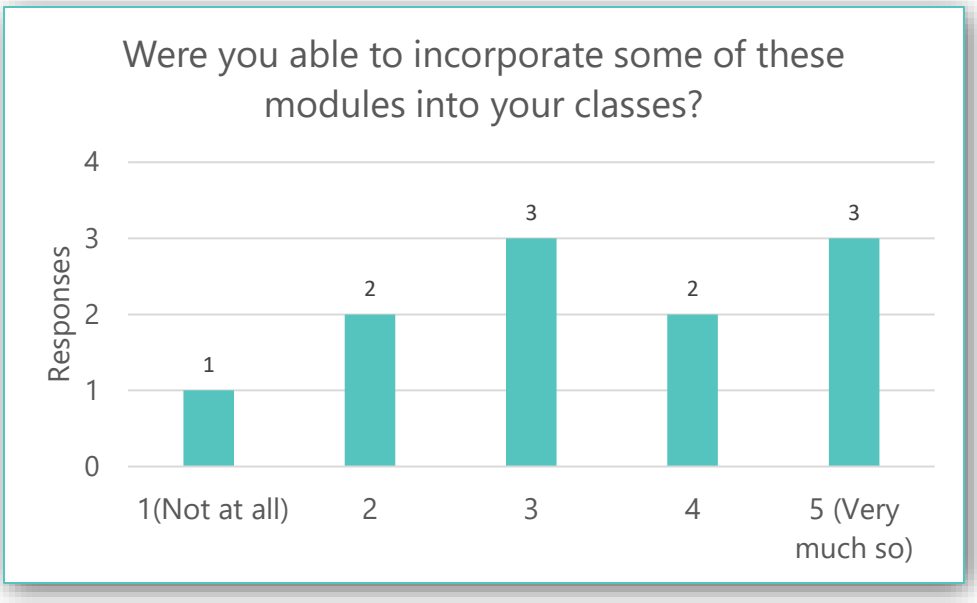

Figure 8. Responses to the post-program survey question asking "Were you able to incorporate some of these modules into your classes?"

3.2 Class Use Information

Question 6. The first piece of information we requested from teachers was the grade levels of the students that they had used the program with. This provides context to understand the rest of the results of the survey, as the outcomes of the program might be different depending on whether an older or younger grade level was involved. **Figure 9** shows the results of this question, and teachers were able to select more than one grade level. As a reminder, the Kids Making sense program is geared towards grades 6-12. Based on the teacher responses, there was a good spread of teachers working across all grade levels. An equal number of responses reported working with students in 7th, 11th, and 12th grade, followed by 6th and 9th grade. Knowing that teachers were working with a diverse age range of students is helpful in contextualizing the subsequent survey results, as there will not be a bias from a majority of teachers working with either older or younger students.

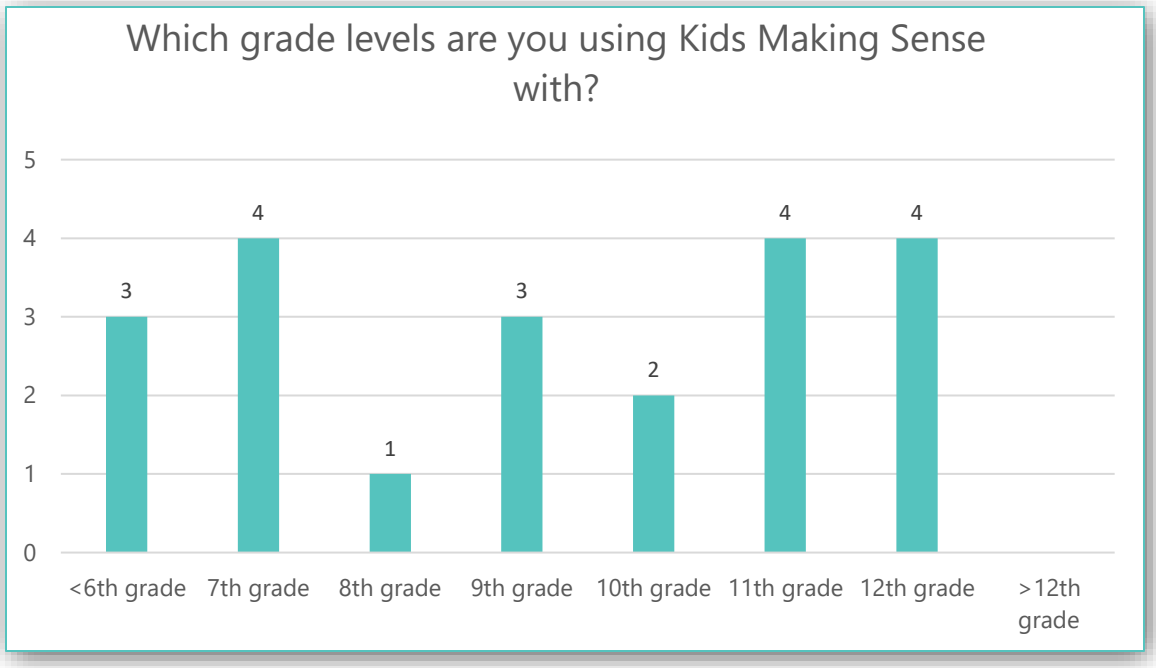

Figure 9. Responses to the post-program survey question that asked teachers which grade levels they were using Kids Making Sense with.

Question 7. Next, we wanted to understand the reach of the program within the various schools and how many students the program would potentially reach. As such, teachers were asked, "On average, how many students do you envision engaging with on aspects of Kids Making Sense per year?" The results (shown in Table 5) show that this teacher group serves almost 1,000 students in total across all grade levels.

Table 5. Raw responses to the post-program survey question that asked teachers on average how many students they engaged with on Kids Making Sense material.

Which grade levels are you using Kids Making Sense with?	On average how many students do you envision engaging with on aspects of Kids Making Sense per year?
9th, 10th, 11th, 12th	66
7th	160
7th	100
<6th grade	140
11th, 12th	30
9th	100
9th, 10th, 11th, 12th	40

Which grade levels are you using Kids Making Sense with?	On average how many students do you envision engaging with on aspects of Kids Making Sense per year?
<6th grade	40
11th, 12th	120
7th	100
<6th grade, 7th, 8th	100

Question 8. To understand how the Kids Making Sense material fits into the curriculum and programming that teachers across grade levels already teach, we asked "In your opinion, when does this material fit best into your schedule?" Figure 10 shows the results from this question, and the typed-in responses for teachers who selected "other" are listed on the right side of the plot. When cross-compared to the grade levels that the teachers teach, there were no clear patterns between the grade level and the time that teachers felt the material best fit. The conclusion from responses is that teachers are able to find parts of the curriculum that fit throughout the year, and that where the Kids Making Sense material best fits is very much dependent on the teacher, school, and current curriculum being taught.

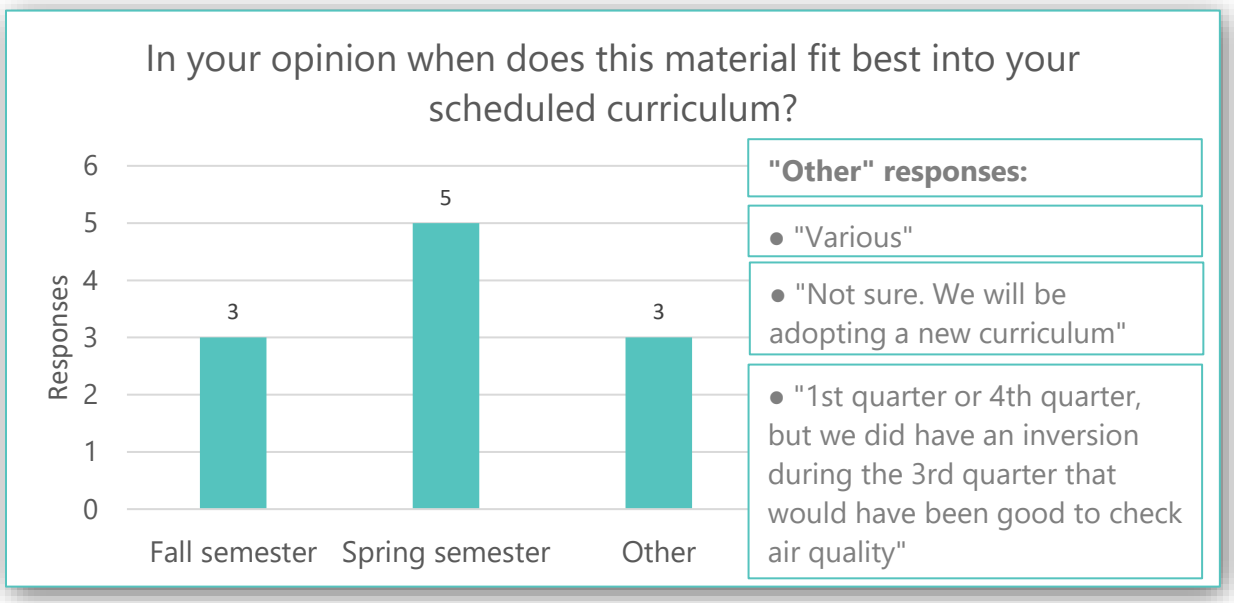

Figure 10. Responses to the post-program survey question that asked teachers when the Kids Making Sense curriculum material fit best into their scheduled curriculum. Responses that were filled in as the user selected "other" are listed on the right side of the figure.

3.3 Curriculum Usage

Question 9. Teachers were asked which of the modules from the Kids Makin Sense curriculum they covered with their students. Responses to this question provide insight on (1) which modules fit best with the curriculum teachers were already teaching this year, and (2) which modules teachers were most enthusiastic about sharing with their classes. Teachers could choose more than one answer, and the responses are shown in Figure 11. Module 6 responses are colored in teal to make them stand out, as this is the module that involves the sensors.

Module 1 (our air and pollution) was the most shared with students. This module covers the basics about what is in the air we breathe and invites students to investigate online resources that provide information on air and air quality. Since all of the teachers said they already taught air quality topics in their classes, this could also indicate that they preferred the material in the Kids Making Sense curriculum to the types of material they were previously using with students. As implied by the shape of the graph and from looking at the individual responses, it appears that most teachers started at the beginning of the material and worked their way through, with about four teachers using Module 6 (and the sensors) with their students. Due to time limitations, teachers may not have gotten all the way through the curriculum. A few teachers focused on Module 1 and then one other module from the rest of the curriculum, such as Module 6 (Field Measurements) or Module 4 (Health Effects of Particles). One teacher chose to focus only on Module 8 (Be a Part of the Solution). The raw results from the same question as shown in Figure 11 are tabulated and shown in Table 6. This view helps to show the pattern of how teachers navigated the modules with their students and also shows the grade levels the teachers taught. This view of the responses showed that teachers who taught higher level classes (11th and 12th grade) typically covered more of the modules than teachers who were teaching younger classes. This could be for many reasons including the time the teacher had available, how well the Kids Making Sense modules fit with topics already being taught in the teacher's curriculum, or the comfort level of the teacher with the material. It is also possible that now that teachers have had time to work with the curriculum, they could implement more of the modules with students in classes next year. Based on latter question responses, time was a large factor impacting teacher's schedules this year.

Figure 11. Responses to the post-program survey question that asked teachers which modules from the Kids Making Sense curriculum they covered with their students.

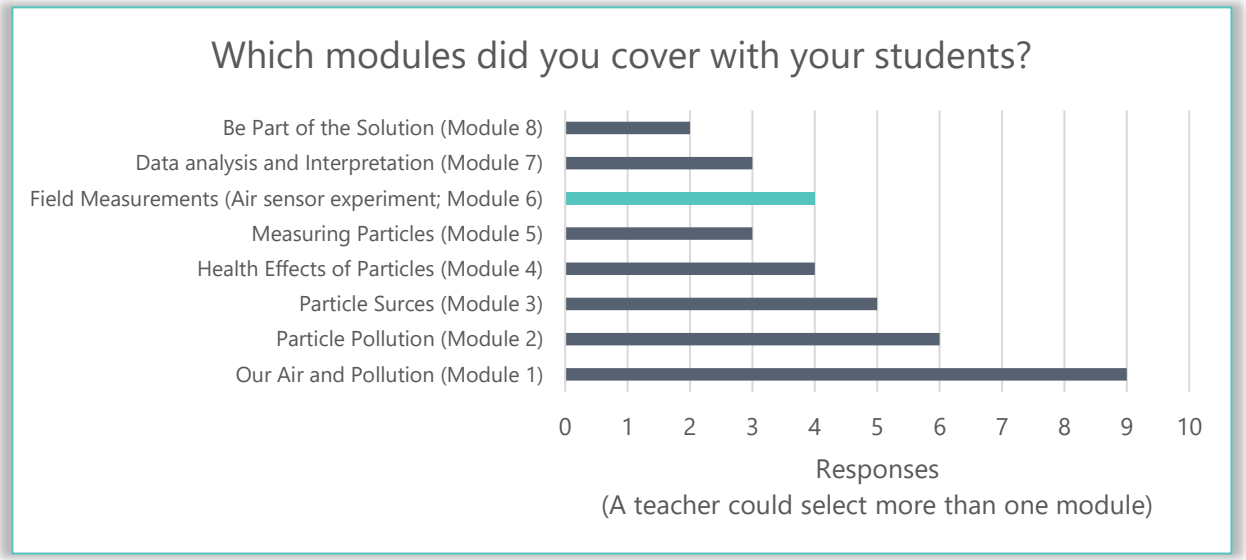

Table 6. Raw responses to the post-program survey question that asked teachers which modules from the Kids Making Sense curriculum they covered with their students. Blue cells indicate that teachers used the module.

Grade levels the teacher is using Kids Making Sense with	Our Air and Pollution (Module 1)	Particle Pollution (Module 2)	Particle Sources (Module 3)	Health Effects of Particles (Module 4)	Measuring Particles (Module 5)	Field Measurements (Air sensor experiment; Module 6)	Data analysis and Interpretation (Module 7)	Be Part of the Solution (Module 8)
<6th grade, 7th, 8th	■	■	■	■				
7th	■							
11th, 12th	■	■	■	■	■	■	■	
<6th grade	■					■		
9th, 10th, 11th, 12th	■							
9th	■	■	■					
11th, 12th	■	■	■	■	■	■	■	■
<6th grade	■			■				
7th								■
7th	■	■						
9th, 10th, 11th, 12th		■	■		■	■	■	

Questions 10 and 11. We were also interested in understanding whether teachers had worked with students on Module 6, where the students get to use the handheld air sensors. Figure 12 shows that over half (64%) of the teachers did have their students use the sensors.

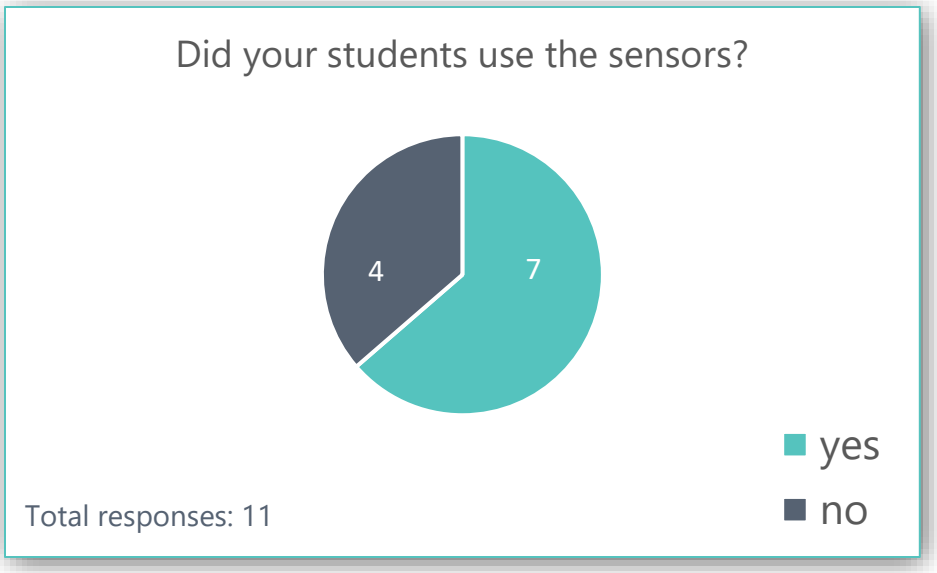

Figure 12. Responses to the post-program survey question that asked teachers whether their students had an opportunity to use the air sensors this school year.

For teachers who responded that their students did have a chance to use the sensors, they were then asked whether the students used them indoors, outdoors, or both (Figure 13). Due to an error in the form, the first two teachers who stated that their students used the sensors were not prompted to answer this question, resulting in only 5 responses. However, there was an equal split of students who used the sensors indoors and outdoors, and one set of students used them in both locations.

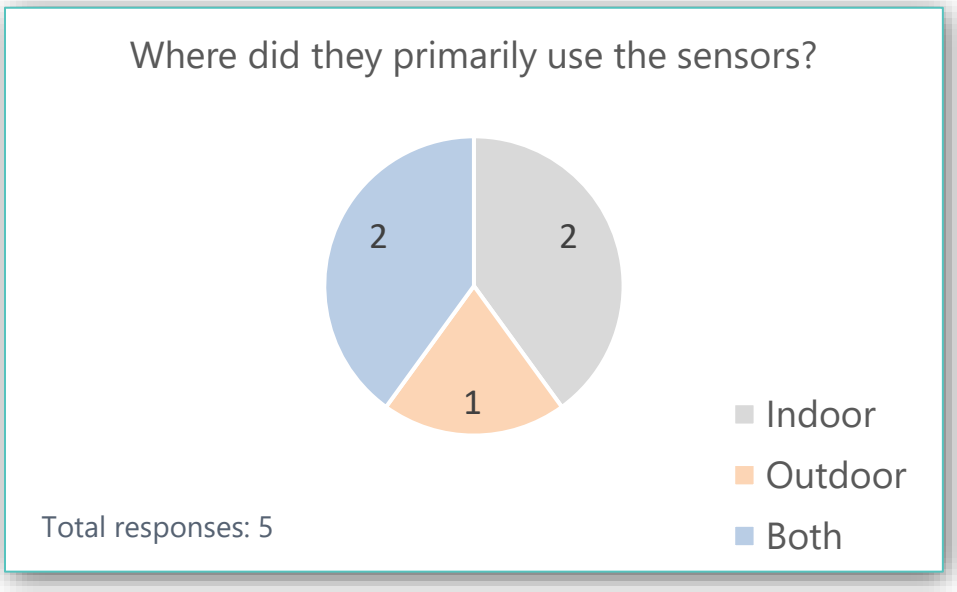

Figure 13. Responses to the post-program survey question that asked teachers whose students were able to use the sensors whether they used them indoors, outdoors, or both.

From **Questions 10 and 11**, it is evident that the majority of teachers were enthusiastic about the sensors and were able to use them with their students. Based on other responses in the survey, those who were not able to use the sensors with students were limited by time restrictions this school year.

Question 12. Next, we wanted to understand the types of projects students had used the sensors for. We realize that as teachers become more comfortable with the technology and material, the activities students use the sensors for will likely expand and grow, but as a starting point we wanted to gather information on how this first student cohort used the sensors. We asked teachers to fill in the blank and "describe some of the projects students performed with the sensors and any significant outcomes." The responses are listed in Table 7. All teachers were asked to respond to this question whether their students used the sensors or not, so some responses explain when they plan to use the sensors or why they were not able to use them this year. Responses with descriptions of student projects are in bold.

Table 7. Fill in the blank responses to the post-program survey question that asked teachers to describe some of the projects that students performed with the sensors and any significant outcomes from those projects.

Please describe some of the projects your students performed with the sensors and any significant outcomes.
They noticed air quality diminished near busy streets and city bus stops in comparison to residential areas with low traffic.
We measured the air quality in the classroom and then the hallways.
We were not able to use sensors this year.
I was unable to do any of the projects with the sensors. I am planning to use them this coming fall.
We will start using the sensors later this week.
Just had time for a basic set up in a position and record for a short period of time and look at results. very basic.
N/A
We just introduced air pollution and collected air samples from around our school. We mapped different locations and looked at our data and talked about why some areas had different numbers, why the data might have been skewed, and what we could do differently next time.
Sadly, I did not leave enough time for projects. I was able to use the curriculum and the sensors. Next year I am looking forward to leaving more time and expanding on module work, data collection and a final project. With AP curriculum I am bound to get through certain content and the first time doing something new there is always room to grow, change, make it better on my end. I look forward to creating better and more experiences for my students next year on air pollution.
I am sorry that we weren't able to use the sensors this year. I may be able to use them at the end of Ecosystem unit coming up.
Looking at air quality at school and in their neighborhood.

Question 13. Teachers were offered a chance to use "chat with a scientist" time, where air quality experts from Sonoma Technology make themselves available to virtually join a class of students to answer their questions about a specific air quality topic, discuss air quality-related career paths, help with their handheld air sensor project, and more. We asked teachers whether they used the "chat with a scientist" time made available to them, and if they did not, the reason. None of the teachers used the time allocated (though one teacher responded 'yes' – this teacher requested one-on-one time to help understand how to use the sensors more in depth). The reasons for not having used the time are listed in Table 8, and almost all of them relate to time constraints.

Table 8. Responses to the post-program survey question that asked teachers whether they used the "chat with a scientist" time allocated, and if not what the reason was.

Did you use your chat with a scientist time that was offered?	Reason
No	Haven't had time to
No	We have been so busy with adopting a new curriculum this year that our department wasn't able to carve out time to math this happen.
No	Honestly ran out of time, I hope to incorporate this piece next year.
No	Did not have time within our current curriculum.
No	Time constraints.
No	Just ran out of time.
No	I have run out of time. I may try and utilize it still but at this time with the end of the year coming I may have difficulty fitting it in.
No	This school year was very difficult to manage in terms of scheduling and curriculum.
No	I did not get a good chance to show the curriculum to my students.
Yes	[*this was not technically used for its purpose- teacher used time to understand how to use the sensors as he was not at one of the trainings where their use was covered*]
No	Wasn't necessary. I felt I had the resources I needed.

3.4 Value Added

Question 14. The most important aspect of the Kids Making Sense program is that students have an opportunity to learn about the air they breathe and how to protect themselves. However, this cannot happen unless the material adds value to classrooms. To evaluate the value of the curriculum and the modules, we asked teachers "Which sections or topics from the curriculum did you find most

valuable to your students?" Teachers were invited to type a response, and the answers are recorded in Table 9. Key sections of responses that relate directly to modules in the curriculum are in bold. Overall, the health module was mentioned most frequently across responses.

Table 9. Responses to the post-program survey question that asked teachers to describe which of the sections or topics from the curriculum they found most valuable for their students.

Which sections or topics from the curriculum did you find most valuable to your students?
During a STEAM lab elective, we were able to spend a day briefly going over details of the modules, but mainly focused on **data analysis and interpretation.**
Making sense of air pollution and particle size. Students were able to understand what else is in the air around them other than gases.
-
I found that the **health effects** was the most meaningful part for my students.
I am still working through this content. I have currently made it through Module 5. At this point in the curriculum I have found that the **Health Effects of Particles** (Module 4) has been the most valuable.
All activities went over really pretty good with students. **My student liked the building of their on particle sticky traps** that we made and they placed in or around where they leave. **Coming back to school and looking at the particles under the microscope was very reviling to them.** Starting to use the air sensors now towards the end of school so we will see how far we get.
N/A
The field measurements. Not only the content of the air quality but just **learning how to gather data,** the rolls each student plays in a group.
Students have not learned about air pollution beside what they get from the news, especially air quality. How each of the Modules build upon the next leading to gathering and analysis of data is a great way for students to have a deep understanding of air pollution, where it comes from and its effects on health. **As an AP teacher I saw a huge improvement in their knowledge and ability to answer air pollution questions on the college board test.**
Students found Module 1 interesting to compare our air quality in Spokane to cities throughout the country.
Talking about health this year in school made for an easy connection with the module.

Question 15. In addition to learning about air quality, Kids Making Sense has been designed to foster STEM concepts and skills through the *topic* of air quality. We wanted to know from teachers what kinds of skills their students had gained by working through the modules. Figure 14 shows teacher responses and indicates that all teachers felt their students gained "air quality knowledge," followed by over half of the teachers who felt that their students learned about "interpreting and analyzing data" and how to "design a scientific investigation." Module 8 focuses on science communication, and since very few teachers covered this module with their students, it makes sense that the responses were lower for this category.

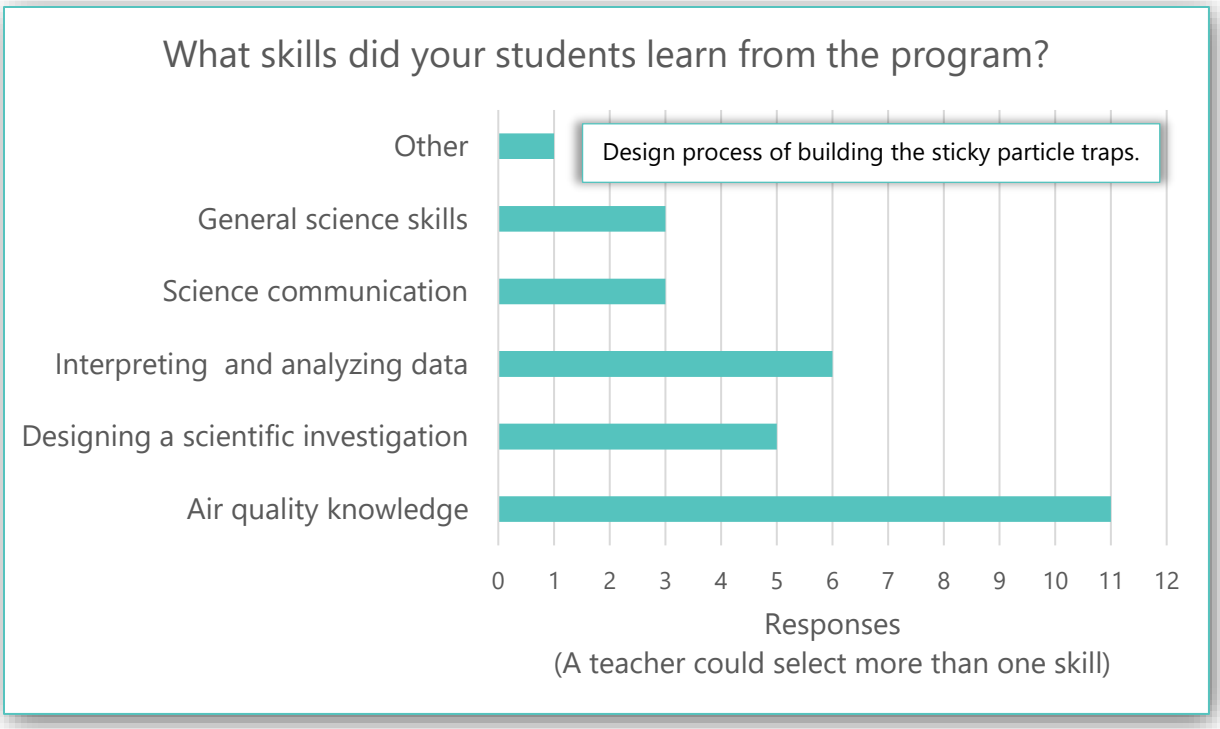

Figure 14. Responses to the post-program survey question that asked teachers "What skills did your students learn from the program?" Teachers were able to select more than one answer.

Question 16. Overall, we wanted to understand from the point of view of the teacher, and with the amount of use they were able to get out of the kit this school year, how much value they felt the kit materials and curriculum have added to their classroom. The answers to this are plotted in **Figure 15**. The results show that overall, most teachers felt that the program added "a good amount of value" or higher, with some stating that it was too early to tell.

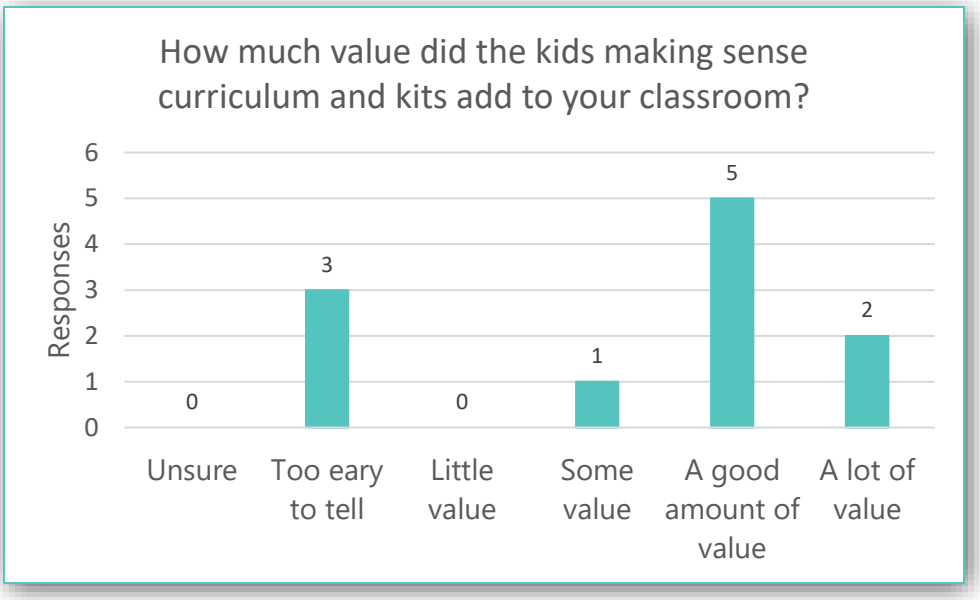

Figure 15. Responses to the post-program survey question that asked teachers "how much value did the Kids Making Sense curriculum and kit add to your classroom?"

Question 17. To round out this section, we asked teachers if they had any other comments they would like to add about the program, kits, curriculum, or their experiences. Four teachers took the opportunity to respond, and their responses are shown in Table 10. The summary of responses show that teachers were very appreciative of the program and training, and for the opportunity to participate and include these materials in their classes moving forwards.

Table 10. Responses to the post-program survey question that asked teachers whether they had other comments they would like to share.

Any other comments you would like to add?
Thank you for providing us with the equipment to do these experiments. Very exciting to have these portable air quality meters that the students can touch and walk around with. I think it makes it more 'real' for them when they know exactly where the reading is coming from.
I am hoping to involve this in my curriculum for next year!
Thanks you for the training and equipment. Great materials that can be used for years.
Thank-you for your help and support

3.5 Suggestions for Future Teachers and Training

Question 18. In the interest of improving training and meeting teacher needs for the future, we asked "how could the training be improved in the future? For example, what was missing that you would like to have seen? Or what could have been emphasized more? Would you have preferred more time?" The responses are shown in Table 11. While some were satisfied with the training, or felt it went into too much detail, the major theme of the responses was that teachers would prefer it if more training time was spent on the sensor portion. In the future, giving teachers time to run a practice with the sensors during the session will be implemented during the training. While teacher's "spare time" to participate in this training is limited, it appears this is a worthwhile exercise to ensure teachers are more comfortable with the technology.

Table 11. Responses to the post-program survey question that asked teachers how training could be improved in the future.

How could training be improved in the future? for example, what was missing that you would like to have seen? or what could have been emphasized more? would you have preferred more time?
The training was a little overly thorough and could have been a little shorter. It was modeled well for us.
The use of the sensors and phones and troubleshooting issues that can arise. Like an updates on the phone, sensors not linking, Wifi issues.
Well really enjoyed the training. more time working with the sensors would be nice. Knowing that there is always a time crunch for curriculum it is nice to have the unit that can be used in a stand alone way.
Nothing, I wish we had more trainings in the same format
I would have preferred more time to really understand how to use the sensors. When I was trained, I was also in a steep learning curve on piloting new curriculum for our district.
More time with sensors and modeling how to use in classroom.

Question 19. Teachers rely on the experience and advice of other teachers. As such, we asked, "What advice do you have for the next school year when we recruit 8-10 more educators/schools for Kids Making Sense? This could be advice for running the program/training or advice for teachers who will participate." Responses are listed in Table 12. The overall sentiment is that the training is very useful for teachers, and that they should spend time after the training building their comfort level with the sensors by practicing using them firsthand.

Table 12. Responses to the post-program survey question that asked teachers what advice they have for teachers participating in the program next year.

What advice do you have for the next school year when we recruit 8-10 more educators/schools for kids making sense? this could be advice for running the program/training or advice for teachers who will participate
I would stress the importance of using the sensors outside and giving the students the chance to see how air quality changes in their local setting.
Spend more time using the technology. Actually go around and use it. Then come back and analyze it.
I loved the training. I thought it was informational, well-paced, and the trainers were knowledgeable. Teachers: Look early to find a way to put this into your lessons!
I would let them know the objectives of the course and have them schedule and calendar map some time for the lessons. It would be helpful to start making the plans before the start of the school year.
Make sure you spend time working with the sensors and the phones. The curriculum is easy to follow and the labs are engaging.
Training should be in the summer or very early in the year. Teachers need to practice using sensors.
N/A
Practice with the sensors before you use them in class. Walk some of the routes you map, or sure they're all connected to Wi-Fi well before you start the modules. Have students do practice runs as well to make sure they know what they're doing before you start.
This training is worth the time. You will walk away with great lessons and tools to teach hands on Science. As a result students will have a deep understanding and knowledge about air pollution.
Training 6th grade teachers and incorporating the training into their focus of Earth & Space science would be a better fit!
I think this is really useful and teacher friendly.

Question 20. Lastly, we asked for feedback about the timing of the training sessions. Figure 16 shows the responses. Interestingly, despite noting that teachers next year should find time to use the sensors before integrating them into their classes (see the previous question), the majority of teachers also thought that the early school year was the best time for training. One teacher stated that the month of October is ideal, while two teachers felt the summer was more appropriate.

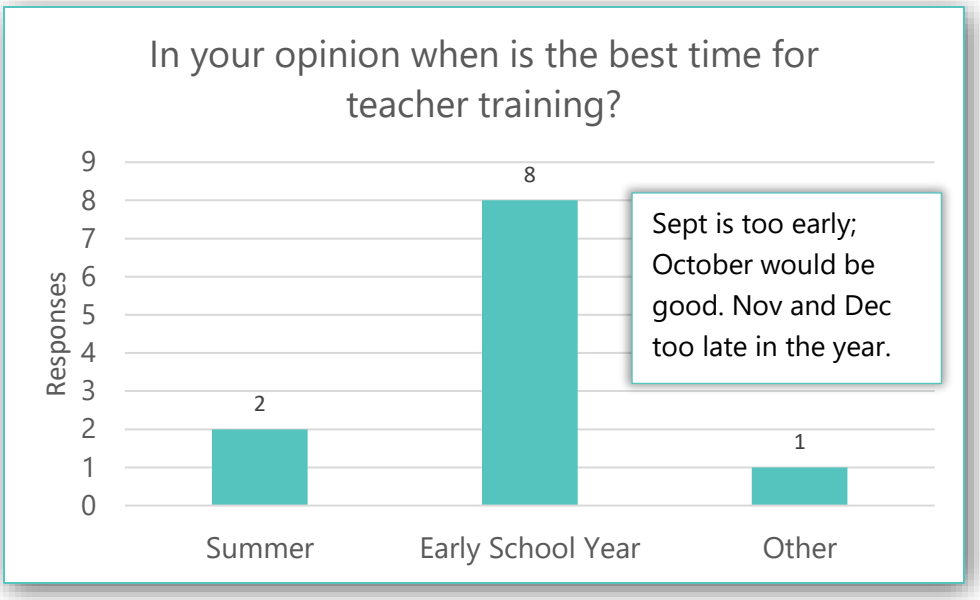

Figure 16. Responses to the post-program survey question that asked teachers when they felt the best time for teacher training would be in the future.

4. Summary and Lessons Learned

Overall, this program and its implementation in Spokane classrooms was a success. Teachers were able to serve approximately 1,000 students with the material this year, and this will continue long into the future. Teachers expressed that they found value in this type of a program and feel their students learn valuable skills, including data analysis and interpretation and how to design a scientific investigation, as well as general air quality knowledge that can help them with the AP college board test. The Kids Making Sense modules were successfully implemented across grade levels, and each of the eight modules was implemented by at least one teacher this year. The majority of teachers were able to use the sensors with their students, investigating both indoor and outdoor air quality.

Teachers found value in the training and felt it was a helpful introduction to the program, materials, and curriculum. For future training sessions on the Kids Making Sense program, more time should focus on the sensors and teachers should have an opportunity to practice using them during the training session. This year's teachers also suggest that future training should be early in the school year as opposed to during the summer, and recommend that teachers practice using the sensors themselves before using them with their students. This will help to build familiarity and comfort with the technology.