

Automobile Idling Reduction Program
Kristen Weston-Smith
Arizona State University

Executive Summary
Automobile Idling Reduction Program

Description

By avoiding vehicle idling for three minutes every day of the year can reduce 1.4 million metric tons annually, which is equivalent to taking 320,000 cars off the road for the entire year (Canada.ca, 2016). The Automobile Idle Reduction Program (AIRP) is an outreach initiative to prevent carbon emissions from being released into the air by automobiles idling in Maricopa County. The initiative establishes a campaign to promote behavioral changes that target high idling industries: freight and delivery, schools and drive- thru facilities.

Background

Globally, carbon emissions negatively alter the air we breathe and is a leading cause in climate change. These problems adversely affect the global environment and human health. Additionally, they have cancer causing agents in the particulate matter. Unfortunately, over the years, Maricopa County has failed to meet air quality standards for particulate matter pollution which effects the health of residents. By not meeting the air quality standards, Maricopa County can receive sanctions and the Environmental Protection Agency can reject Arizona's State Implementation Plan. This looming threat can financially impinge the economy of Maricopa County, potentially costing taxpayers a substantial increase in taxes.

Strategy and Solution

To battle the creation of carbon emissions and particulate matter, AIRP has developed a strategy for each industry. In partnership with the Maricopa County Air Quality Department, AIRP will introduce the freight and delivery companies to the Diesel Emission Reduction Act (DERA) Grant promotion to facilitate and fiscally assist with changing older diesel engines into higher efficiency engines that burn cleaner. Provide educators a fifth to eighth grade state approved education program to teach students the importance of vehicle idling reduction at no cost. And work with community organizations to offer a discount at their stores for those patrons who choose to turn their engine off and order inside, rather than idling in the drive-thru facilities. The campaign will market the interest of AIRP to the general public through purposefully placed billboards, light rail wraps, social media pushes, handouts and vinyl stickers.

Automobile Idling Reduction Program

Imagine being a five year- old child watching your friends playing outside. The sun is shining, birds are chirping and all you want to do is join your friends outside. But, you are not allowed to unless you carry a breathing machine wherever you go because the pollution is too high. Imagine this is your life everyday for the rest of your life. Well, this is daily for my daughter. Watching her sitting at the window or having to stop playing every 30 minutes to do a breathing treatment for 20 minutes is the reason why improving the air quality is so important to me.

Over the last two years, I have made it my mission to teach and promote behavioral changes to better the air quality in Maricopa County. While waiting to pick my daughter up from school, I noticed there was an extremely long line of vehicles parked and idling in the school's pickup line. This made me think about how many pounds of carbon emissions were being generated as we all waited. After finding out that one vehicle idling for three minutes every day of the year can produce 1.4 million metric tons annually (Canada.ca, 2016), I decided to develop a campaign to reduce automobile idling in Maricopa County.

Using the ABCD framework, I was able to create a vision to fight carbon emissions with the Automobile Idling Reduction Program (AIRP). Realizing there was a significant carbon emissions crisis in Maricopa County raised awareness of an automobile idling problem. I used backcasting to decide that within two years I wanted to execute a campaign to address automobile idling in the three high idling industries of freight and delivery, schools and drive-thru facilities. I decided to prioritize the steps to implementation. First step was creating a communication plan to gain support and resource assistance by collaborating with the Maricopa County Air Quality Department (MCAQD). After a staff meeting, I proposed to the Maricopa County Air Quality Department Director (Director) my elevator pitch for AIRP and was able to set a meeting to discuss my vision and how it would affect MCAQD and our county constituents. The meeting with the Director, included MCAQD's Outreach Program Manager who was directed to assist me with whatever was needed to put AIRP into action. The partnership allowed for resources and networks to create an educational program for 5th – 8th grade that is aligned with the Arizona State Standards. The support also created a general media campaign for public and focused idling industries.

There were ups and downs throughout the development process. I was able to collaborate with environmental and educational groups to expand AIRP with media collateral and a

standardized educational curriculum. The largest issue that affected and postponed the campaign launch was the Novel Coronavirus 2019 (COVID-19). COVID-19 shutdown the entire state causing non-essential businesses to close organizations and restaurant dining rooms forcing patrons to idle in the drive-thru; and closed all schools for the foreseeable future.

This process and journey of creating AIRP taught me to be adaptable, patient, open-minded and hone my leadership skills. I know that everyday that I continue to promote AIRP is one step closer to helping my daughter have a normal childhood free of breathing machines.

Background

Throughout the world, there is an undeniable need to become a more sustainable world. Sustainability focuses on meeting the needs of the present without compromising the ability of future generations to meet their needs; and is composed of three pillars: economic, environmental, and social (Grant and Kenton, 2019). One key factor that affects global sustainability and how the three pillars work together is carbon emissions. Carbon emissions, or sometimes known as carbon footprint, is the measurement of greenhouse gas emission emitted into the air causing climate change and the depletion of resources (Jaines, 2018). The United States, which makes 4 percent of the world's population, alone creates 25% of the world's carbon emissions (Jaines, 2018). Over half of the emissions are created by transportation related activities (Jaines, 2018) and, automobile idling, attributed by personal vehicles, creates around 30 million tons every year wasting three billion gallons of fuel (U.S. Department of Energy, 2015). Automobile idling occurs when the engine of a vehicle is running but not engaged with the transmission or is simply not in gear (Shancita, Masjuki, Kalam, Fattah, Rashed and Rashedul, 2014). Automobile idling has adverse effects on the global environment and human health, and has cancer causing agents in the particulate matter (Sentoff, Robinson and Holmen, 2010). Particulate matter (PM) are particles in the pollution emissions and makes up about one third to one half of what is federally regulated (Dominici, Greenstone and Sunstein, 2014). Furthermore, airborne particulate matter is detrimental to human health as it shortens lives and increases morbidity rates (Dominici, Greenstone and Sunstein, 2014).

For nearly 30 years Maricopa County has failed to meet air quality standards for PM pollution, effecting the health of the community (Fominaya, 2017). By not making the air quality standards Maricopa County can receive sanctions and the Environmental Protection Agency (EPA) can reject Arizona's State Implementation Plan (SIP) (Cook, 2011). This looming threat can financially affect the economy of Maricopa County, potentially costing taxpayers substantial

increase in taxes. MCAQD has implemented various programs, rules and sanctions to reduce air pollutants and emissions. However, a concept that was not previously considered was an automobile idling reduction program.

The mission for AIRP is to educate and create behavioral changes to reduce carbon emission. After thorough research and consideration, the Automobile Idling Reduction Program (AIRP) was proposed to MCAQD. The proposal requested resource support for a community outreach program that would reduce automobile idling in high idling industries: freight and delivery, schools and drive-thru facilities. The program is designed to promote patrons to turn their vehicle engines off, if they were to idle longer than 30 seconds (this is not inclusive while driving in traffic). The vision and mission for AIRP is to prevent carbon emission from being released into the air by automobiles idling in Maricopa County. In turn, the reduction of carbon emissions will provide cleaner, healthier air to the community members of Maricopa County, inadvertently creating a positive global impact. Implementation of AIRP is met through strategic objectives that include an outreach campaign, educational training and program initiatives conducted in three phases. The phases were organized by consideration of public impact, information and resource availability.

AIRP Strategic Objectives

AIRP is developed as a campaign with initiatives to address the air quality issues within Maricopa County and surrounding communities. It promotes a behavioral change that reduces carbon emissions from polluting the air causing particulate matter and ozone. AIRP's goals will be met through strategic marketing campaigns and programming.

The campaign leverages the general public to turn their engines off if they will be idling longer than 30 seconds however, not while driving in traffic. The promotional collateral includes the use of purposefully placed billboards, light rail wraps, social media pushes, handouts and vinyl stickers. Promotional collateral items are used during events and during high polluting times of year, such as, summer ozone season and winter no burn days. Items are also made available to participating organizations for additional promotion.

The initiatives are specifically addressed to the aforementioned high idling industries and were implemented in phases. The first phase was creating a fifth to eighth grade education program that teaches students the importance of vehicle idling reduction. The education program was assimilated with the current fifth to eighth grade air quality curriculum that is regulated to the Arizona Education Standards allowing it to be taught in Maricopa County schools. The fifth

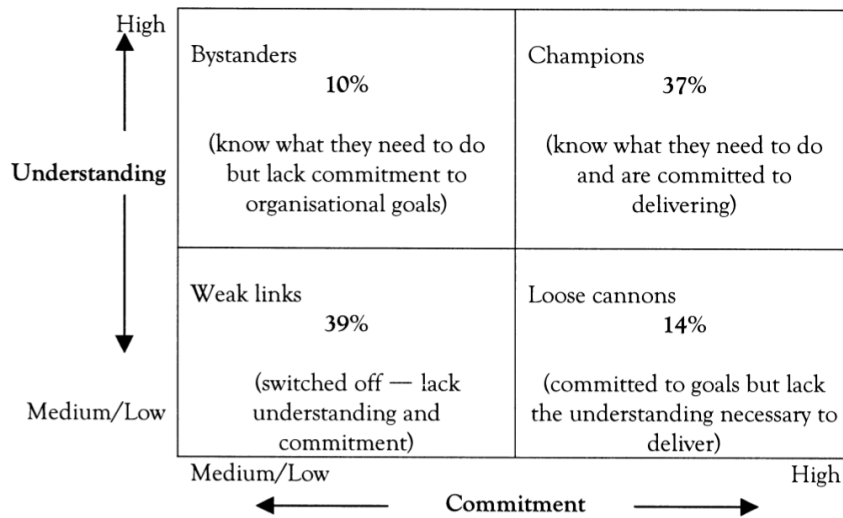
to eighth grade education program is free to teachers and offers the necessary supplies to conduct each lesson. The second phase introduced a collaboration with community drive- thru facilities to offer a discount program. The community organizations with a drive- thru were requested to offer a discount at their store for those patrons who choose to turn their engine off and shop inside their store, rather than idling in the drive-thru. These organizations were offered “no idling” signage at no additional cost to the participating organizations. The third phase introduced financial assistance to freight and delivery trucks that changed their older diesel engines to higher efficiency engines that burn cleaner. Each participating organization was trained and informed on how they could participate in the Diesel Emission Reduction Act (DERA) Grant.

While the campaign and initiatives are simple in nature, they require substantial resources to implement and maintain AIRP. Because AIRP is provided as a public service, it does not create fiscal profitability for MCAQD. However, the benefits are intangible as they will promote healthier and wealthier living environments for the County constituents. The magnitude of AIRP required support from the internal stakeholders and collaboration efforts with external organizations.

Gaining Support from Internal Stakeholders

Internal stakeholders are instrumental to the success of any program. They will be the supporter, influencer, resource, facilitator and control many other facets of the program. Creating that buy- in from internal stakeholders can be difficult if not strategic in your approach. Buy- in happens when people are aware and aligned with key business issues and understand how these issues can positively affect them; and builds commitment and engages people in the achievement of goals (Thomson & Hecker, 2000). The higher the understanding, the higher the commitment, and the greater success the program will have (see Figure 1).

Figure 1 (Thomson & Hecker, 2000, p.52)



The AIRP communication plan was targeted toward the Director and supporting organization, MCAQD. The first strategies developed and implemented were creating an elevator pitch, having a one-on-one conversation and describe how AIRP’s vision aligns with MCAQD’s vision, mission and purpose (Center for Creative Leadership, 2019). The elevator pitch was made to be quick and concise to get the attention of the Director. The pitch focused on the urgency needed to make air pollution emission reductions to make the EPA 2015 Ozone Attainment Standard, program summary and a call to action. Elevator pitches allow for a chance to get a “foot” in the door and make an appointment for a longer discussion and more structured meeting to make a formal proposal. A more structured meeting allocates time for a deeper conversation opening the Director to be more empathetic and receptive (Loehr, 2016) to AIRP’s vision. Additionally, an assertive but polite reminder stated that Maricopa County was dangerously close to not being in compliance with the 2015 EPA Ozone Attainment Standard. And by not making that standard, stricter regulations will be enacted possibly causing more of a burden on community organizations, stakeholders and creating a political predicament.

Although, the Director substantially supported AIRP, there were additional resources needed to implement the program. Without those resources, AIRP would not have been executed properly resulting in the demise of the program. Development of external collaborations helped to alleviate the pressure on one entity and ensure a stronger outreach to the public.

Developing External Collaborations

Because AIRP affects many companies within three different industries, it is not feasible for one organization to support such an audacious initiative. MCAQD benefited from collaborating with external organizations. Collaboration with external organizations are beneficial because they are helpful in managing large problems, dealing with suppliers, meeting customer requirements, facing costly regulation and developing inside/outside strategies for sustainability issues (Sarda, 2018). Collaborating with the external sources made it possible to cover costs, resources, audiences and support.

Strategic collaborations were made with the Arizona Department of Environmental Quality (ADEQ) and the Maricopa Association of Governments (MAG). It was beneficial to MCAQD and AIRP to form these partnerships to gain access to federal funding, grant money and technological resources. Additionally, because they are publicly managed and regulated organizations, they offer the support needed to motivate organizations to promote and assist with the idle reduction campaign. Also, MCAQD and AIRP found it valuable to collaborate with high idling industries, freight and delivery companies, schools and local drive thru facilities, as they are key audiences in which AIRP initiatives and programs are designed to address. These collaborations included: working with freight and delivery companies to access the DERA Grant promotion to facilitate and fiscally assist with changing older diesel engines into higher efficiency engines that burn cleaner; creating a fifth to eighth grade education program for schools to teach students the importance of vehicle idling reduction; and work with community organizations to offer a discounts at their stores for those patrons who choose to turn their engine off and order inside, rather than idling in the drive-thru facilities.

Developing collaborative partnerships allowed for AIRP to have a further reach and create more sustainable programs. Regardless of the resources available, if risk management is not considered the program will not be efficient or successful. And a waste of everyone's resources and time.

Risk Management

Any strategic program needs to include risk management into their plan. Analyzing the strengths, weaknesses, opportunities and threats to AIRP better anticipated obstacles and challenges, and ways to manage those potential incidences. A SWOT analysis identified AIRP specific issues (see Table 1).

Table 1. SWOT Analysis for AIRP

<p style="text-align: center;">STRENGTHS</p> <ul style="list-style-type: none"> • Reduces air pollution from emissions • Bettering air quality making healthier air • Increased productivity and less sick days • Ability to tie with air quality initiatives • A small behavioral change 	<p style="text-align: center;">WEAKNESSES</p> <ul style="list-style-type: none"> • Large audience to address • Hard to regulate • Controversial regulation • Desert environment, too hot
<p style="text-align: center;">OPPORTUNITIES</p> <ul style="list-style-type: none"> • Opens collaboration opportunities with other municipalities • Develops new carbon reducing policy • Identify inefficiencies and waste • Improve the health and wellness of Maricopa County 	<p style="text-align: center;">THREATS</p> <ul style="list-style-type: none"> • Political ambitions • Lack of support from decision makers • Changing air quality standards • Vehicles becoming more efficient

AIRP offers many strengths and opportunities for the business community and general public. It reduces air pollution from carbon emissions providing cleaner air to improve the health and wellness of Maricopa County residents and outlining communities. The improvement in air quality reduces missed days of work due to illness and increasing productivity. AIRP promotes behavioral changes that further collaborative efforts with other municipalities to encourage sustainability principles and develop carbon reducing policies.

Although there are many strengths and opportunities within AIRP, there are weaknesses and threats that are harmful to the overall success of AIRP. According to the U.S. Department of Commerce, Maricopa County has an estimated 4,410,824 population (U.S. Department of Commerce, n.d.). Having this large of a population makes it difficult to address all constituents and is quite challenging to regulate. AIRP is also a controversial topic as it contradicts shared political opinions and the desert environment causes heat related illnesses. The most challenging obstacles have been gaining additional assistance from decision makers within external organizations to continue supporting and allocating resources for AIRP.

These weaknesses and threats are being mitigated through active planning and flexibility to accommodate change. These plans and changes are considered through the Gantt Chart (see Appendix A. Figure A1).

Conclusion

AIRP was developed to address the looming particulate matter and ozone problem within Maricopa County, all of which affects the global problem of climate change. Additionally, AIRP address health, wellness and fiscal issues associated with air pollution. As the vision for AIRP is to prevent carbon emission from being released into the air by automobile idling in Maricopa

County. This vision has been successfully implemented due to strategic objectives and planning of an idle reduction campaign and initiatives. The campaign and initiatives focus on high idling industries to create informative promotional collateral, educational training and assistance. As with any successful program, internal and external partnership were leveraged to help alleviate any potential obstacles that would distract from accomplishing AIRP's vision.

References

- Canada.ca. (2016, September 20). Emission impacts resulting from vehicle idling. Retrieved from <https://www.nrcan.gc.ca/energy/efficiency/communities-infrastructure/transportation/cars-light-trucks/idling/4415>
- Center for Creative Leadership. (2019). The Best Ways to Communicate Your Organizations Vision. Retrieved from <https://www.ccl.org/multimedia/podcast/communicating-the-vision/>.
- Cook, H. (2011). Maricopa County particulate matter source study.
- Dominici, F., Greenstone, M., & Sunstein, C. (2014). Particulate Matter Matters. *Science*, 344(6181), 257-259.
- Fominaya, T. (2017). *Suitability modeling using rescale by function in ArcGIS: Predicting health impacts from PM₀RWIS34RfeSDcfkexd09rT4101RWIS34RfeSDcfkexd09rT4 pollution in maricopa county, arizona* (Order No. 10599261). Available from ProQuest Dissertations & Theses Global. (1926761619). Retrieved from <http://login.ezproxy1.lib.asu.edu/login?url=https://search-proquest-com.ezproxy1.lib.asu.edu/docview/1926761619?accountid=4485>
- Grant, M., & Kenton, W. (2019, November 18). Understanding Sustainability. Retrieved from <https://www.investopedia.com/terms/s/sustainability.asp>.

- Jaines, Kira. (2019, December 2). Effects of Carbon Footprint. *sciencing.com*. Retrieved from <https://sciencing.com/effects-of-carbon-footprint-4984464.html>
- Loehr, A. (2016, May 6). 7 practical tips for increasing empathy [Huffington Post Blog]. Available at http://www.huffingtonpost.com/anne-loehr/seven-practical-tips-for-b_9854350.html
- Sarda, B. (2018). Global Lecture 2: *Why Collaborate?* [Video file]. Retrieved from https://asu.instructure.com/courses/24063/pages/module-2-viewings?module_item_id=1390637
- Sentoff, K., Robinson, M., & Holmen, B. (2010). Second-by-Second Characterization of Cold-Start Gas-Phase and Air Toxic Emissions from a Light-Duty Vehicle. *Transportation Research Record*, 2158(1), 95-104.
- Shancita, I., Masjuki, H., Kalam, M., Fattah, I. R., Rashed, M., & Rashedul, H. (2014). A review on idling reduction strategies to improve fuel economy and reduce exhaust emissions of transport vehicles. *Energy Conversion and Management*, 88, 794-807.
doi:10.1016/j.enconman.2014.09.036
- Thomson, K., & Hecker, L. (2000). Value-adding communication: Innovation in employee communication and internal marketing. *Journal of Communication Management*, 5(1), 48-58. doi:http://dx.doi.org.ezproxy1.lib.asu.edu/10.1108/13632540110806668
- U.S. Department of Commerce. (n.d.). U.S. Census Bureau QuickFacts: Maricopa County, Arizona. Retrieved from <https://www.census.gov/quickfacts/maricopacountyarizona>
- U.S. Department of Energy. (2015). *Idling Reduction for Personal Vehicles*. *Idling Reduction for Personal Vehicles* (pp. 1–2). Argonne National Laboratories.
- Valenzuela, H. (n.d.). Development of Maricopa County's Emission Reduction Credit Program. Retrieved from https://www.epa.gov/sites/production/files/2017-11/documents/emission_reduction_program.pdf

Appendix A

Figure A1. Gantt Chart

Idle Campaign

Maricopa County Air Quality
Kirsten Smith

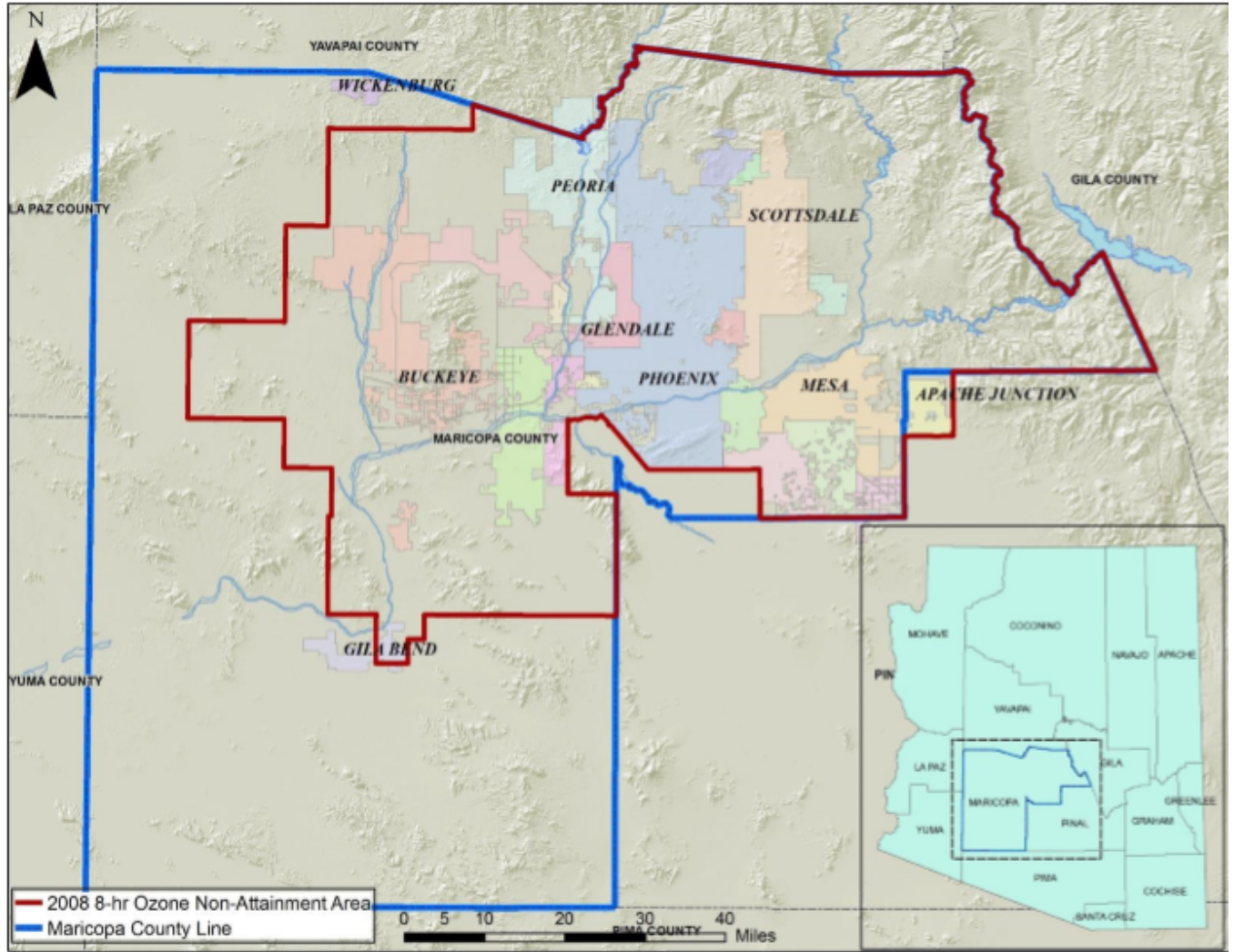
Project Start: Tue, 1/23/2013
Display Week: 1

TASK	ASSIGNED TO	PROGRESS	START	END	Gantt Chart																														
					Jan 28, 2013	Feb 4, 2013	Feb 11, 2013	Feb 18, 2013	Feb 25, 2013	Mar 4, 2013	Mar 11, 2013	Mar 18, 2013																							
Research																																			
Driver Time		100%	1/23/13	2/28/13	[Gantt bar]																														
Freight and Delivery	Kristen/Wendee-Smith	100%	1/23/13	2/28/13	[Gantt bar]																														
Schools	Kristen/Wendee-Smith	100%	1/23/13	2/28/13	[Gantt bar]																														
State	Kristen/Wendee-Smith	100%	1/23/13	2/28/13	[Gantt bar]																														
Other Programs	Kristen/Wendee-Smith	100%	1/23/13	2/28/13	[Gantt bar]																														
Create Work Plan																																			
Create Draft	Kristen/Wendee-Smith	100%	1/23/13	3/31/13	[Gantt bar]																														
Draft LR and TW	Kristen/Wendee-Smith	100%	3/31/13	3/31/13	[Gantt bar]																														
Draft calendar messaging	Oulerzak, PIO	100%	3/31/13	3/31/13	[Gantt bar]																														
Create communication plan	Kristen/Wendee-Smith	100%	3/31/13	3/31/13	[Gantt bar]																														
Feasibility Study	Kristen/Wendee-Smith	100%	3/31/13	4/3/13	[Gantt bar]																														
Create Buy-in and Support																																			
Present to Director Phil Maloney	Kristen and Oulerzak	100%	2/15/13	2/18/13	[Gantt bar]																														
Discuss collaboration efforts with MFG	Oulerzak Manager	50%	2/15/13	2/23/13	[Gantt bar]																														
Discuss collaboration efforts with ADEQ	Oulerzak Manager	85%	2/24/13	3/1/13	[Gantt bar]																														
Find schools to implement curriculum	Educative Oulerzak	100%	3/2/13	3/5/13	[Gantt bar]																														
Find participating driver-less facilities	Kristen/Wendee-Smith	50%	2/24/13	2/28/13	[Gantt bar]																														
Find participating freight and delivery camp	Kristen/Wendee-Smith	25%	3/2/13	3/5/13	[Gantt bar]																														
Implementation																																			
School curriculum	Educative Oulerzak	100%	4/28/13	4/1/13	[Gantt bar]																														
Driver-less dismissal program	Kristen and Oulerzak	8X	4/1/13	4/1/13	[Gantt bar]																														
DERA Grant assistance	Grant Administrator	8X	5/1/13	4/1/13	[Gantt bar]																														

Notes:

Appendix B

Figure B1. Maricopa County Non-Attainment Area A (Valenzuela, n.d.)



Notes:

Appendix C

Figure C1. Program Logo for Media Collateral



Notes:

Appendix D

Figure D1-6. Sample 5th – 8th Grade Lesson Plan

Car Idling Investigation
Problem-Based Learning Lesson Plan

How can we reduce car idling to protect student health at our school?

1

Investigation Overview

Background

Take a look around you. All that empty space is filled with something vital to your existence. Air. Clean air is as necessary for life as clean water, but students typically don't think about the invisible ocean of air that surrounds them. Neither do they think about harmful substances that are added to our air every day. Daily activities like turning on lights or driving a car create air pollution, which can be harmful to our health.

Many parents choose to drive their children to school. This results in long car lines with idling car engines during student arrival and dismissal times. Wait times may be ten to fifteen minutes or longer. Idling vehicles emit toxic air pollutants that may cause serious health effects such as cancer. Monitoring at schools has shown elevated levels of benzene, formaldehyde, acetaldehyde, and other air toxics during the afternoon hour coinciding with parents picking up their children (EPA, Idle Free Schools Toolkit). Children are especially sensitive to the damaging effects of air pollution because their lungs are still developing. They breathe faster and take in more air. If the air is polluted, they will take in more pollution as well.

The purpose of this Problem-Based lesson is to educate students about the health effects associated with car idling and to empower them to find solutions to reduce car idling at their school and within their community.

Table of Contents

Investigation Overview..... 2-4
Phase 1: Introduce the Problem..... 5-11
Phase 2: Collect & Analyze Data..... 12-19
Phase 3: Design a Solution..... 20-23
Phase 4: Implement your Solution..... 24-27

Acknowledgements

Authors:
Jenny Frank, Maricopa County Air Quality Department (MCAQD) Education Outreach Coordinator
Katrice Swenson, MCAQD Education Outreach Associate

Editorial Assistance:
Lorelei Ramirez, MCAQD Outreach Services Supervisor
Brian Hoffman, Maricopa County Education Service Agency (MCESA) Science and STEM Resource Director

Resources from MCESA's "Solve It: Air Quality" have been utilized in this lesson plan. Additional STEM resources are available at www.teachmeanearth.com.

CLEANAIRMAKEMORE.COM

2

Investigation Overview

Driving Question

- How can we reduce car idling at our school to protect student health?

Learning Goals

- Students will understand the impact of car idling on human health and the environment.
- Students will design and implement a process or system to reduce car idling at their school.

Standards

Core Ideas for Knowing Science
E1: The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface and its climate.

Core Ideas for Using Science
U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products.

Science and Engineering Practices

- Asking questions and defining problems
- Constructing explanations and designing solutions
- Obtaining, evaluating, and communicating information

Crosscutting Concepts

- Cause and Effect
- Systems and system models

Standards for Mathematical Practices (MP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Use appropriate tools strategically.

ELA Anchor Standards

R.1 Read carefully to determine what the text says explicitly and to make logical inferences from it.
W.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
W.7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
SL.1 Prepare for and participate in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
SL.4 Gather relevant information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

3

Investigation Overview

Investigation Notes

This lesson is divided into four phases: introduce the problem, collect & analyze data, design a solution, and implement your solution. Some phases may require more than one class period to complete. For example, you may wish to collect data over the course of several days or allow students to work on their solutions for more than one class period. You may also wish to assign some tasks for homework. The lessons are intended to be flexible. Please use pacing that is appropriate for your students and situation. A sample schedule is included below.

Phase 1
Introduce
the Problem

Phase 2
Collect &
Analyze
Data

Phase 3
Design a
Solution

Phase 4
Implement
your
Solution

Sample Schedule

Phase	Day	Tasks
Phase 1	Day 1	<ul style="list-style-type: none"> Complete Phase 1 Anticipation Guide Watch Background Video Read the Problem Statement Watch Sample car idling video and complete Phase 1 Lab Sheet
	Day 2	<ul style="list-style-type: none"> Design a Data Collection System Collect car idling and survey data (most likely outside of class) Analyze collected data
Phase 3	Day 4	<ul style="list-style-type: none"> Review Burn Cleaner, Bum Better Case Study
	Day 5	<ul style="list-style-type: none"> Students work in groups to design a plan to reduce car idling at school
Phase 4	Day 6	<ul style="list-style-type: none"> Review group plans with the whole class Create a whole class plan Assign tasks to students
	Day 7 and Beyond	<ul style="list-style-type: none"> Submit solution to Maricopa County Air Quality Department Implement the determined plan at your school After the plan has been implemented, collect data again to determine if there has been a reduction in car idling at your school. If there has not been a reduction, revise and implement a new plan.

4

Phase 1: Introduce the Problem

Overview

Students will learn that car idling produces air pollution which is harmful to human health and the environment. Students will discover the importance of reducing car idling at their school through reading the problem statement and analyzing sample car idling data.

Materials

- Class set of Phase 1: Anticipation Guide, one for each student
- Class set of Phase 1: Lab Sheet, one for each student

Preparation

- Ensure computer, projector, and sound are setup for videos
- Use the video, "Common Air Pollutants and their Sources": <http://www.youtube.com/watch?v=3451m>
- Use sample footage of a school drop off/pick up lane: <http://bit.ly/3W5P5VU>
- Copy a class set of Phase 1: Lab Sheet, one for each student
- Copy a class set of Phase 1: Anticipation Guide, one for each student

5

Phase 1: Introduce the Problem

Procedure

- Engage students with the Phase One Anticipation Guide. Read each statement as a class and ask students to rate each statement as true or false in the "Before Reading" section. Students will re-evaluate these statements after reading the problem statement.
- Tell students they are going to watch a short video (7 minutes) to learn more about air pollution. Students will list air pollution sources on the Anticipation Guide during the video. Show the video, "Common Air Pollutants and their Sources" Link to video: <https://bit.ly/3451m>
- Distribute copies of the Problem Statement. Students will read the Problem Statement with a partner or in a small group. They will re-evaluate the statements in the Anticipation Guide highlighting or underlining information from the Problem Statement. Discuss as a class using the following guiding questions:
 - Which statements from the Anticipation Guide were true?
 - Which statements were false?
 - What have you learned about car idling?
- Remind students that car idling is a source of air pollution. Introduce the Driving Question: How can we reduce car idling at our school to protect student health? Explain to students they will investigate car idling at their school and design a car idling reduction plan to protect student health.
- Tell students they will watch a video showing the drop off/pick up area outside of a typical school. While the video is not specific to their school, it is representative of what occurs at many schools each day.
- Show the Sample Footage of a school drop off/pick up area on Maricopa County Education Service Agency's (MCESA) Solve It Challenge. The video can be accessed here: <http://bit.ly/320C7VU>. At the beginning of the video, identify the yellow car in the line. Tell students to count the number of seconds the yellow car spends waiting in line. Stop counting when the car exits the school property. Convert the seconds to minutes by dividing the number of seconds by 60. (The yellow car waits approximately 3.6 minutes in line.)
- Working with partners, or in small groups, students will answer the Calculation and Analysis Questions on the Phase 1 Lab Sheet. Give students approximately 10-15 minutes to complete these tasks and then discuss the results as a class. Use the following guiding questions for the discussion:
 - Are there more or fewer cars in the video compared to our school's drop off/pick up line?
 - Do the drivers at our school idle their cars for approximately the same amount of time or longer?
- At the conclusion of the lesson, tell students they will spend some time investigating car idling during arrival and dismissal times at their school.

6

Notes:

Phase 1 Anticipation Guide

Name: _____

Directions: Read each statement. Decide if it is True or False. Circle your choice in the "Before Reading" section.

Before Reading	Statement	After Reading
True False	Car idling for one minute produces as much carbon monoxide as smoking one cigarette.	True False
True False	Idling wastes more than 6 billion gallons of fuel at a cost of more than \$20 billion per year in the United States.	True False
True False	Personal vehicle idling produces 30 million tons of carbon dioxide each year in the United States.	True False
True False	Air pollution is more dangerous for adults because they breathe faster than children.	True False
True False	Idling for more than 10 seconds uses more fuel than stopping and restarting your engine.	True False

Directions: Watch the video and answer the question below.

1. List all of the sources of air pollution that are identified in the video.

7

Phase 1 Lab Sheet

Name: _____

Directions: Use the data from the Sample Footage video to answer the questions below.

1. Approximately how many minutes was the yellow car waiting in the line?
_____ minutes
2. If the driver of the yellow car spends the same amount of time in line to both drop off and pick up their student, approximately how many minutes a day are spent idling in front of the school?
_____ minutes (from Question 1) \times 2 times per day = _____ minutes per day
3. There are approximately 180 school days in a year. If the yellow car driver idled the same amount every day, how many minutes would the car idle per year?
_____ minutes per day (from Question 2) \times 180 school days = _____ minutes per year
4. As you saw in the video, the yellow car was not the only idling car. If 200 drivers idled their car for the same amount of time as the yellow car, how many minutes would be spent idling at the school per year?
_____ minutes per year (from Question 4) \times 200 cars = _____ total minutes per year
5. Did you know that approximately 0.01 gallons of gasoline are wasted for every minute of car idling? Using your answer from question four, how much does car idling cost 200 cars per year if gasoline is \$2.75 per gallon?

Analysis

1. There are approximately 1,100 schools in Maricopa County. If all schools have arrival and dismissal procedures similar to the video, do you believe that car idling at schools is a major problem? Why or why not?

8

What's the Problem?

Name: _____

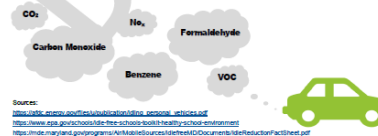
Directions:
1. Read the problem statement below.
2. Return to the anticipation guide questions and circle whether each statement is true or false in the "After Reading" section. Underline where you found your answer in the problem statement.

Car idling is a significant source of air pollution. Car idling occurs when a car engine is running but the car is not moving. While idling, a car is burning fuel and creating air pollution even though it is going nowhere. In the United States, idling engines waste more than 6 billion gallons of fuel, and costs more than \$20 billion each year! Contrary to popular belief, restarting your car does not burn more fuel than leaving it idling. In fact, idling for just 10 seconds wastes more gas than restarting the engine. But that's not all, personal vehicle idling produces 30 million tons of carbon dioxide each year. That is not good for the environment!

Did You Know?
Car idling for one minute produces as much carbon monoxide as smoking three packs of cigarettes.

Many parents choose to drive to their children to school. This results in long car lines with idling car engines during school arrival and dismissal times. Air monitoring at schools has shown higher levels of benzene, formaldehyde, and other dangerous chemicals in the air during the afternoon when parents are picking up students. When children are exposed to high levels of these air pollutants, they have an increased risk of developing asthma and other health problems. Children are more sensitive to the damaging effects of air pollution because they breathe faster than adults, and because their lungs are still developing. It is important to reduce car idling at schools to protect student health.

Your challenge is to find out why parents idle their car engines and design a solution to reduce car idling at our school.



9

Phase 1 Anticipation Guide

Name: _____

Answer Key

Anticipation Guide: Read each statement. Decide if it is True or False. Circle your choice in the "Before Reading" section.

Before Reading	Statement	After Reading
True False	Car idling for one minute produces as much carbon monoxide as smoking three packs of cigarettes.	True False
True False	Idling wastes more than 6 billion gallons of fuel at a cost of more than \$20 billion per year in the United States.	True False
True False	Personal vehicle idling produces 30 million tons of carbon dioxide each year in the United States.	True False
True False	Air pollution is more dangerous for children because they breathe faster than adults . Children breathe 20-40 breaths per minute . Adults breathe 12-18 breaths per minute .	True False
True False	Idling for more than 10 seconds uses more fuel than stopping and restarting your engine.	True False

Short Video: Watch the video and answer the question below.

1. List all of the sources of air pollution that are identified in the video.

Vehicle Idling
 Gas Powered Lawn Equipment
 Car and Diesel Truck Emissions
 Smoke
 Dust

10

Notes:

Appendix E

Figure E1. Idle Free Pledge – Public Pledge

Idle Free Pledge

I pledge that that I will turn off my vehicle engine on school grounds and anywhere else that I am waiting in my vehicle for longer than 10 seconds.

Name _____

Signature _____

Date _____

Teacher's Name _____



Notes: