

IN THE AIR

IN THE AIR

www.intheair.org

CORE Activity

"Matt Tackles
Air Toxics"

3-6 EDUCATION MODULE



 MISSOURI
BOTANICAL
GARDEN

Correlation with Education Standards Summary

CORE Activity “Matt Tackles Air Toxics”

For a narrative description of these standards and how they relate to the connecting activities please refer to the Teacher’s Guide.

National Standards

SOURCE: www.education-world.com/standards

Grades K-4:

NPH-H.K-4 .1 .4
NL-ENG.K-12 .3 .4 .7
NS.K-4 .1 .6
NSS-C.K-4 .5

Grades 5-8:

NPH-H.5-8 .1
NL-ENG.K-12 .3 .4 .7
NS.5-8 .1 .6
NSS-C.5-8 .5

Missouri Show-Me Standards

SOURCE: www.dese.mo.gov/standards

Performance Standards:

GOAL 1: 6, 10
GOAL 3: 1, 5, 6, 7
GOAL 4: 1, 7

Knowledge Standards:

CA 1, 3
HPE 5
SC 8
SS 7

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IN THE AIR

CORE Activity

OVERVIEW

In this chapter book, Matt and his friends discover many businesses, individuals, and government agencies actively protecting our environment from hazardous air pollutants. We can also play a part in protecting health by being aware of potentially harmful chemicals in our environment and reducing our exposure to them. Individual actions matter in protecting our own personal health and in protecting community and environmental health.

GOALS

- To provide scientific background needed to understand the relationships between personal choices and impacts on the environment and human health
- To remove misperceptions about air pollution and to demonstrate that there are many sources of airborne toxics
- To explore health risks posed by the environment in a safe and familiar context
- To empower students to make positive changes in habits to promote a healthier environment

“MATT TACKLES AIR TOXICS”

Recommended Grade Level
3-6
Preparation Time:
- Time will be needed to: - Read the Teacher's Guide. - Plan the integration of Connecting Activities. - Make copies and assemble materials.
Presentation Time:
Read aloud time is approximately 140 minutes.

OBJECTIVES

When the activity is completed, students will be able to do the following:

- List the three categories for air pollution sources and give one example of each.
- Identify a toxic as a substance that can harm human health.
- Identify three factors used to determine our risk from hazardous air pollutants.
- Explain how an air pollutant might pollute land and water.
- Describe the factors that contribute to risk from airborne toxics.
- Compare and contrast the community in the story and the one in which students live.
- Strategize a personal action to reduce his or her exposure to airborne toxics in a given situation.

MATERIALS

Photocopies of the chapter book, “Matt Tackles Air Toxics.”

PROCEDURE

The book may be used as a stand-alone activity or may be combined with one or more Connecting Activities or extensions. For third and fourth grades, we recommended that the teacher read the book aloud. Allow approximately ten minutes per chapter (chapter nine may be divided into three sections). If you choose to read the story to your class, it will require approximately fifteen sessions. These sessions do not include the Connecting Activities. If using the Connecting Activities with the story, please refer to the chapter-by chapter breakdown for planning purposes.

DISCUSSION QUESTIONS

1. Name an everyday activity that causes pollution. Are there ways that pollution from this activity can be reduced or avoided?
2. How does the town in the story compare to where you live? What are the similarities and differences? What are some examples of area, point and mobile sources in the story and in your community?
3. How can an air pollutant become a water pollutant? Give an example of how this occurs.
4. Our cars, trucks, and buses are directly responsible for about half of the toxics in our air. What were some actions people took in the story to reduce this type of pollution?
5. Does anyone do something that saves energy? What might be a simple action to save energy at home and school? How does saving energy prevent pollution?
6. Air pollutants, through deposition, can pollute our water and land. After naming examples in the story, can you think of more?
7. What determines your risk from pollutants?
8. We must read the labels on products that we use. What are some examples of products used in our homes that have warnings on the labels?
9. In the following scenarios, what specific things can you do to reduce your risks?
 - You are about to start a painting project.
 - You have broken a thermometer that contains mercury.
 - You need to dispose of a compact fluorescent light bulb that has burned out.
 - You are using household products to clean your house.

CONCLUSION

All of us share the responsibility to protect the air in our community and can participate in strategies to reduce our exposure to air pollution.

CHAPTER BY CHAPTER BREAKDOWN AND VOCABULARY

A glossary for the vocabulary words appears at the end of the book.

Chapter One

Vocabulary:

- | | |
|---------------------------|-----------------------------------|
| - pollutant | - Environmental Protection Agency |
| - hazardous air pollutant | - Clean Air Act |
| - airborne toxic | - asthma |
| - toxic | - heart disease |
| - adverse health effects | |

Connecting Activity One

- “Now You See It, Now You Don’t” is the activity that students in the story experience. If you wish to use this activity in your classroom do so by inserting the activity in the middle of the chapter or before introducing the book. One suggestion is to read the first part of chapter one aloud, conduct the activity, and conclude by reading the remainder of the chapter. (This activity is primarily targeted to younger students but may be useful for older students as well.)

Chapter Two

Vocabulary:

- | | |
|------------------------------|-------------------------|
| - volatile organic compounds | - deposition |
| - atmosphere | - mercury |
| - air | - Poison Control Center |
| - dispersion | - Scrubber |
| - precipitation | |

Extension

- Have the students make an inventory of household products that contain warnings or special instructions on how to use and dispose of them. Research safer alternatives. See <http://www.epa.gov/kidshometour/index.htm>.
- Locate the poison control information number for your area. Have students create labels to be posted by their home telephones.
- The national number for poison control is 1 800-222-1222.

Chapter Three

No extensions or listed activities.

Chapter Four

Vocabulary:

- | | |
|-----------------|----------------------|
| - mobile source | - benzene |
| - point source | - toluene |
| - area source | - xylene |
| - health risk | - methylene chloride |

CHAPTER BY CHAPTER BREAKDOWN AND VOCABULARY - (CONT.)

Connecting Activity Two

- Conduct “Pee-Yew! Is That You?” at the end of this chapter. The preparation time for this activity for the teacher involves creating the map tool, making photocopies, and assembling other materials. Students will need 15-30 minutes to color the map in preparation for the activity. The activity itself will take one 60-minute class period. An additional 30-minutes is required for the Town Hall Meeting option.
- For a community search of toxic air releases in your area by zip code, see www.scorecard.org from the Environmental Defense Fund. You can link to an EPA Envirofacts web page that will give you specifics about businesses in your area. Only large pollution sources that file a Toxic Release Inventory will be in this database (best for upper grade levels).

Chapter Five

Vocabulary:

- brownfield
- sewer

Extension

- Conduct a mapping activity in your neighborhood. Activity referenced is from EPA New England Region’s Project A.I.R.E. Lessons 9 & 10
See www.epa.gov/region01/students/teacher/aire.html.

Chapters Six and Seven

Vocabulary:

- shroud
- Ringelmann chart
- air monitors

Connecting Activity Three

- “In a Shroud of Smoke” should be introduced between chapter six and seven for the best effect. If the entire activity is to be done during class time, it will require two class periods to complete. This is a reading-based activity in which students analyze political cartoons from the 1930s and 1940s addressing smoke control in St. Louis.

Extension

- To learn more about an air monitoring program in St. Louis, see www.stlcap.org.

Chapter Eight

No extensions or listed activities.

Chapter Nine

Each interview section explores a different hazardous air pollutant.

Interview one

Students visit an auto repair garage and dry cleaner.

Vocabulary:

- transmission fluid
- antifreeze
- ethylene glycol
- propylene glycol
- biodegradable
- solvent
- tetrachloroethylene
- perchloroethylene (perc)

Extension

- Have students look in a phone book. Do any dry cleaners advertise environmentally friendly processes? For more information about carbon dioxide dry cleaning, see www.co2olclean.com.
- If the student's family owns a car, have students check the regular parking place for spots of oil or other fluids that may be leaking from the engine. If so, have them tell an adult.

Interview two

Students visit a furniture refinisher and special waste hauler.

Vocabulary:

- varnish
- fluorescent lamp
- landfill

Extension

- Have students check around their home for paint or varnish products. Did they find oil or water-based products? Is the product for interior or exterior use? What are the precautions for using the product? Are special instructions listed for the disposal of the unused product or empty container?
- Have students look at light fixtures in their home. Do any of them use fluorescent or compact fluorescent bulbs? Are special instructions included on packages of compact fluorescent bulbs? If so, what are they? If not, learn why. Contact your waste hauler or local environmental agency for more information.

Interview three

Students visit a busy business owner and golf course.

Vocabulary:

- pesticide
- DDT
- integrated pest management

Extension

- Have students look for pesticide products around their home (bleach and bathroom cleaners that kill molds and fungus are pesticides). What kind of warnings and precautions are listed on the label? Are special instructions listed for the disposal of the unused product or empty container? For a look at the Audubon Cooperative Sanctuary Program for Golf see - <http://www.auduboninternational.org/programs/acss/golf.htm>

Chapters Ten & Eleven

No extensions or listed activities.

Chapter Twelve

Extension

- Invite a member from the neighborhood business community to speak to the class about how they take responsibility for air pollution. Many state and local agencies have education programs available at no cost or low cost relating to air pollution or pollution prevention. Check with your water treatment facility, health department, solid waste management district, and other organizations such as the American Lung Association for speakers, field trip opportunities, and additional resources to use in your classroom.



MATT TACKLES AIR TOXICS

by Margaret Lilly

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Chapter #1



Matt slumped in his seat and readjusted his glasses as they slipped down on his nose. Kim and Erica were passing notes again in science. That was fine with Matt, as long as none of the notes were about him.

The teacher, Ms. Delgado, interrupted his thoughts. “Our next unit is related to the lessons we just finished on energy. What were the drawbacks of using some of the energy sources we studied?”

“I know,” Erica said. “Some sources of energy cause air pollution. Like from our cars.”

“You’re right. Today we will learn about air pollution in our community. We will focus on pollutants that can harm human health. Let’s begin brainstorming ways that we might detect air pollution. What kinds of things would you notice?”

Boring! Matt thought. As far as Matt was concerned, most of the stuff they learned in school was useless information. Ms. Delgado called on people as they raised their hands.

Maria was the first to answer, “You can see air pollution coming from smokestacks.”

“Smoke from cars,” Nathan said.

Ms. Delgado listed their ideas on the board and then waited patiently while everyone continued thinking.

“Smoke from lawn mowers,” Jasmine said.

“Cigarettes,” Kim said.

Jamal volunteered the next idea, “Stinky

smells?” The whole class laughed, but Ms. Delgado wrote it on the board anyway.

“Anything else?”

“Sometimes, when my dad puts gas in our lawn mower I can see the fumes evaporating into the air even before he starts the engine. Would that be pollution too?” Erica asked.

“It sure would. I think we have a pretty good list. Let’s create a working definition of pollution.” Ms. Delgado’s voice droned on into the background. Matt slumped even lower in his seat. His legs stretched out underneath the desk in front of him. With a couple more inches he could kick Nathan, who sat in front of him unsuspecting. The minutes crawled by on the clock.

“A **pollutant** is a natural or man-made substance in the environment that can damage living or non-living things,” Ms. Delgado said and glancing over at Jamal added, “and may include stinky smells. Some air pollutants are **toxic**. A toxic pollutant is something that can harm human health. An **airborne toxic** is a toxic that travels through the air. We can also call it an air toxic or a **hazardous air pollutant**.”

“I don’t get it. Why don’t we just call all of it pollution?” Jamal asked.

Ms. Delgado laughed, “That would certainly be simpler! Many of these terms are legal definitions. The people in the government who write the laws and the scientists who provide them with information have to be specific when they talk to each other about pollution. It’s important to understand what words they use as you’ll see when we start looking at all of the news stories about this topic. Now, I need you to think a little bit. What might be a good way to describe a

hazard?”

Jamal made a guess. “Something that’s risky?”

“Good,” Ms. Delgado said. “Being exposed to toxic air pollutants can put our health at risk. Over the next few weeks, we will be looking for stories on the news and in the paper that mention the **adverse health effects** from air pollution and ways to reduce our exposure to pollutants.” She turned away from the class to pick up a paper printout from her desk.

It was time for Matt to make his move. He extended his right foot and kicked Nathan. Nathan turned around and shot him a warning look. Matt tried to appear innocent and interested in the lesson. Ms. Delgado scanned their section of desks. Not able to determine who was misbehaving, she turned her attention back to the class but moved closer to Matt’s side of the room.

“The U.S. **Environmental Protection Agency**, or USEPA, is the government agency that oversees the quality of our air, land, and water. Its purpose is to protect the environment from pollution. One way it does this is to help create laws and make sure that people follow them. The laws that control air pollution are a part of the federal **Clean Air Act**. Laws and regulations that limit the amount of pollution in our air help protect us from these health risks. Remember, a federal law affects all of the states.”

Ms. Delgado unfolded the list. It was several pages long. “Tiny amounts of almost all of these pollutants are found in the air where we live. Each of these pollutants poses a specific threat to health. Some of those threats are mild, like irritated eyes; some threats are extremely serious, like cancer and birth defects. Our risk from a hazardous air pollutant

depends on many things: what chemical you are exposed to; how much of it you are exposed to and for how long. Young children, older adults, and people with health problems such as **asthma** or **heart disease** are more likely to be affected by air pollutants than others. I am going to keep a vocabulary list on the board. We can add words and definitions as we learn them.” Ms. Delgado began writing the list of words and definitions on the board.

Just what I need, Matt thought. *Another list of useless words*. He pulled his glasses down low on his nose and looked over the top of them at Ms. Delgado. She looked blurry. He slid his glasses back up. She was in focus. Down blurry, up focused, down blurry, up focused. Matt caught Maria looking at him. He stopped playing with his glasses and sat up straighter in his seat.

“What are you looking at?” he hissed. Maria looked away. The minutes dragged; even the second hand on the clock seemed frozen in place. Matt wondered if time in the entire universe had slowed or if it was just time in this classroom. He soon realized that the second hand was broken. Matt considered taking a nap on his desk but decided against it. He would save the nap until later, closer to the end of the period. Ms. Delgado was still talking about stuff that he was sure no one in class cared about.

“But Ms. Delgado, once pollution travels up into the air and away from us, it’s OK? I mean it can’t hurt us anymore, right?” Maria asked. Matt corrected his previous thought. Maybe the teacher’s ‘favorite’ students could get excited about this stuff. He felt fortunate that the category of favorite student didn’t apply to him. Other kids were good at school but not Matt. He was good at things that mattered to him. Right now he was really good at looking



out the window at the empty playground. A chain link fence sectioned off the uneven field where they played kickball. In left field was a steep slope. With just the right aim, you could get a home run even if you couldn't kick the ball hard. There was an ongoing debate during every lunch recess to make it a ground rule double.

Matt looked at the clock with the broken second hand. This was the longest, most boring class ever. At the front of the room, Ms. Delgado was still talking away.

"Some pollutants we can see and some we cannot," she said.

Matt looked out the window again. The air looked all right to him.

"If we can't see air pollutants, how do we really know they're there?" Erica asked.

"That's a good question and it leads us into our next activity." Ms. Delgado pulled tubs of prepared frosting and a box of animal crackers out of a grocery bag. She asked everyone to wash their hands because they would be working with food. At the mention of food, Matt became a little more interested.

"Absolutely do not touch anything to your mouth," Ms. Delgado instructed. "We don't want to spread germs." She divided the class into teams, grouped the desks together, and distributed plastic knives and paper towels to everyone. Each team was given four paper cups of frosting. The cups were labeled A through D. She placed a pile of animal crackers on a paper towel in the center of the desktops for each group. Ms. Delgado directed everyone to take four animal crackers, and using a plastic knife spread the crackers with samples from the four frosting containers.

"You may use all of your senses for your

observations except taste. Scientists never use taste to identify what something is. Never taste anything in this classroom unless you have specific permission to do so."

Matt rolled his eyes. Kids in their class would never be dumb enough to eat food in science class. They didn't even eat the food in the school cafeteria.

"I am giving you permission to smell your samples but I want you to know that when scientists use their sense of smell they do it in a special way that protects them from harmful substances." Ms. Delgado stood ready at the chalkboard at the front of the room and asked for their observations.

"Three of the crackers look the same," Jamal said, "but the frosting on one of the crackers has black specks in it." Matt eyed his crackers with suspicion. What was Ms. Delgado up to?

"One of them smells funny," Maria said, wrinkling her nose.

"Does everyone have a cracker that smells funny?" Ms. Delgado's gaze lingered on Matt for a moment, giving him an opportunity to answer. He hated when she did that. She couldn't make him participate. Matt tied his shoe and then looked at the light fixtures on the ceiling. He was getting over a cold and couldn't smell anything anyway. Other students raised their hands. Ms. Delgado called on Kim.

"The one that smells different has runnier frosting. Did you do something to the frosting?"

"That's for you to decide. Go ahead and fill out the first part of your worksheet. Please make sure that your descriptions are thorough." Ms. Delgado walked around the room monitoring the students' progress

and looked amused when she read some of the responses. When everyone was finished, she tallied answers on the board. Almost everyone believed that only two cups of frosting contained pollutants. Several people decided that all the frosting was polluted because they suspected that Ms. Delgado was playing a trick.

“So, what’s the right answer?” Nathan asked.

“Three of the paper cups have frosting that contains a pretend pollutant.” Ms. Delgado wiped the chalk dust from her hands. “In one container of frosting, I mixed in black pepper. In another, I added vinegar, and in the third I mixed in salt and baking soda. The paper cup labeled ‘B’ contains plain vanilla frosting. You may eat the frosting in cup B and the leftover crackers.”

“Can we eat the ‘polluted’ crackers, too?” asked Jamal.

“Well, you can if you wish. The frosting won’t hurt you, but it won’t taste good. While you are eating, please complete the last question on your worksheet.” Ms. Delgado began to clean up the materials.

Matt ate the cracker with the plain frosting. It tasted pretty good. He spread the plain vanilla frosting on a few more crackers and ate them. The cracker with the salty frosting looked just like the crackers he had just finished eating. Matt left it on the paper towel, believing Ms. Delgado when she said it tasted bad.

“Can I have your other crackers?” Nathan asked.

“Sure,” Matt pushed the paper towel across the desk. Some of the other boys were showing off for the girls at the back of the room eating the ‘polluted’ crackers and then pretending to be poisoned. Ms.

Delgado assigned them some clean-up work to settle them down.

At the end of the class she assigned homework. “I want everyone to be on the lookout for news stories about pollution or toxics. You don’t have to bring them in, but it will be interesting to see how many we notice. So, keep track of anything on television or in magazines and newspapers.”



Chapter #2



The next day in science, Ms. Delgado wrote a heading in large letters on the board, ‘What human activities cause pollution?’ Matt sat down in his desk and prepared himself for boredom. He looked out the window as gray storm clouds filled the sky. The custodian had blocked off the kickball field. Even if it didn’t rain they would need to find something else to do at recess. Ms. Delgado began the lesson. Almost every activity the class could think of caused some type of pollution.

“Air pollutants can be particles, droplets of liquids, or gases. Liquids that evaporate quickly are called volatiles. Some **volatile organic compounds**, or VOCs, are airborne toxics. Half of the VOCs in our air are from products used in our homes and small businesses,” Ms. Delgado said.

“Homes and small businesses!” Jamal exclaimed. “We don’t use any of that stuff at our house.”

“You may be surprised. Anything that evaporates quickly probably contains VOCs. Perfume is one example.”

“But Ms. Delgado, perfume isn’t a pollutant, is it?” Jasmine asked.

“Perfume is not an air pollutant, but in some circumstances it can be considered an unwanted substance.”

“My grandma says she’s allergic to perfume. Nobody can wear perfume or aftershave when she comes to visit,” Nathan said.

“She’s probably sensitive to some of the chemicals they use to make perfume. Many household products contain perfumes and VOCs as well. I bet your

grandma doesn’t use many strong smelling cleaners, does she?”

“No. She uses a lot of baking soda, and lemon juice, and vinegar.” Nathan said.

“That stuff is food!” Kim blurted out.

Ms. Delgado laughed, “Well, both of you are right. Yes, those are food items, but they also work for cleaning and they aren’t hazardous to use. At home, I use white vinegar and water as a glass cleaner.”

Matt began to doodle on his paper. Ms. Delgado could clean her mirrors and windows with peanut butter as far as he was concerned. There were more important things to think about. Jamal and Nathan were coming over to his house after school. They were helping the second grade Boy Scouts build birdhouses and tool boxes. The Scout meeting was tonight and there was still a lot of preparation to do. It would take at least two meetings to complete the projects.

Ms. Delgado moved over by the sink. She collected tubs and jars of stuff and placed them on the lab table at the front of the room next to a big aquarium that had some rocks sitting in the bottom of it. Next to it was a large round fishbowl. She filled an electric pot with water and plugged it in.

“Before we start learning about airborne toxics, we need to review what we already know about the **atmosphere**. Nathan, what do you remember about our atmosphere?”

“The atmosphere is a mixture of different gases,” Nathan said.

“Good! We call the mixture of gases, **air**. Does anyone know what those gases are?”

“Oxygen,” Erica said.

“Yes, Oxygen makes up twenty-one percent of our atmosphere. What else?” Ms. Delgado clunked some more glassware.

“Nitrogen,” Jamal said.

“Good! About seventy-eight percent of our atmosphere is nitrogen. What’s left?”

“Is it carbon dioxide?” Maria made a guess.

“Yes, carbon dioxide and other gases make up the remaining one percent.” Ms. Delgado filled the fishbowl with water from the sink. Then she put on heavy gloves and unwrapped a hunk of white stuff that she pulled from a small cooler.

“When air pollution enters the atmosphere in the form of a gas, it mixes with the other gases.” She dropped the hunk of white stuff into the fishbowl. A chorus of ‘Oohs!’ and ‘Oh, cools!’ rose from the class.

“I know what that is! It’s dry ice!” Jamal exclaimed. White vapor was bubbling up and over the edge of the fishbowl and drifting toward the floor. Students in the back of the room left their seats and crowded forward to see what was happening.

“Does anyone know what dry ice is?” Ms. Delgado asked.

“Frozen carbon dioxide,” Maria volunteered.

“That’s right!” The class looked at the fishbowl. The vapor looked like steam, but it wasn’t rising like steam. It was falling to the floor before it spread out into feathery drifts and disappeared. Erica was sitting in the front row. Vapor was all around her desk.

“Ooh! It feels cold!” she said.

“Carbon dioxide gas is invisible, but it’s cold enough to condense the water vapor in the air,” Ms. Delgado explained.

“It looks like a cloud,” Jasmine said.

Ms. Delgado nodded. “Much like a cloud. The vapor sinks to the floor because it is colder and denser than the surrounding air. As it warms up to room temperature, it begins to mix with the other gases in the air. Where does it go?”

“It just disappears,” Nathan said.

“Ah! Appearances can be deceiving. Think about it a little more.”

“Well, if it doesn’t disappear it’s still in the air,” Kim said.

“Yes, it’s still in the air, but it’s more diluted than when we could see the vapor. What might we find if we took a sample right now of the classroom air near the floor by Erica’s desk and compared it with a sample taken at the back corner of the room near the ceiling?”

“The sample by Erica’s desk would have more carbon dioxide in it,” Maria said.

“Good. What if I waited and conducted the sampling next week?”

“I don’t think there would be a difference. The air in the classroom would be all the same by then,” Jamal said.

“As the gases spread and get mixed up with other gases we call that **dispersion**.” Ms. Delgado added dispersion to the growing vocabulary list on the board. By the time the vapor from the dry ice disappeared, the water in the electric pot started to boil. The students returned to their seats. Ms. Delgado unplugged the pot and removed the lid.



“Now let’s look at some steam. Are there any differences?”

“The steam is rising up toward the ceiling,” Kim said.

“Steam is water vapor. The amount of water in the air is measured as humidity. The warmer air is, the more water it can hold. If it gets colder, the water vapor will condense and fall to the ground in the form of rain or snow. The word for this was on one of our old vocabulary lists.” Ms. Delgado started to write the word on the board. The first letter was a P.

“**Precipitation**,” some of the students called out as they recognized the word.

“Precipitation washes some pollutants out of the air and deposits them on land and into bodies of water. Particles of pollution can also just fall out of the air. When air pollutants contaminate land and water in this way the process is called **deposition**. It’s easy to remember because the pollution is being deposited.” Deposition joined the list of vocabulary words. “On the news was a story about pollution in our lake. Did anyone see that story?”

“I did. The reporter said it’s not safe to eat some kinds of fish from the lake because they have a lot of **mercury** in them,” Maria said.

“I don’t get it,” Nathan said. “Isn’t mercury that silver stuff inside thermometers?”

“Yes, some thermometers use mercury. Who has a thermometer with silver liquid inside of it?” Some of the students raised their hands. Ms. Delgado continued. “If a mercury thermometer breaks get an adult to clean it up. And whatever you do, never use a vacuum cleaner. A vacuum can spread harmful mercury vapor throughout your house. You can call the **Poison**

Control Center for directions on how to dispose of it safely. Mercury is a toxic, it can make people sick, and cause brain damage.”

“I still don’t get it. Is mercury from broken thermometers getting into our lake?” Nathan asked.

“No, the mercury in our lake is mostly from air pollution. Mercury is one of the pollutants released when coal is burned. We burn coal to make electricity. The particles of mercury are deposited onto land and into the water. Mercury and other pollutants can be a really big problem because plants absorb it. Fish eat the plants and absorb the mercury. The bigger fish eat the smaller fish and the mercury builds up all along the food chain until people eat the fish, which is when we absorb the mercury. Eating too many fish that contain mercury can harm your health.”

“What else is mercury used for?” Kim asked.

“It was used for many things before we knew how harmful it could be. Let’s see if I can think of an example.” Ms. Delgado thought for a moment. “Have you heard the phrase ‘Mad as a Hatter’?”

“Oh, yeah! Like the Mad Hatter in the story *Alice in Wonderland*,” Maria said.

“The phrase refers to some of the people who made hats out of felt made from beaver fur. To remove the hair from the beaver pelts, hat makers used a mixture of chemicals that included mercury. Hat makers gained a reputation for thinking and behaving in strange ways or acting mad. Saying someone was mad would be like saying someone was acting crazy today. Historians and scientists believe that mercury poisoning was responsible for

their odd behavior.”

Ms. Delgado moved to the lab table at the front of the room. “Our next activity is an experiment.” Ms. Delgado filled the aquarium with water. “Let’s pretend that the clear water in the fish tank is our atmosphere without much pollution. We will use some common substances to simulate different types of pollution in our environment. How do these items represent types of pollution in our air?”

She dumped some ground black pepper into the aquarium. Some of the pepper swirled on the top of the water the rest drifted slowly to the bottom of the tank.

“The pepper is like particles,” Kim said.

“Good. Particles can be dust from roads and farms, metals, or even soot from fires, and exhaust from buses and trucks.” Ms. Delgado picked up a carton from the table. “To see how gases disperse, or mix in the atmosphere, I am adding milk.” As she poured the milk it made clouds in the water, mixing until it turned the aquarium a uniform white. Ms. Delgado divided the class into small groups. She distributed a box of food coloring to each group and a plastic cup half filled with water to each student.

“Listen carefully. I am going to describe various activities. For every activity that you participate in, you will place a drop of food coloring in your cup of water. The water represents clean air. The food coloring represents different types of pollutants. We will begin with yellow. Yellow represents VOCs. Who has used nail polish or nail polish remover?” Ms. Delgado paused as two girls put a drop of food coloring into their cups. “Who has cleaned a window or mirror with window cleaner?” Ms. Delgado continued to read from her list: “Used spray paint? Been with someone when they have

filled the gas tank of a car or lawn mower?” Some cups of water were still clear. “The next color we will use is red. The red will represent pollutants from cars, trucks, and buses. Put a drop in your cup if you rode the bus to school or rode in a carpool. Put two drops in your cup if you rode to school in a car and did not carpool.”

“What if you rode your bike?” Erica asked.

“Riding your bike did not cause any air pollution, so you would not put a drop in your cup,” Ms. Delgado answered.

“What if you walked to school?” Jamal asked. Ms. Delgado gave him a narrow look. Jamal grinned. “Never mind,” he said.

Ms. Delgado continued the lesson. “The blue food coloring will represent mercury and other pollutants that are produced by electric power plants that burn coal. Place one drop of coloring in your water if you have used any of the following.”

Ms. Delgado began a long list, pausing in between each example for everyone to add their drops of coloring: toaster, hair dryer, electric oven or stove, CD player, television, radio, lamp or light fixture, hot water from an electric water heater, something from the refrigerator. The list seemed endless. The water in Matt’s cup darkened a lot. He looked around at other cups. Maria’s water was only a little purple. Nathan’s looked brown. Matt figured his was somewhere in between.

“See, my air is the cleanest!” Erica boasted. Her water was light blue. Matt looked at his own cup and wondered if Erica had cheated.

Ms. Delgado examined all of the cups and then took Erica’s and held it up to the light. “I believe you are correct.”



“But that’s not fair!” Maria protested. “She can walk to school. Some of us have to ride the bus or take a car.”

“You’re right, but let’s think about this for a minute. Just because Erica produced less pollution was she breathing cleaner air than the rest of us?” Ms. Delgado emptied Erica’s cup into the aquarium. “We all share the same air. The pollution we make as individuals affects everyone.” Ms. Delgado had the students empty their cups into the water. Little by little it changed color until it turned a purplish brown.

Once the tank was completely polluted, the students read an article in their science newspapers about different ways to remove the pollutants contained in smoke. One device was called a **scrubber**. A scrubber uses water and chemicals to clean smoke before being released from smokestacks.

“It would be pretty difficult to use polluted smoke in the classroom,” Ms. Delgado said, “but I did find an experiment where we can test the same idea using our polluted water and a filter.”

Using her lab book as a guide, Ms. Delgado built the filter for the pollution experiment, connected it to the pump, and placed it in the tank. She dried her hands and plugged it in. The pump made a bubbling sound. She turned on a light over the aquarium.

“Our experiment is completely set up. All we do now is make daily observations of the tank and monitor the improvements. Does anyone have any closing thoughts?”

“Yeah, it’s a good thing we don’t have any fish living in there!” Nathan said.

Chapter #3

After school, Nathan, Jamal, and Matt walked over to Matt's house. They discussed plans for that night's meeting and talked about their frustrations working with the younger kids.

"They don't want to read the directions. They just assume they know how to do everything," Matt complained.

"Today, we need to glue more tool box handles and paint the ones we've finished. They need to have an example to follow," Nathan said.

"Yeah, your kids need all the help they can get!" teased Matt. The boys started laughing. Last week, one of Nathan's Scouts put his toolbox handle on upside down.

As they approached Matt's house, it began to rain.

"Oh, man! I was hoping we could paint today," Nathan said as they broke into a run to keep from getting soaked.

"That's okay, we'll just paint out in my garage," Matt said. He called to his mom when they got into the house. "Hey, Mom we're here. We're going to be outside in the garage."

"Okay!" His mom called from a far corner of the house. "If you're going to be painting, make sure you leave the big garage door open and turn on the fan."

It was raining hard as the boys went outside and made a quick dash for the garage. Matt opened the large garage door and they watched the dark clouds move across the sky.

"Man, it's really coming down!" Jamal said shouting to be heard over the pelting rain. The gutters were overflowing. The bucket Matt's dad had placed underneath the downspout to catch the rainwater was full to the top. Thunder boomed and crashed. The intense storm was brief. Within a few minutes, the sky lightened and the pale sun glowed weakly through the remaining veil of clouds. The boys started to set up the work area. They left the garage door open as Matt's mom had instructed them to do. Nathan and Jamal located a stack of newspapers and the samples that needed painting.

While they were working, Matt's younger sister Katie came out the back door of the house. She was holding a container in her hands. Katie splashed through every puddle on the driveway and entered the garage through the big door.

"Matt! Look what I got from school today!" She held up a small fish bowl with a goldfish in it. "I'm going to name her Goldie. Look Nathan! Look Jamal! I've got a pet!" Katie was wriggling so much with excitement that water was sloshing out of the bowl. "Mom says I have to keep her out here until the fish tank is ready." Matt took the bowl from her and set it on the workbench. Katie surveyed the activity in the garage. "What are you doing? Can I help paint?"

Jamal, who was standing behind Katie, rolled his eyes, shook his head, and mouthed the word 'no' to Matt. Matt ignored him. Jamal didn't have little brothers or sisters. He thought little kids were a pain.

"Maybe some other time you can help us. Don't you think Mom is going to need your help with Goldie's new home?" Katie's disappointment about not painting vanished, and she started wriggling again. Matt was relieved that she had

something else to do.

“I’ll be back to check on you later, Goldie,” she said to the fish. Waving goodbye to the boys she ran out of the garage and splashed through the puddles again all the way to the house. Jamal closed the big door behind her, so they wouldn’t be interrupted again and the boys quickly returned to work.

Matt glued the wood handles together for the toolboxes while Nathan and Jamal carefully spread newspaper on the workbench to protect the surface from the paint.

“We’re kind of low on paint,” Jamal said, shaking a spray can. “I don’t think there will be enough here.”

“I figured we might need to buy more,” Matt said. “There is a can on the back shelf that has some leftover paint in it. When we run out of spray paint we can use that. There’s probably enough to get the samples done today. I can buy some more paint before the younger Scouts need it.”

Nathan found the paint in the far corner of the garage. It was an oil-based formula. “Hey Matt, do you have anything to clean the brush with?”

“There should be some brush cleaner on the same shelf,” Matt pointed to the can. Nathan located the container and some old rags. The boys worked steadily until they ran out of paint.

“I need to take a break,” Jamal said. “Boy, those fumes are really strong.” He sat down. Then Matt remembered the door and opened it to let some of the fumes out of the garage.

“I can’t smell anything,” he said. “I have a cold.”

“Yeah, I think the fumes are making me a little dizzy.” Nathan sat down near the open door far away from the drying projects.

“Whoa!” Matt’s mom said as she entered the garage, trying to fan the smell away from her face and holding her nose. “Didn’t you boys read the warning labels on the cans? Turn on the exhaust fan!”

“Sorry, Mom.” Matt switched the fan on. “We accidentally closed the door when Katie left and I forgot about the fan.”

“Your sister wanted to come out to see how you were doing. I’ll have her wait a little longer until some of these fumes clear. Dinner will be ready soon.” Matt’s mom returned to the house. Soon the fumes began to clear. “Why was your mom worried about your sister?” Nathan asked.

“She has asthma. She has trouble breathing around fumes and stuff. All kinds of things bother her. Cigarette smoke and cats, mostly.”

Jamal was back at the workbench cleaning the brushes. “Matt, what’s wrong with your sister’s fish?” The boys went over to the workbench. Goldie was lying on her side flopping and twitching at the bottom of the bowl. She twitched for a bit and then laid still. Her mouth was opening and closing really fast. Then she began twitching all over again. It was terrible to watch.

“I think she’s dying!” Nathan said.

“What can we do?” Jamal asked Matt. “Should I get your Mom?”

“No, I don’t think she could get here in time. We’ve got to do something now!” Matt looked around the garage. He spied the bucket of rainwater under the downspout.

“Somebody get her out of the bowl, we can put her in here.” Matt dragged the bucket into the garage spilling a good bit of the cold water onto his shoes.

“I’m not touching a slimy fish,” Nathan said.

Jamal grabbed the fish bowl and began pouring the water out through his fingers so that Goldie wouldn’t fall into the utility sink. The fish felt limp in Jamal’s hand. “I think we’re too late,” he said as he deposited her into the bucket of rainwater. Goldie was lying on her side, motionless at the bottom.

“Oh, man! I can’t believe we killed Katie’s fish!” Matt stared down into the bottom of the bucket. “Please, don’t be dead, don’t be dead.”

“I can’t understand how it happened.” Nathan was looking at the area where they had been working. “We were careful not to spray her bowl.” Suddenly, Goldie started moving again. There was a sigh of relief from the three boys.

“I think she’s going to be okay!” Jamal smiled.

“What a relief. I can’t imagine how I would tell Katie I killed her pet.” Matt examined the fishbowl. There was no obvious sign of paint on, or in it. He handed the bowl back to Nathan. Nathan turned the bowl over in his hands, he smelled inside it. “Hey, this really smells like paint fumes,” he said.

“It was the paint fumes? That makes no sense. Fish don’t breathe air. They live in water,” Jamal said.

“I don’t care what it was. I’m just glad Goldie’s okay.” Matt watched her swimming improve steadily; she was only a little lopsided now.

“Hey, you should see the bad stuff in this

brush cleaner and paint!” Jamal was reading the label on one of the cans. “There’s even a big warning about how to use it and how to dispose of the container.” They read the labels on the products they had used.

“It’s amazing they can even sell this stuff. I didn’t know it could be so dangerous,” Nathan said. He got out his notebook and copied down some of the chemical names and the warnings on a sheet of paper.

“And I was the one complaining about the second graders not reading directions,” Matt said, shaking his head. He was glad that his sister didn’t come into the garage when the fumes were so strong and especially glad she didn’t witness the Goldie episode. Nathan closed his notebook and put it in his backpack. Matt read the labels on the cans again as he put them back on the shelf. Many of the words he couldn’t pronounce. They were probably the name of the chemicals, he reasoned, but the warnings were clear enough. The chemicals in the paint and the cleaners could be dangerous if not used responsibly. Matt wondered if using the paint and brush cleaners around little kids was safe at all.

Chapter #4

The next day at school Nathan gave the list of chemicals to Ms. Delgado. She placed it in a file folder marked Air Research. The aquarium at the front of the room was still murky. Ms. Delgado looked in the instruction book to see if everything was set up correctly.

“It may take another day or so to become clear,” she said putting the book away. The black pepper was gone. Matt looked to see if it had just fallen to the bottom of the tank, but he couldn’t tell because the water was too cloudy.

“Today we will learn about sources of air pollution.” Ms. Delgado began organizing a list on the board. “Some sources of air pollution are natural; forest fires and volcanic eruptions are two examples. Humans have little control over pollution from natural sources. What we can control are the pollutants from man-made sources. They can be divided into three groups,” Ms. Delgado wrote them on the board: **mobile sources**, point sources, and area sources. “The word ‘mobile’ means that these sources of air pollution move around. Most of this pollution comes from trucks, cars, buses, and other forms of transportation. Mobile sources account for about fifty percent of the toxics in our air.” Matt never thought about the pollution from cars and trucks. Many highways passed through the city.

Ms. Delgado continued. “A **point source** is stationary. It doesn’t move. Point sources include factories, electric power plants, and oil refineries, where they make gasoline and other products. A point source can be confusing because you can point to many sources of pollution. Point sources produce large amounts of pollution. Other sources of pollution are classified as **area**

sources. These sources are smaller and may be spread over a wide area. Some examples of area sources are road dust, farming, fireplaces, dry cleaners, and furnaces to name only a few. Any pollution that cannot be traced to a mobile source or to one point source is classified as an area source.”

“Ms. Delgado, doesn’t the worst pollution come from factories?” Erica asked.

“It depends on what you mean. Different sources produce different toxics. How dangerous these pollutants are depends on many things. Who remembers what factors are used to estimate **health risk**, or how likely you are to become sick from being exposed to that pollutant?”

“What chemical it is,” Jamal volunteered.

“Good. What else?” Ms. Delgado wrote his answer on the board.

“I know,” Maria waved her hand to be called on. “How much of it you are exposed to and for how long.”

Jasmine spoke up next, “What if you’re a baby or an old person or someone with asthma? Doesn’t pollution make them sicker?”

“It might,” Ms. Delgado answered. “I’m pleased that you have remembered what we talked about in class. In our activity today, we will be using some of these ideas.”

She passed out maps, triangular pieces of transparencies, and brass paper brads. The class read a short story about a pretend town named Hopeful City. Everyone in the class was to investigate how clean the air was at three locations on the map and determine the best place to build a preschool. At first, it looked simple

to pick which part of the map would have the cleanest air, but the results surprised Matt. The place he first thought to be the best, ended up being the worst. Near the end of class, Ms. Delgado asked students to share their findings. Everyone came to the same conclusion.

“I’m sure glad we don’t have any stuff like that in our town. Our air would be really bad if we did,” Jamal said.

“Actually, all the airborne toxics on the map are found in our town,” Ms. Delgado said. “But we don’t have a refinery here,” objected Erica.

“You’re right, but some of the same pollutants that are produced at refineries like **benzene** are pollutants from gas stations and mobile sources like cars and trucks. In fact, you find benzene in cigarette smoke.”

“We don’t have a paint manufacturer,” Maria said.

“Right again, but volatile organic compounds like **toluene**, **xylene** or **methylene chloride**, are in products that are used in our homes and businesses. Our home products have directions that tell us how to use them to reduce our risk from the chemicals in them. Our risk depends on those three things we talked about: what chemical we are exposed to, how much of it there is, and for how long we are in contact with it.”

“Ms. Delgado. Yesterday after school, Matt, Jamal, and I were working on a Scout project. The brush cleaner had that xylene stuff listed on the label,” Nathan said.

“The fumes were pretty bad,” Matt added.

If Ms. Delgado was surprised that he volunteered a comment, she hid it well.

“I’m glad you read the label. It’s important to know what chemicals you are working with and how to use them,” Ms. Delgado said.

Jamal looked embarrassed. “We didn’t read the instructions until afterward. We figured we didn’t have to read the directions because it was just paint and we paint stuff all the time. Matt’s mom reminded us about using the fan and opening the door when the fumes got bad.”

Matt thought about the goldfish. Would Ms. Delgado know what happened to make Goldie sick? Neither Jamal nor Nathan mentioned it. Matt decided not to say anything about it either.

“It sounds like you learned an important lesson. Many of the products we use everyday contain ingredients that can be harmful if the products are used incorrectly.”

“We sure found that out. It’s good to read the label even if you use the stuff all the time,” Nathan said.

“Did you finish your project?” Ms. Delgado asked.

“Not yet. We have to buy more paint,” Jamal said. “We have another meeting planned to finish them.”

“There may be some products you can buy that are safer to use. Maybe you can research some alternatives during computer time,” she suggested.

During computer time, students looked up various airborne toxics on the Internet. They printed out page after page of information about dangerous chemicals and air pollution. Matt looked up paints and found there were safer paints to use. Even the local hardware store sold them.



Erica found an EPA web site that listed the businesses in their zip code that produced toxic air pollution. She printed the sheet and showed it to Ms. Delgado.

“This is an excellent piece of research!”
Ms. Delgado said.

All of the pages went into the air research folder at the end of class. Looking over the information, Ms. Delgado could see a problem. The folder was bulging, but with the exception of Matt’s paint information, no one found much that was useful. The topic was too general. Ms. Delgado looked perplexed. What, she wondered, could make this topic more meaningful to her students? She glanced at the list that Erica had printed of the area businesses and she had an idea.

At the end of the day Ms. Delgado handed out permission slips for a last- minute field trip. She didn’t say where they were going, but the method of transportation was walking. Matt made sure to remember his permission slip. With any luck they would get out of science for that day.

Chapter #5

Ms. Delgado was in a cheerful mood the day of the field trip. She whistled a tune as she turned on the light over the aquarium. “That looks a little better,” she said. The water was lighter in color even though Matt thought it looked greener somehow.

Ms. Delgado called the class to order. “Our field trip today is a walking tour. We will identify the potential sources of air pollution in our town.” On the board she tacked up several pieces of paper on which she had made a rough sketch of the neighborhood.

The class helped to fill in the street names and the locations they knew such as Robinson Park, Big Creek, and the high school. They decided to narrow the walking tour to the business district. Ms. Delgado took the pieces of paper down from the board and put them on a clipboard. Everyone lined up and went outside.

Beginning their walk at the playground, the students marked down all the buildings they passed along the route as they made their way to the center of town. They were careful crossing the streets because of the continuous heavy traffic. One of the public bus routes ran along Main Street. A bus passed by that was mostly empty. On the corner of School Street and Main was a furniture refinisher. Next door was the frozen custard store. The class begged Ms. Delgado to let them go in, but she said it wasn’t on the agenda. As the pages of the map were filled in, Matt was surprised at the number of businesses he’d never noticed before.

“This is where we get our dry cleaning done,” Jamal said as they passed Butler Cleaners. Exhaust was coming from stacks on the roof. Tony’s Italian Restaurant was

next door. Mr. Chen was the owner. He had donated delicious pizzas to the school for a fund-raiser last year. Everyone in school knew him. He came out to say hello to the class.

“Hello Ms. Delgado! Hi kids! Did you walk all the way down here just to visit me?”

“We’re taking a field trip of the neighborhood. We’re studying about air pollution,” volunteered Kim.

Mr. Chen’s eyebrows shot up. “Are you finding any?”

“We just started looking,” Kim replied. Just then a large grocery store delivery truck rumbled by. It made a lot of smelly smoke.

“Sometimes the automobile exhaust is bad out here. I think that’s a big part of our problem. Well, good luck on your field trip. Let me know what you find out.” He waved goodbye and returned to his restaurant.

They walked along the well kept grounds of the golf course for several blocks. On the lot next door, in stark contrast to the manicured lawns, an abandoned factory loomed.

“This property has been vacant for many years,” Ms. Delgado said.

The students looked through the old chain link fence at the empty hulk of a building. Through the opening in the front of the building some rusting barrels could be seen stacked up inside. Several had fallen over and were lying on the ground. The yard was littered with trash and old automobile tires. A ‘NO DUMPING’ sign was attached to the gate.

“It’s creepy,” Jasmine said.



“Why doesn’t somebody do something about this?” Maria asked.

“People think the property might be contaminated by some dangerous pollutants. I don’t think anyone has ever really investigated. Places like this are called **brownfields**,” Ms. Delgado said. “Most businesses would rather build in new areas and not be bothered with cleaning up old ones.” She moved the group along past the property.

Valley Service Station was at the end of the street. Mike, one of the mechanics, was working on a car that was up on the rack. He waved to the class as they passed by. It was only a short distance to Robinson Park. They crossed Big Creek at the bridge. The stream divided the business district from the park. Once across, they could see the rear entrances to the businesses they had just passed on the street. Sticking out of the opposite bank was a large storm **sewer** pipe that emptied into the water below.

“What’s the pipe for?” Erica asked.

“That pipe drains some of the rain water runoff from the downtown area,” Ms. Delgado answered.

“Oh, like the water from the street gutters,” Erica said. “I never thought about where it went.” The class watched the water flowing through the pipe. The water had an iridescent sheen to it. J

asmine lived nearby and hiked the creek trail often. “That’s more water than usual,” she observed.

“Probably because of the rain,” Ms. Delgado said.

“Is that some kind of pollution?” Erica asked.

“I’m not sure, I’ll have to take a closer look.” Ms. Delgado carefully climbed down the steep slope to the water’s edge and looked into the stream. After a few moments, she turned and looked along the bank. Spotting a safer place to for the students to make a descent, she invited the class to join her. The water looked different at the edge of the stream. If the light caught it in just the right way, they could see a sheen on its surface making little rainbows of purple and green.

“It’s pretty!” someone said.

“It may look pretty, but that is definitely pollution,” Ms. Delgado replied.

Jamal scanned the opposite bank. “I wonder where it came from. It’s probably something that was washed into the gutters by the rain.”

“That sounds like a possible explanation,” Ms. Delgado agreed. Making their way upstream they came to a bend in the stream. Here the flow of water slowed, creating two deeper pools. Sometimes, Matt and his friends would search this area for golf balls. The practice range of the golf course backed right up to the opposite bank.

There was a sudden commotion at the front of the group, “Yew! Gross!”

“Don’t you dare splash me!”

“Yuck! That smells!”

As Ms. Delgado pushed her way through the knot of students, Jamal headed to the back of the group successfully slipping past her.

“What’s going on?” Matt asked him. Jamal just grinned. He was wet from splashing in the creek.

“Okay, class! It’s just a dead fish.” Ms. Delgado herded the remaining students past the fish and found a path to the top of the bank. From the top, they could see dead fish floating in the water.

“I’ve never seen that many dead fish in the creek before,” Erica said. “Ms. Delgado, do you know what might have killed them?”

“That’s hard to answer. It could be many things. We’ll talk about it back in the classroom. Maybe we can figure it out,” she replied. The trail brought the class back to the school playground. The walking tour of the town was completed.

When they returned to their room, Ms. Delgado asked them to check that the sources for air pollution were marked on the map. “For homework, I want everyone to map the block where you live. Tomorrow, we will create a map of the entire neighborhood.”

When Matt got home after school, he rode his bike around the block and marked down the houses on a clean sheet of paper. His map was boring. He had no businesses in his part of the neighborhood. As an afterthought, he marked all of the cars he saw. On his way home Matt thought about the dead fish they saw on

the field trip. He still felt bad about the close call with Goldie in the garage.

The neighborhood map was huge when it was spread on the floor and assembled the next day. Matt thought it looked goofy because everybody’s map was a different size and some of the areas were missing. Ms. Delgado had students compare and contrast different city areas where people lived. The business district map with the places they visited on the field trip was tacked to the bulletin board. Looking at both maps, the class identified some of the possible sources of pollution in the town. Many of them were area sources such as Butler Cleaners, Like New Furniture Refinishing, and Valley Service Station. They colored the highways and main roads with highlighter markers to represent the mobile sources. Using colored push pins, the class marked the stationary sources on the downtown map. They used a pushpin to mark the storm water pipe that emptied into the creek. Ms. Delgado placed a question mark next to it since they didn’t know where the pollution was coming from.

“Ms. Delgado, what do you think killed the fish? Was it the water from the pipe?” Erica asked.

“I don’t know too much about fish and we don’t know what was contaminating the water, but that might be a possibility.”

When they were finished coding the map, Ms. Delgado stepped back to look at the results. “Wow!” she said. The black and white map was now a wash of color. Class time was almost over. Jamal and Erica helped Ms. Delgado fold up the big map of the neighborhood and store it safely in the



closet. Ms. Delgado was not sure how to use it yet.

Matt looked at the map on the bulletin board and saw more pushpins than he ever imagined. He was thinking about the field trip. Something was wrong about the water from the pipe being responsible for the dead fish. Matt walked through the field trip in his mind, from the time they got to the creek until the time they found the dead fish.

“Ms. Delgado!” Matt burst out, “It couldn’t have been the pollution from the pipe. The pipe was downstream of the dead fish.

That pollution would have never reached them.”

Ms. Delgado blinked. She thought for a moment, a look of mild surprise crossed her face. “I didn’t think of that Matt. You’re right. Our first guess was not based on all of the facts. It looks like we have to dig a bit deeper to find out what happened to those fish.”

Chapter #6

On Monday, the classroom was decorated with many posters with a pollution theme. The desks were arranged in a circle facing each other. Ms. Delgado's chair was in a part of the circle next to the windows. She seemed as enthusiastic as ever when she began class, but the aquarium still looked terrible and it was starting to smell. Matt thought that the water looked much greener and wondered if he was imagining it. No one else said anything. Matt decided he wouldn't either. A book was open on the lab table. It was turned to the page describing the experiment.

Ms. Delgado sat down in her chair to begin discussion. "I was thinking this past weekend about the information we've been able to gather. We did a good job investigating our community. What do you think about our results?"

Maria raised her hand, "There are a lot more pins than I thought there would be."

"And that doesn't even count the cars and buses and stuff," Jamal said. "Matt's the only one who included those on his neighborhood map."

"That's true, we know from our research that mobile sources are half of the problem," Ms. Delgado replied.

Jamal was called on next. "I thought our air was clean."

"How can our air be clean with so many people making pollution?" Kim said not bothering to raise her hand. "Look at all the sources of pollution we found."

"Our map does look a little overwhelming. To help us put our project into perspective, I would like to share a short story with you about air pollution. Please take out your Reading Response Journals."

Everyone took out their journals from their desks. Ms. Delgado picked up a booklet from her desk. On the cover was a drawing of a menacing figure wrapped in a dark cloak. Ms. Delgado explained that the cloak was a **shroud**, a covering that protects the bodies of the dead. Shroud can also mean something that covers up a view.

"As I am reading this story, I want you to picture the events being described and determine if the setting of the story takes place in the past, the present, or the future." Ms. Delgado turned off the classroom lights and returned to her chair. Using only the light from the window she began to read.

In a Shroud of Smoke

"Hi, I'm home!" Jim put his books on the bench by the front door and hoping to find a snack, headed for the kitchen.

"You're home early." His mom took a cake out of the oven.

"Yeah, they shut down the school. There won't be school tomorrow either. Sam went home sick this morning. I don't think he should've come to school at all when the air is this bad."

"I'll have lunch ready in a minute." She gave Jim's hand a little slap as he reached to pick at the cake. "That's for dinner. Start your homework and take off your smelly coat. I swear, it stinks bad enough outside, you don't have to bring it in here."



Jim took off his coat and hung it in the hall closet. He went into the living room and turned on the light. It was hard to believe it was only noon. Jim heard his dad come in the front door.

“You’re home early, too?” Jim’s mom said, as she entered from the kitchen.

“No point in working today. Traffic is all tied up. Even with the streetlights on you can’t see across the street. It just seems to get worse and worse, people are getting sick and some are dying.” Dad tossed the daily newspaper on the coffee table. “There’s an editorial in the paper saying that the city’s plan to clean up the air is working. I wonder if the editor has been outside today.” He pointed out the window. It was as dark as night.

“We’ll do what we can to help like we always do,” Mom straightened the sections of newspaper on the coffee table.

“It will cost us more money and it won’t do any good. Maybe if they had tried to clear the air twenty years ago, we might have had a chance.” Dad shook his head. “This problem is just too big and it’s gone on too long.”

When Ms. Delgado finished the story she turned on the lights. Everyone was quiet. “Kind of a bleak picture, isn’t it?” she asked.

Kim was the first to respond. “That’s just how I feel. I feel just like Jim’s dad. The problem of air pollution is too big and it’s too late to do anything about it.”

“So, when do you think this story takes place?” Ms. Delgado asked her.

Kim thought for a moment. “I think the story takes place in the present.”

“How many people agree with Kim that the story takes place in the present?” Several kids raised their hands. Ms. Delgado scanned the room. “Nathan, why do you think so?” she asked.

“We know our air is really bad. All of the news reporters say so.”

“Everyone knows that air pollution is a big problem,” Maria added.

Jasmine raised her hand. “My brother has asthma and sometimes in the summer when the pollution is bad he has to stay indoors.”

“Look at the tons of articles and news stories we found about pollution.” Kim said pointing to the tally marks on the bulletin board.

“I don’t think it takes place in the present,” Jamal disagreed. “I never saw pollution like that around here. Sometimes it’s hazy, but the air has never been as bad as it was in the story.”

Matt had a different idea. “I think the story takes place in the future. I think it’s supposed to scare people into cleaning up the air.” When it came time for a vote, most everyone thought that the story took place in the future.

“Why didn’t anyone choose the past as a setting for the story?” Ms. Delgado asked.

“Because everyone knows that pollution doesn’t get better,” Kim said. The stinky polluted fish tank gurgling at the front of the room seemed to confirm it. The map of the neighborhood tacked up on the bulletin board was a sea of brightly colored pushpins.

One of the pollution posters at the front of the room read in big bold letters “Hey Kids, It’s Up To You.” Matt felt as if a giant invisible weight was pressing down on the room.

Finally, Erica spoke up, “You never hear about anything getting better.”

“Adults always say it’s up to us kids to make things better,” Nathan said.

“It’s not fair when adults say that,” Maria complained. “We can’t change anything. Adults are the ones who make all the decisions.”

“It’s hopeless,” Jasmine concluded and the room fell silent.



Chapter #7

Ms. Delgado looked at the discouraged faces of her students. “Sometimes it can seem that way. I chose this story because I didn’t want to end our unit on a negative note and I thought you might be feeling overwhelmed. We do have some serious environmental questions facing us and none of them will be answered anytime soon. Pollution is a long-term problem but sometimes things do get better.” She picked up a large yellow envelope from a stack of papers on her desk. “The story that I read to you was based on a real event that happened in the past called Black Tuesday. It took place November 28th, 1939, in St. Louis, Missouri.” From the envelope she pulled out several photographs of city streets. The people wore old-fashioned clothes. The cars were old, too. A tremendous black cloud engulfed the scene. The pollution was much more terrible than the students had imagined from the story.

After looking at the first set of photographs, Ms. Delgado brought out another set, taken at the same locations one year later. The air was clear. Even the buildings looked cleaner. Everyone was amazed at how different the two sets of photographs were. After they finished looking, Ms. Delgado pinned them to the bulletin board at the front of the room. “For your journal entry, I want you to imagine how the character Jim was feeling in the story. Who can get our ideas started?” she asked.

Jasmine raised her hand. “I think Jim was feeling like we do. That nothing would get better.”

“Good. Write that down. When your entries are complete, we will learn more about

Black Tuesday and what people did to make the air cleaner. After our research we will write a new ending to the story.” Using booklets supplied by Ms. Delgado and working on the Internet, the students learned what was done in St. Louis to rid the skies of smoke.

“If everyone could look up here please,” Ms. Delgado held a chart up high, so that everyone could see. “I thought you might like to see one of the tools people use to measure how dark smoke is. Smoke from coal was a big problem in our cities. Most people burned coal to heat their homes. Many times, the coal was dirty and the fires were not properly built, so they made a lot of dark smoke. Factories burned coal too. This chart is similar to a **Ringelmann Chart**. In the 1940s, Smoke Inspectors in St. Louis carried a chart to compare with the smoke they saw coming from a smokestack on a building. If the smoke was darker than it was supposed to be, the home or business was in violation. Even today, people use tools like these to monitor air pollution in some situations.”

“But Ms. Delgado,” Kim interrupted, “What about the pollutants that can’t be seen?”

“Good question! Many of the same types of pollutants that we have in our air today were also in the air in the 1940s. Today, **air monitors** are used to make precise measurements of specific pollutants. Eliminating coal smoke was only a first step to cleaning our air. More work still needs to be done.”

When they were through with their research, they were ready to write their story using some of the facts they learned. The class decided to have the setting be a schoolyard and classroom similar to theirs.

“Ms. Delgado’s Class Story”

Later that afternoon Jim fell asleep on the couch. He had a strange dream. A boy about his age was shaking him by the shoulder.

“Wake up! My name is Tom and I’m going to take you on a trip to the future.” Jim and Tom flew high above the streets of St. Louis. They flew above the cloud of pollution and into the bright sunshine. All they could see below them was an oily dark smoke cloud that blocked the view of the streets and buildings.

“Wow, the air is so much better up here!” Jim exclaimed. Soon Tom and Jim could see a school playground below. The rest of Tom’s class greeted them as they landed. They told Jim all about a unit they studied on air pollution and how they read a story about Black Tuesday. Jim never heard the term air pollution before. Everyone he knew called it smoke. The kids played a game of kickball together. Jim couldn’t believe how bright and sunny it was.

“It’s amazing,” he said. “Even the buildings are cleaner. How did this happen?”

The class told him about how the people in St. Louis stopped burning dirty coal and switched to cleaner fuels. In the following year of 1940, the smoke from coal was greatly reduced. St. Louis was so successful that people from more than 230 cities across the nation sought advice on how to clean up their air.

“Keep watching your paper Jim, big things are coming,” Tom said.

“I can’t believe it. People want the air to be cleaner, but cleaner coal costs more money. I didn’t think anyone would change. I can’t wait to go back and tell my folks and

my friend Sam. This is great!”

“We still have a lot of pollution in our air,” Sue said. “Sometimes my brother has a lot of trouble breathing when it’s bad.”

Jim looked at her with a serious expression on his face, “I know this might sound strange coming from someone living in the past, but pollution can get better. It’s gotten better already.” His face broke into a great big smile. “This was a great trip. Thanks for having me.”

When he awoke, Jim looked out the window and was disappointed to see the cloud of smoke. The dream had seemed so real. He closed his eyes and imagined the bright sky. Jim was determined to do all he could to stop polluting the air.

When the story was finished, Kim raised her hand. “So, the answer was the people believing they could make a difference?”

“That was an important part of it. That’s why we are learning about how we can reduce the amount of pollution we are making today,” Ms. Delgado said.

“Yeah, but if I take the bus or ride my bike instead of driving in a car, I can’t see it making a difference. There’s still a lot of exhaust,” Matt objected.

“That’s true, but remember the smoke problem in St. Louis didn’t get better overnight,” Ms. Delgado reminded him. “It took the continuing efforts of many people to improve the air.”

“But even if everyone in our class tried their best to prevent pollution it wouldn’t make a difference, not even in our own neighborhood. Look at the places that we marked on our map! How do we get all of them to stop polluting?” Jasmine asked,



pointing to the wall. All eyes turned back to the map covered with pushpins. It was as overwhelming as ever.

Matt looked at the fish tank and thought about all the drops of food coloring. He raised his hand. "It's not just the businesses that are polluting the air, it's us too. Wasn't that the point of the story and all of this stuff we've been doing?"

"I think factories make more pollution than schools or homes do," Kim said, "Their smokestacks are bigger and you can see all of the pollution they're making."

"Some of that may just be steam, we really don't know what—"

"There are a lot more homes than businesses," Maria said to Kim, cutting Ms. Delgado off in mid-sentence.

"Sometimes Saunders Factory makes a terrible smell!" Kim exclaimed. "We can't even go outside our house because it stinks!"

"But that's just Saunders. It's not all businesses," Maria's face was getting red.

"All of them pollute. That's why our air is so bad!" Kim shouted.

"That's not true! My uncle owns a factory and they don't make a lot of pollution!" Maria shouted back at Kim.

"Class!" Ms. Delgado's voice rose above the students. "Everyone needs to calm down." She waited for the class to quiet. "Maria, no one is accusing your uncle or anyone else of anything. Kim, we need to be more careful about not making statements we can't support." Maria and Kim glared at each other. Ms. Delgado continued, "I think Matt said it best. Air

pollution is everyone's responsibility. We all contribute to it." She stepped back from the bulletin board and studied the map. "All we did is to mark the places that could be a potential source of pollution. We're making a lot of assumptions. We don't know what the businesses are doing to the air." Ms. Delgado leaned against her desk and folded her arms in front of her. She raised one eyebrow and looked at the class. Kids looked at the floor, at the ceiling, or out the window. Anywhere but at Ms. Delgado.

Finally, Matt spoke up. "Maybe we should ask them."

"That would be the thing to do, but it would be a large undertaking. I don't think we'll have the time to do it. We only have a few more days to finish this unit." Ms. Delgado straightened papers on her desk, preparing to move on to the next subject.

"But Ms. Delgado, you said it was important to learn about our community. We can't stop now. Look at the pollution we found," Jasmine said.

"Do those people even know that they're polluting? Someone should tell them what they're doing to our air," Kim declared. Maria rolled her eyes.

"I'm sure that the business owners are aware of the pollution they produce." Ms. Delgado said, glancing at the clock. "Okay, we are out of time for this topic today." She hated cutting off the discussion but she had no choice. "We need to finish up our maps tomorrow and start thinking about writing our final reports. Now we will move on to our next topic." There was some grumbling, but Ms. Delgado ignored it.

"Our principal has requested that our class be in charge of the next edition of the school paper. We can select any issue

that we would like. The teachers thought of several that might work well. Whatever topic we choose, our articles will need to include interviews.” Ms. Delgado began making a list on the board of the teacher’s ideas: student council, student of the week, sports, what students like to do on vacation.

“What about interesting field trips?” Nathan suggested.

“Good,” Ms. Delgado added field trips to the list.

Jamal offered the next idea, “Why don’t we do our newsletter on pollution in our community?” he said. Ms. Delgado put down the piece of chalk. She didn’t add the suggestion to the list on the board.

“I’m not sure that would be the best topic for the school newsletter. The newsletter is supposed to be of interest to everyone in school. We should cover school events.”

“But Ms. Delgado, everyone at our school lives in our community. I think they would be interested in our air,” Nathan said.

“Every issue of the school paper is always the same,” Jasmine complained. “Why can’t we write something different for this one?”

Ms. Delgado looked at her students. She knew they were on the verge of learning something important about their community, but there was only so much time left in the school year and too much material for her to cover. She thought about the incomplete mapping activity and the failing fish tank experiment. Taking a moment, she flipped through her plan book. They had already spent more time on this unit than she had intended. How could she squeeze any more time into

her day, or days, into the school year? Somehow, she had to make this work for her students.

“The principal will want to know what we’ll cover and why it’s important to the school before she will approve the newsletter. We will only have time in class to write the articles. I don’t think we will have time available to conduct additional research.” She paused and then shook her head, “I don’t think it’s going to work.”

“But we don’t know the whole story without talking to the businesses. What if we spent time on it after school?” Matt suggested.

“Would anyone be willing to do that?” Ms. Delgado looked surprised when several hands went up. Even Maria and Kim volunteered. Matt guessed they were over being mad at each other. Ms. Delgado laughed. “Well then, I guess there’s no harm in speaking with the principal.” The class cheered.

For the rest of the period they developed their strategy. Matt, Jamal, Jasmine, Nathan, Kim, and Maria all volunteered for the interview teams that would contact some of the businesses they saw on the field trip. Erica was to research background information on the Internet. They set the first meeting for the next day after school.

Chapter #8



At the first meeting Erica showed no enthusiasm as she looked through the class folder of research. “There’s too much information here. I can’t make any sense of it. The names of the pollutants are too long and I can’t pronounce any of them. How are we going to explain it to somebody else if we don’t even understand it ourselves?”

The students thought. The green murky aquarium bubbled away in the background.

“Maybe if we figure out what basic stories we need to include first, we’ll get an idea of what else can fit in,” Matt suggested.

“I think we need an article about air pollution and a description of the field trip,” Kim said.

“I agree,” said Maria, “We have to be careful to use simple explanations and to use words everyone can understand.”

Jamal was looking at the map. “We can’t put every business in our newsletter. We don’t have room.” After some discussion, they narrowed the number of businesses to interview.

“What are we going to ask them about anyway? You just can’t walk into a business and accuse them of polluting,” Matt said. “We won’t get much of a story that way.”

“We need to find a positive approach. If I owned a business, I wouldn’t want people saying negative things about me,” Nathan said.

“If they’re making so much pollution, maybe they shouldn’t be in business,” Jasmine said.

“People buy the stuff they make,” Jamal said.

“Well, maybe people shouldn’t. Not if it makes pollution,” Kim said.

“When people use electricity, it causes pollution,” Erica said. “That’s not going to make me stop using it. It doesn’t stop you from using it either!”

Matt interrupted them. “I’m tired of everybody arguing about this. Everybody does stuff that makes pollution. I don’t think anybody has the answer to all of this, but we can do something to make it better. Maybe knowing that using electricity makes pollution will make someone turn off the lights when they don’t need to use them. We need to quit blaming each other and think about this in a different way.”

“I told my uncle about our field trip,” Maria began. Kim rolled her eyes and heaved a sigh. Maria did her best to ignore her but a flush crept up on her cheeks as she continued. “At his factory, the employees are trained to use chemicals safely. He said that he put in new equipment to make it safer for the workers and to cut down on the amount of pollution that the factory makes.”

Matt’s face brightened. “That’s exactly the approach we have to take! We write about that! What businesses are doing to make things better to protect our air.”

Erica caught some of Matt’s enthusiasm. “That’s a good idea. I’m sure business owners would want people to know about the positive things they are doing.”

“We could offer a copy of our newsletter to the people who work downtown,” Jamal said.

“I don’t want to go and talk to people,”

Erica said. "I think I'll just work on the computer stuff. We could offer the newsletter by e-mail too. That would cut down on the number of copies we have to make."

Maria took notes of the plan. "I think we should include the story about Black Tuesday." Everyone agreed that was a good idea.

"We need to know what chemicals each business uses, so we know what to ask about when we interview them," Jamal added.

"There is information in the research folder on that." Erica pushed the folder of papers over to him.

"Some places we can probably skip," Matt said, looking at the map. "The frozen custard shop is probably not a big source of pollution," Matt observed.

"We can probably cross the golf course off the list, too," Maria said.

By the end of the meeting they narrowed the potential interview list to four businesses: Valley Service Station, Saunder's Manufacturing, Butler Cleaners, and Like New Furniture Refinishing.

Matt arrived home after school and made himself a snack. He watched Goldie swim in her fish tank while he ate. She seemed all right after her ordeal in the garage. Not knowing what exactly happened bothered Matt. It reminded him of something he heard in class—deposition, that was it! Ms. Delgado talked about toxics from the air polluting water. Droplets of the brush cleaner or spray paint must have gotten into the water of Goldie's bowl. Matt began to think about the dead fish on the field trip. What if an air pollutant had landed in the creek? He wondered if someone in the neighborhood knew what had happened.

Chapter #9

Interviews: Team One

At the next newsletter meeting the teams were ready to conduct their interviews. Kim phoned Valley Service Station. Mike, the mechanic, answered. He told the kids to come on over. He would be more than happy to talk with them. The students arrived a short time later. Mike, just finished with a customer, wiped his hands on a rag. He bought the kids each a soda from the vending machine. The garage smelled like engine grease and tires. Kim briefly described the newsletter and the class project.

“I saw you on your field trip. How did that come out?” Mike asked.

“That’s partly why we’re here,” Jamal began. “When we were walking in the creek bed we noticed some oily stuff in the water coming from the storm drain. We want to find out what might have washed into the creek. The storm sewer comes out behind the back of your property.”

Mike gave the kids a long, hard look. Kim was worried that they may have made him angry.

“You know, a large area of town drains into the creek through that same pipe.” Mike took a binder out from a shelf under the counter. He paged through the book. “No, nothing happened here,” he said. “The stuff you saw in the creek was probably just the rainwater running off from the streets. Lots of cars leak oil or **transmission fluid**. People don’t stop to think about where all of the leaking oil and fluid goes. It drips onto the streets and eventually gets washed into the storm sewers. Some of it ends up polluting our creeks and streams.”

“What’s in the book?” Kim asked.

“Let’s say a gas truck driver or a customer spills gasoline on the driveway. We call the fire department and they come out and take care of it. Anytime there is an incident or a spill that involves a hazardous material we keep track of it and write it in here.” Mike put the book back on the shelf.

“What other kinds of chemicals do you use here?” Jamal asked, looking around the garage.

“You name it. We use a lot of cleaners and **lubricants** when we work on cars. Most service stations train their employees to handle chemicals safely and to dispose of them properly.”

“My Mom gets the oil in her car changed here. What do you do with it?” Kim asked.

“Oil is a good example. Many things we dispose of in a special way. You can’t flush everything down the drain or throw it away in the trash. When we change the **motor oil** or transmission fluid in a car, the used oil or fluid is collected and put into a large tank out back. In the winter we can burn some of it in a special furnace to heat our garage. What we don’t use goes to a company who comes and pumps it out of our tank. They truck it back to their place, filter out the impurities, make it usable again, and sell it to someone else.”

“Kind of like recycling,” Kim said.

“Exactly. All of the **antifreeze** is collected too, but that’s handled separately. Antifreeze can be really bad to have leaking in your garage. Especially if it has an **ethylene glycol** base. The antifreeze has a sweet taste and can poison animals and children. When we change antifreeze, all of the old antifreeze is collected and

disposed of properly. It, too, can be made into something that can be used again.”

“How do you keep track of all of those names? They all sound the same to me.” Jamal was having a hard time spelling the names of the chemicals in his notebook.

“It’s important for people who work with chemicals to understand what they are and how to handle them. We have an information sheet with safety information for every product we use in our shop. It lists all the health risks and precautions for the product and instructions on the proper use and disposal of the chemical.” Mike pulled two sheets of paper from the notebook. One for ethylene glycol and one for **propylene glycol**. “Both of these chemicals are used in deicers and antifreeze. Ethylene glycol is a toxic. As little as one teaspoon can kill a cat. Two tablespoons can injure a child. We also use antifreeze that has a base of propylene glycol. It’s less toxic and in most cases it works just as well. Propylene glycol is not only used in antifreeze; small amounts are even used in food products. It’s also used in cosmetics and medicines.” Mike walked them over to the big workbench. On the workbench was a large covered tank.

“One of the positive changes we made in the shop was switching the chemical we use to clean some of our car parts. Before we made the change, we used a chemical called xylene. Xylene is a chemical you can buy at the hardware store. People use it to dissolve grease and clean up paints and glues. If you breathe too much of it, it can cause headaches and confuse your thinking.” Mike indicated a drum of cleaner in the corner. “If I find a safer product, I’ll use it. Most of the time it even saves me money.”

“Hey, that green cleaner is the same stuff

we use at home,” Kim said.

“It could be,” Mike said. “You can buy smaller amounts of this at the hardware store.”

“My dad uses it to clean a lot of stuff. He says it’s really good at breaking up grease,” Kim said.

Jamal read the label. “What does **biodegradable** mean?”

“Biodegradable means that when it is disposed of it can be broken down by microbes into harmless substances. The products we used before this had to be handled by a disposal company. Now we use this alternative product and water. It saves us a lot of money because it’s cheaper, and after we filter the oil and grease out of it, it’s safe enough to flush down the drain.”

“This will make a great story,” Jamal said as he finished his notes. “Thanks for letting us come to interview you.”

“Good luck with your newsletter. Can you send me a copy?”

The students promised they would.

When they arrived at Butler Cleaners a short time later, a sign in the window said that the store would be closed for remodeling and would not open for a couple of weeks. Jamal and Kim were disappointed. They had read the research information about the chemicals most dry cleaners used and were eager to ask some questions. Most of the chemicals were hazardous air pollutants; others caused environmental damage if they got into the groundwater. They looked in the window of the darkened shop. There was a man far in the back. Jamal knocked on the window.



The man looked up and saw them. He came to the front of the shop and unlocked the door.

“Do you need something?” He looked annoyed.

“Are you Mr. Butler?” The man nodded. “My name is Jamal and this is Kim. We’re writing a school newsletter about the businesses in our community,” Jamal said.

“What does this have to do with me?” Mr. Butler asked. A workman from the back of the store motioned to him. “Excuse me a minute.” Mr. Butler went back into his shop leaving Jamal and Kim at the door. They exchanged uncomfortable looks.

“Maybe we should leave,” Jamal whispered.

“No, it’ll be okay. He’s coming back.” Kim took the notebook from Jamal. Mr. Butler returned to the front door. He was obviously busy.

Kim spoke, “We did some research on the chemicals used to dry clean clothing and would like to ask you some questions about protecting the environment.” There was a pause — then Mr. Butler smiled.

“You’re kidding. I would be thrilled to talk with you. Come on in the back.”

Kim and Jamal were surprised by Mr. Butler’s reaction. They followed him to the back of the shop. One of the huge machines was pulled out from an opening in the wall leaving pipes and wires exposed. Several men were disconnecting the machine and taking measurements. A large crate sat near the back of the workroom.

Mr. Butler found stools for them to sit on. “What do you want to know about dry

cleaning?”

“We really don’t know much about it. Just a little about the chemicals that are used,” Kim said.

“Let me tell you about the traditional process of dry cleaning,” Mr. Butler began. “When you wash your clothing at home you are using water as your **solvent**. A solvent is usually a liquid that dissolves substances. Water is one of the most effective solvents around. Soap and detergent just help it along and make it work better. Some fabrics don’t wash well in water. Wool is one example. When you take a wool suit to a dry cleaner, they wash the suit in a different type of solvent; usually a chemical called **tetrachloroethylene**. If used incorrectly, the chemicals used in dry cleaning plants are bad for the environment and hazardous to workers. Another name for this chemical is **perchloroethylene** or **perc**.” Kim wrote the information down on her paper.

“A problem can occur when perc is released into the air either by accident or when it leaks from poorly maintained equipment,” Mr. Butler said. “Perc can cause health problems for people who are exposed to it for a long time. It can cause kidney and liver damage. Some scientists believe that it may even cause cancer. Come look at the pictures of my family.”

The students followed him to the area behind the counter. Many photographs were displayed on the wall.

“This is my grandfather. He began this business almost forty years ago.” An old black and white photograph showed a young man cutting a ribbon in front of a storefront. “My uncle inherited the business and I bought the business from him. He just recently retired because of health problems. No one blames the dry cleaning

business for my uncle's condition, but it started me thinking about my employees' welfare and about my own health."

Many photographs on the wall were of Mr. Butler's uncle posing with local celebrities who were regular customers of the shop. "I'm always careful about how chemicals are handled here. I make sure that my equipment is kept in tip-top shape. I do know of a shop where the workers were complaining of dizziness, headaches, and burning eyes. When they checked the equipment they found some of the chemicals were leaking. The shop owner cut some corners, and saved a little money by not maintaining his machines, but you can't do that when you're working with this equipment. These chemicals are nothing to mess around with."

"When we were doing research, dry cleaners were listed in the phone book as 'perc free'. What does that mean?" Jamal asked.

"Good question. You two have really done your homework. When it came time to replace my machines, I investigated some of my options." Mr. Butler pulled a folder out of a file drawer. "At first I thought about just using a different type of chemical that had a petroleum base. That's what the majority of the 'perc free' cleaners use. From an environmental viewpoint, petroleum solvents are only a little better than perc, and I wanted to make a real difference." He led them to the large crate at the back of the room. "So I did more research. I thought about using a wet-clean process that is showing some good results. Most of the wastes from my shop would be water. Using a wet-clean system would increase the amount of wastewater that I already produce now with my laundry. I didn't like that idea much either. Then I found this system that uses carbon

dioxide instead of chemicals to clean the clothing." Mr. Butler unfolded a brochure that described the entire process. "Ninety-eight percent of the carbon dioxide is recovered from the clothing and recycled to be used again. It's better for the clothes because they don't have to be heated. The clothes just need to be brought up to room temperature—"

"And the carbon dioxide becomes a gas! We learned that at school," Kim said.

"That's right! The best part is that after cleaning, no chemicals or odors are left in your clothing." Mr. Butler stood up and walked them to the door. "It has been a real pleasure speaking with you this afternoon. My shop should re-open soon. Stop by and see me at the Grand Opening!"

"OK, we will. We'll send you a newsletter, too. Thank you for talking with us," Jamal said and he and Kim left to return to school.

Interviews: Team Two

Jasmine and Nathan arrived at Like New Furniture. As they entered the shop, a little bell attached to the doorway jingled.

"Just a minute!" A woman's voice called out from the back. The shop was dim. The main section was filled with all kinds of wooden furniture; tall antique dressers, dining room tables, china cabinets, and nightstands filled every available foot of floor space. The kids poked around, looking at the variety of furnishings. All of it gleamed. They smelled chemicals in the air.

An older woman came out to the counter and smiled at the students. "My name is Ms. Lee. How can I help you?" Nathan and Jasmine introduced themselves and



explained their project. “So, you want to know how I address the issue of air pollution?” The students nodded. “Hmm. No one has ever asked me about it before. Come into my workshop area.” Ms. Lee escorted them back into the working area. Here the chemical smell was stronger. She took a ring of keys from her pocket, unlocked a metal storage cabinet, and opened the door. Inside, various cans of chemicals were neatly lined up on the shelves.

“The bad news is that some of the chemicals I work with are toxic. If I am restoring an antique, I haven’t got many good alternative products to use.” Ms. Lee pulled a can down off the shelf and showed the label to them. “The most important thing you can do to protect yourself and the environment is to know what you are working with and to follow the safety precautions to the letter.” She placed the can back on the shelf. “Whenever possible, I substitute a safer chemical. I use the charcoal filter mask when I’m working on a big project.” A pair of heavy gloves, and a facemask with filters attached to it were on the workbench. “And, I always make sure to have a lot of ventilation even if the job is small.” A huge exhaust fan was mounted in the back wall. Ms. Lee flipped a switch and the fan roared to life. The students covered their ears. Ms. Lee laughed and turned off the fan.

“What a great fan!” Nathan exclaimed.

“When I first began my business I shared space with another refinishing company. It was horrible! They paid no attention to the fumes in the shop and they were careless when it came to safety. Every night I went home with a headache and every time I got sick with a cold, the cough seemed to hang around forever.”

“You think it was the fumes?” Nathan asked

“I believe it was,” Ms. Lee said.

“Didn’t the fumes make the other people sick, too?” Jasmine asked.

“I can’t say. Maybe I was more sensitive than the other people who worked there. I imagine they would laugh out loud if someone questioned them about protecting the environment.” Ms. Lee shook her head. “The city would send someone out when a neighbor complained, but no follow-up occurred. As soon as I could, I got my own shop.” She rooted around in her desk. “I have some pamphlets that you may be interested in. These list some of the safer alternatives to toxic chemicals used in furniture refinishing and home remodeling. Some of the citrus-based strippers work well, as do some of the water-based paints and **varnishes**. What you use depends on the type of project you’re doing.”

“I need to find some safer paint for a project.” Nathan related the incident in Matt’s garage.

“You were lucky!” Ms. Lee said. “Many of the products used in homes are just as hazardous as the ones professionals use. The difference is that professionals usually have a better idea of the risks involved when using them. I have a couple of good basic rules to follow. I use every bit of the product. If I’m working with something that evaporates, I put the cap back on when not using it. The less product wasted means fewer chemicals polluting the air. If I can’t use it up, I give it to someone who can. Some communities even have exchange programs for household chemicals and products. Usually, the local health department or the company that disposes of your trash will have that kind of information.”

Nathan looked through the pamphlet. “Hey, there’s some paint that we can use for our birdhouses. It says that it’s even better than the oil-based stuff.”

“It is. You can buy it at the hardware store. Make sure that the can is labeled for exterior or outdoor surfaces. It protects the wood from the effects of weather and the sun,” Ms. Lee said.

“I can see how rain or snow can be bad for paint,” Jasmine agreed. “But the sun is bad for paint, too?”

“Sure is. That’s why paints and coatings are designed especially for outdoor use. The same rays that can damage your skin can damage painted surfaces. Outdoor products have special ingredients that protect surfaces from damage.” Ms. Lee handed the pamphlets to Nathan.

“I’m definitely going to buy this paint,” he said as he placed them in his backpack.

“Good. I also have a sheet of painting tips that you may have. Perhaps it will help you with your project.”

“Thanks!” Nathan added the sheet to the sack of pamphlets.

“If you could tell people just one thing, what would it be?” Jasmine asked.

“The best advice to anyone is, not to cut corners when it comes to safety. You should talk to Mr. Walker; his business handles wastes that can’t be thrown in the trash or poured down the drain. He could give you much more information than I can. When my solvents get too dirty to use, he’s the one that takes care of them for me. I’ll write down his office number for you. It’s just across the street in the big office building.” Jasmine took the address from

her. Nathan and Jasmine thanked Ms. Lee for her time and then crossed the street to Mr. Walker’s office building.

When they arrived at Mr. Walker’s office, he was at his desk talking on the phone. He motioned for them to have a seat. Official looking documents, schedules, and charts with numbers on them were pinned on various bulletin boards. Mr. Walker ended his phone call. He grinned.

“That was Ms. Lee on the phone. She told me about your project. You have come to the right place.” He laid several brochures on the desk for them to take back to the classroom.

“Ms. Lee told us that you can tell us what happens to the stuff that can’t be thrown away. What did she mean?” Jasmine asked.

“My business provides what is called an environmental service. We find better ways to reuse or recycle products that can’t be flushed down the drain or thrown away with your trash. Let me give you an example. What do you think happens to the oil from your car when you get it changed?”

Nathan shrugged. “The gas station takes it.”

“You’re right, but what happens to it after that?” Mr. Walker asked.

Jasmine and Nathan looked at each other. Nathan shrugged again. “We don’t know.”

“Most people never think about what eventually happens to the products they use. Gas stations usually collect used motor oil in a big tank. When their tanks are full, my job is to collect it from them and then turn it into a usable product which we sell to someone else. That is



called recycling. Oil is pretty easy. Other chemicals are harder to deal with. I know Ms. Lee talked with you about solvents already today. Solvents are a little tougher. Sometimes they can be filtered and used again, but when they become too dirty we combine them with other products to produce a type of blended fuel that can be burned.”

“You mean for cars?” Jasmine asked.

“More likely for use in industry. One good example is asphalt. Do you know what asphalt is?”

“Yeah, its the black tarry stuff they patch holes in the street with.” Jasmine said.

“Exactly. The dirt and particles that we filter out of used motor oil are mixed with other materials and made into asphalt. Blended fuel made from dirty solvents can be burned at an asphalt plant to melt it all together.”

“So everything you collect gets made into something else?” Nathan asked.

Mr. Walker laughed. “I wish that were true. Some substances have to be disposed of in special ways. Sometimes wastes are biodegradable. That means that they can be broken down by microbes into harmless substances. Other wastes have to be diluted or mixed with something so that they are no longer toxic. Sometimes wastes can be buried in a special **landfill**.”

Kim looked over a brochure. “It says here that you take light bulbs. How is a light bulb a pollutant?”

“We take all of the **fluorescent lamps**, used by office buildings, schools, and factories. You probably have the long tube fluorescent lamps in your classroom at school.”

“We use light bulbs like that at home in our garage. When they burn out we just throw them in the trash.” Jasmine said.

“In some places, you can do that. Most of those lamps last for years and you may only throw away one or two at a time. Businesses are a different story. Think about the number of lamps in your school for instance. Some buildings may have thousands of fluorescent lamps,” Mr. Walker said.

“Why can’t they put them in the trash like we do?” Jasmine asked.

“Each of those lamps contains mercury vapor. All of that mercury could escape from landfills and potentially contaminate the environment. What we do is to reclaim, or take back, the mercury from those lamps. Lighting companies then use the mercury again in new bulbs.”

“We learned that mercury from air pollution is getting into the water. It’s not good to eat some kinds of fish because they can make people sick,” Jasmine said.

“If those lamps are so bad for the environment, why do people use them? Why don’t they just use regular light bulbs?” Nathan asked. They looked at Mr. Walker and waited for an explanation.

Mr. Walker scratched his beard. “The less coal we burn to make electricity the less mercury and other pollutants enter the environment. Coal burning power plants are the biggest source of mercury pollution today. Fluorescent lamps are better for the environment than ‘regular’ light bulbs because they use less energy to make the same amount of light.”

“Oh, I see,” Jasmine said. “Saving electricity helps by making less air pollution.”

“And the mercury in the light bulb is used again,” Nathan added.

“We use compact fluorescent bulbs at my house. Do they contain mercury, too?” Jasmine asked.

“Yes, they do. As compact fluorescent bulbs become more popular people will be more concerned about how to dispose of them. Right now in some places, you can throw fluorescent bulbs into the regular trash. People should check with their trash hauling company. If you have a burned-out compact fluorescent bulb, it should be put in the box that the replacement bulb came in and then sealed in a plastic bag. This will help protect the people that handle your trash from being exposed to mercury vapor if the bulb should break. The best thing to do with burned out fluorescents is to take them to a reclamation facility,” Mr. Walker said.

“Thank you for seeing us today. Would you like to receive a copy of our newsletter when it’s finished?” Nathan asked.

“That would be great. Put me on your list.” Mr. Walker showed them to the door. Jasmine and Nathan headed back to school.

Interviews: Team Three

Maria and Matt entered the office of Saunder’s Manufacturing. A receptionist greeted them with a smile. “How can I help you?” she asked. As Maria explained the project, the woman’s smile faded. “Mr. Saunder is a busy man. I don’t think he will have time to talk to you about this,” she said. At that moment, Mr. Saunders entered the office.

“What can I do for you?” He asked. Matt and Maria introduced themselves.

Maria flashed a grin at Matt as they followed Mr. Saunder into his office. As Matt explained the purpose of the visit and the research they conducted on the toxic air pollution produced by the company, Mr. Saunders looked at his watch and began to gather papers on his desk.

“I’m sorry kids. I can’t allow you on the factory floor to show you our equipment, and I don’t have the time to discuss this with you right now. I assure you that we do not pose a health risk to the community.” He picked up a pen. “What is the name of your teacher?” Matt suddenly felt like he had done something wrong.

“We’re not trying to cause any trouble. ”

“I know that. What is the name of your teacher?” Mr. Saunder repeated.

“Ms. Delgado,” Matt’s voice was shaking a little as he answered. Mr. Saunder rose from his chair and indicated that it was time for them to leave.

“Ms. Delgado should expect a phone call from me, just to make sure that your school gets the proper information. Thank you for stopping by. My assistant will show you out.”

Back in the reception area, Matt looked over at Maria. She looked upset. Matt hoped she wasn’t going to cry. The receptionist gave them a sympathetic smile.

“I’m sure Mr. Saunder isn’t angry with you. He can be a little gruff sometimes and he’s running late for a meeting. I know that we sometimes go to schools to talk with students about pollution. Maybe your teacher can arrange for a visit. Will you send us one of your newsletters?” Maria wrote down the e-mail address. Matt and Maria walked outside onto the parking lot.



“That got us nowhere!” Matt kicked a piece of gravel. “He could’ve been a little nicer about it.” He kicked another piece of gravel. It went farther than the first one.

“I wonder what he’s going to say to Ms. Delgado,” Maria kicked a piece of gravel. Her piece went a bit further than Matt’s.

“I don’t know. I wish we never began this stupid project,” Matt said. They started back to school. Walking a few blocks made Matt feel a little better. The traffic in town was getting more congested as people began heading home from work.

Maria looked at her watch, “What do we do now? We still have another half hour before we need to be back at school.”

“Let’s walk down by the creek,” Matt suggested. Taking the same path as on the field trip, they walked along the bank of Big Creek. When they passed the sewer pipe it was dry. No water was running out of it today. Matt scrambled down the creek bank when they neared the bend, Maria followed.

Matt began hunting for golf balls. Today the creek water looked clean, and they saw no dead fish. Maria skipped a few rocks and then found a crayfish in the shallow water. She poked at it with a stick. A groundskeeper for the golf course was trimming some dead leaves and branches from bushes near the bank on the opposite side. The man paused in his work.

“I’m going to ask him about the fish,” Matt said.

“He’s not going to know anything,” Maria replied. “The golf course isn’t even on our list. I don’t want to talk to anyone else today.” Maria couldn’t shake off the experience with Mr. Saunder, but Matt wasn’t about to give up.

“Excuse me,” Matt called across the creek. “A couple of days ago, our class passed by here on a field trip. There were a lot of dead fish in the creek. Do you know anything about it?”

“A couple of days ago?” The man took off his hat and used a bandanna to wipe the sweat from his face. “We might. Do you have time to stop by our office for a few minutes?” Matt looked at Maria. Maria glanced down at her watch and gave him a quick nod. Ask for the manager’s office,” the man continued, “I’ll meet you there as soon as I put my tools away. My name is O’Brien. What are your names?”

“My name is Matt and this is Maria.”

“I’ll let the office know to expect you.”

“Thank you, Mr. O’Brien,” Maria called as Matt scrambled up the bank. They retraced their steps and walked to the golf course entrance.

Inside the main building, the groundskeeper, Mr. O’Brien, was waiting for them. He introduced the students to the golf course manager, Mr. Schilling.

“Please have a seat.” Mr. Schilling invited everyone into his office. They sat comfortably in the big leather chairs that faced his desk. “I understand that you had some questions about the dead fish in the creek.” Matt and Maria nodded. “We have had a problem with an insect destroying some of the bushes and trees, like the ones along the creek. Mr. O’Brien is in charge of the grounds he knows what may have happened.”

“One possibility is that **pesticide** dust was carried by the wind into the creek,” Mr. O’Brien began, “but I don’t believe we were responsible. We take many precautions when using chemicals and pesticides. We

do not spray pesticides within fifty feet of any water area to prevent problems like this and we never spray on windy days.”

“All of our employees are trained by the state and licensed to apply pesticides. We’re investigating to make sure our policies were followed. Improper use of pesticides is illegal and we may pay a fine if we’re at fault. Another possibility is that the pesticide might have come from someplace else. Many other people use the same pesticides we do. It may have even come from someone’s yard,” Mr. Schilling said.

“We would like to write an article about the fish for our newsletter about pollution in our neighborhood,” Matt said.

“I think your newsletter is a good idea. One thing you may want to stress is that anyone using pesticides should use them only if they are absolutely necessary, and they should follow the directions exactly. Someone with questions can find information about the product from the manufacturer, the Internet, or from a state or local agency,” Mr. Schilling said. He listed these sources on a slip of paper for them.

“If you’re going to write an article about our golf course I would like you to include the positive things we do to address environmental issues,” Mr. O’Brien said.

“That’s exactly what we’re looking for,” Matt said. He took notes while Mr. Schilling told them about the extensive training program that everyone on the grounds staff must complete in addition to their education. Many of the employees on staff held college degrees in horticulture or in plant sciences.

“The bushes like the type found along the creek are not native to the area,” Mr.

O’Brien said. “They’re gradually being replaced by native plants that need less water and fertilizer and are less likely to be harmed by pests and disease.”

“Part of our problem is that many golfers expect a picture-perfect course, like the ones they see on TV,” Mr. Schilling said. “But things are changing. Golf courses and environmental groups are working together to find solutions that will make everyone happy.”

“When I started in this business, no one seemed concerned if a golf course was built on a wetland area or how it affected wildlife. We are more aware of the environmental issues today. For example, we use an **integrated pest management, or IPM**, approach to control insects,” Mr. O’Brien said.

“What does IPM mean?” Matt asked.

“IPM is almost another way to say, ‘use your common sense’.” Mr. O’Brien listed the steps of their approach. “First, we figure out if pests are the problem. We go out and look at our plants. Do they show signs of disease or insect damage? How bad is it? We figure out what is causing the damage. Can we ignore it and expect it to clear up on its own? If so, that’s great. For example, we had a problem with the wet and cool spring. Fungus was attacking some of our trees. Instead of spraying with a chemical, we left them alone. We knew the hot weather was on the way and then the fungus would die back. If a particular insect is the problem, we might use traps to catch them or we could introduce a natural predator that eats them. We can use chemicals that interfere with the insects’ reproduction. If all of that fails, then we must use a pesticide. It used to be that people just sprayed pesticide on everything, whether they had a problem or not. What we found out was that pesticides



are bad for the environment and caused many problems with other animals. Some animals were faced with extinction because of a pesticide called **DDT**. The sale and use of DDT was banned in the United States in 1972. The bald eagle was one of the badly affected animals and it has taken thirty years for it to recover enough to be removed from the protection list.”

“Since I began in this business, many changes have taken place in golf course management,” Mr. Schilling said. Today, new courses are being built in areas that would have never been thought of years ago. Areas that can’t be used for much else, such as old strip mines and closed landfills, have golf courses on them. Even here, we are looking to expand our clubhouse area into the abandoned factory site next door.”

“The brownfield. We passed that on our field trip. It was a mess,” Matt said.

“Our teacher said that there was toxic waste inside and that’s why no one would build there,” Maria said.

“Are you sure that’s what she said?” Mr. Shilling asked.

Maria thought for a moment. “Well, maybe she said that’s what people thought.”

Mr. Shilling smiled. “That’s an important difference. We had a thorough inspection done of the property. They even took samples of the soil and no major problems were found. We begin construction on the site next month.”

“That’s really good news,” Maria said. At the end of the interview, Matt and Maria thanked Mr. Shilling and Mr. O’Brien for their time and added the golf course e-mail address to the newsletter list.

Chapter #10

At the beginning of class, Ms. Delgado announced that she was giving the aquarium experiment another try. Pushing her sleeves up to her elbows, she reached into the bright green water and removed the filter. Inside was most of the pepper and the white wooly material was brown. Ms. Delgado added some fresh charcoal and some drops to the filter material to makes the spaces smaller. Soon the whole stinky mess was bubbling away again in its spot at the front of the room.

The interview teams took turns reporting to the class. Kim began, “Jamal and I went to Valley Service Station and learned about antifreeze and how people need to fix their cars because leaking oil and stuff washes into streams.”

“We also interviewed Mr. Butler from the dry cleaners,” Jamal said. “He invited us to his grand re-opening. He is putting in new dry cleaning machines that use carbon dioxide and pollute less. Can we go Ms. Delgado?”

“As a matter of fact I spoke with him and several other business owners about this project. We will attend the grand opening.” The class cheered. “Jasmine and Nathan, who did you interview?”

“We went to the Like New Furniture,” Jasmine said. “The lady who owns the shop is Ms. Lee. She’s really nice. She told us all about working with varnish and removers and stuff. They smell really nasty!” She made a face.

“Ms. Lee gave us information about safer products to use,” Nathan said. “I found some of the safer paint at the hardware store. That’s what we’re using to finish our Scout projects.”

“That’s great,” Ms. Delgado said.

“Ms. Lee sent us to see Mr. Walker. We learned that used oil and some chemicals can be made usable again. That’s what his business does. They collect the stuff that people need to get rid of and turn it into other stuff or dispose of it in a safe way.” Jasmine sat down.

“They collect fluorescent light bulbs because they have mercury in them,” Nathan said. “All of them are collected and taken to a place called a reclamation facility. They crush up the bulbs, collect the mercury and then reuse it in new bulbs.”

“It’s important that the mercury is reused instead of entering the environment as pollution,” Ms. Delgado said. “All right, Matt and Maria, what do you have to report?”

“Well, we went to talk to Saunder’s Manufacturing, but Mr. Saunder didn’t have time to talk with us,” Matt said.

“Saunder’s Manufacturing was one of the phone calls I received,” Ms. Delgado interrupted.

Maria blushed. “Are we in trouble?” she asked.

Ms. Delgado’s smile reassured them. “No Maria. You and Matt are not in trouble.”

“What happened?” Erica asked. The room buzzed with people asking Matt and Maria about the interview.

Ms. Delgado quieted everyone down. “After Matt and Maria’s visit, Mr. Saunder contacted the environment compliance officer. She is in charge of all of the pollution control equipment at the plant. She explained that she was busy running some tests when Maria and Matt stopped by. Mr. Saunder has offered



the class a tour of his facility to see and learn about some of the pollution control equipment when they take a break in their manufacturing schedule.” Ms. Delgado said.

“Why do we have to wait for that? Are they hiding something?” Nathan asked.

Ms. Delgado laughed at his earnest expression. “Of course not! It would not be safe to tour the manufacturing plant with all of the equipment running and forklifts going back and forth on the floor.”

“But what about all of the smelly pollution they cause?” Kim demanded.

“We can’t really tell by how something smells if it can hurt you.” Ms Delgado replied. “It would be good to take the tour and ask those questions. Maybe we can find out what the smell is and if something can be done about it.” Ms Delgado looked at Matt and Maria again. “I think you have other news to report?”

Maria nodded, “Matt may have figured out what happened to the fish. It may have been pesticides that blew into the creek from the golf course.”

“The golf course that wasn’t even on our list.” Jasmine exclaimed.

“No one really knows if it was a pesticide yet, and if it was, they might not be able to tell where it came from.”

“And they may never know, people use some of the same chemicals in their backyards.” Ms. Delgado said. “Well, it sounds like the newsletter group has done a terrific job. I am proud of the way the interview teams conducted themselves. I have heard positive things from people in the community. Everyone can read all of their stories in about two weeks when

the newsletter comes out!” Ms. Delgado and the class gave the teams a round of applause.

That night, the boys met in Matt’s garage and set up for the Scout meeting. Nathan brought the new paint that he purchased at the hardware store. There were several different colors. Soon after the Scouts arrived, the garage was full of noisy activity as the boys helped the second graders paint their projects. Katie and Matt’s mom brought out drinks and a snack.

“Hey Katie, I have something for you.” Nathan took an unpainted birdhouse from the sample box. “I thought you might like to paint one.”

“Oh Mom, can I?” Katie jumped up and down with excitement.

“Let me read the label on the paint you’re using.” Matt’s mom read the label on the can and then said, “All right Katie, you can paint if you change your clothes first.”

“I get to paint! I get to paint!” Katie raced off to the house to change her clothes.

“It certainly smells a lot better in here,” Matt’s mom said as she surveyed the pamphlets displayed on the workbench and the Scouts painting their projects. “I’m impressed. You boys did your research!” She returned to the house to help Katie get ready for painting.

Soon, Katie reappeared dressed in old clothes. Nathan set up an area for her to work in. “I’m going to paint my birdhouse orange, like Goldie!” she declared.

“We don’t have any orange paint. How about yellow? That’s pretty close to Goldie’s color,” Nathan suggested.

“No, I want to paint it orange!” Katie

insisted. She furrowed her brows and stuck out her bottom lip.

“To paint it orange you have to mix paint, and I can’t stay to help you. I’ve got other kids to help.” Nathan placed a can of yellow paint near Katie’s birdhouse and went to help his Scouts wipe up a paint spill in another part of the garage. Katie’s pout threatened to turn into tears. Jamal had been watching this from nearby. His Scouts were finished with their projects and were playing in the yard. It wasn’t such a big deal to mix a little orange paint, Jamal thought. Nathan could have done it for her. Jamal looked around. Everyone was busy and Matt’s mom was nowhere in sight. He approached Katie when he saw she was about to cry.

“Hey, I can mix some orange paint for you,” Jamal offered.

Katie smiled and dried her tears. “I want it to look just like Goldie!”

“OK, but you’ll have to remind me what color she is.” Jamal mixed some yellow and red paint together in a used pie tin. Under Katie’s direction he mixed and stirred until she pronounced it perfect. She dipped her brush eagerly into the paint and slathered it on the birdhouse. Jamal helped her cover the missed spots of wood. Soon, the bright orange birdhouse was finished.

“I want Goldie’s name by the door,” Katie said.

“Goldie’s a fish. She can’t live in the birdhouse.” Jamal shook his head at the crazy idea.

“It’s where Goldie’s bird friends are going to stay when they come to visit her.”

“You mean like a guesthouse?” Jamal asked.

Katie nodded, “I want a sign on top of the door,” she said. Jamal picked up a narrow brush and outlined a sign over the door of the birdhouse. He painted ‘Goldie’s Guesthouse’ in dark green letters. Thinking that it looked a little bare he painted a vine and some leaves around the door. Katie watched in rapt attention.

“Ooh, that looks so good!” she said. Jamal switched brushes and added some little blue blobs as flowers. Katie clapped her hands. “It’s beautiful!” Her eyes were shining with delight. “It’s the most beautiful birdhouse ever!”

“Make sure you let it dry before you move it or touch it or anything.” He began to gather the used brushes and paint. Katie ran off to tell her mother. Jamal ran water into the utility sink and began to clean his brush. Matt carried some used paint pans over to the countertop area next to the sink.

“Katie really likes her birdhouse,” Matt said as he emptied some unused paint back into a can.

Jamal shrugged, “I didn’t do much.” He went to put the cans of paint on the shelf at the back of the garage. Matt looked at the orange birdhouse with little painted sign and blue flowers and then at Jamal who was busy cleaning up some used newspaper. Matt grinned. He was glad they were friends.

Chapter #11



The first issue of the newsletter included a survey for people from the neighborhood to fill out and return. The story of Black Tuesday and a description of the class field trip were two of the featured articles. Everyone in class helped distribute the copies to the businesses downtown. Some of the class computer time was spent learning how to make an address book of the people wanting the newsletter sent by e-mail. The principal was so impressed with the work that she requested a follow-up issue.

At the next newsletter meeting, the students were disappointed to learn that no one had responded to the survey.

“We did the best we could,” Erica said.

Nathan put the empty folder away on the shelf. “Maybe people don’t care about pollution.”

“It seemed to me that they cared,” Jamal said. “I thought the business owners were happy to talk to us.”

Maria rolled her eyes thinking of Mr. Saunder. “Well, some of them were.”

“Most people have been nice though,” Jasmine said. “When we delivered the newsletter to Ms. Lee, she read it right away and asked us for extra copies to share with her customers.”

“Maybe they’re busy,” Matt said. “We just need to give them a little more time.”

“One of my neighbors is on the basketball team. Her mom set up a carpool for practice and the games. She said she had been thinking about it but never got around to it. Our newsletter reminded her how

important it was,” Kim said.

“Maybe for the second issue we can put in stories like that.” Nathan began writing a list on the chalkboard.

“We could use the basketball team as an example,” Maria suggested. “They have practices and games every week. We could calculate how much pollution they’re preventing by using fewer cars and driving fewer miles.” By the end of the meeting the group had generated many ideas for the follow-up issue.

During the next week, e-mails started coming in. Butler Cleaners sent an invitation to the grand re-opening celebration. Mr. Smith from the bus company wrote the students about the clean-air buses the company operated. The buses used compressed natural gas for fuel and produced only small amounts of pollution. All of their diesel engines were being improved to burn fuel in a cleaner way. He sent information about bus routes and the discount ticket programs available. A parent who worked at one of the large office buildings downtown set up car-pooling schedules. His employer allowed people to adjust their work hours to accommodate their ride sharing program. The local lighting company wrote to tell the students about the variety of compact fluorescents it had for sale and about new technology being developed for home and office lighting that could reduce the amount of electricity that people used.

Every time the class heard from a business, they marked the map with a small happy-face sticker on top of the pushpin. The number of smiling faces grew daily.

On a poster titled ‘Who Cares About Our Air?’ the class listed the businesses and families that answered the survey and

what they were doing to protect the air. At the bottom Kim wrote 'What Can You Do?' Extra blank spaces existed for people to add their names to the list and to pledge one action they would take to help reduce air pollution. On the day of Butler Cleaners grand re-opening, the whole class, school principal, and several parents attended. Erica's mom brought a huge armful of clothing to be cleaned.

When the class arrived at the grand opening, they swelled the crowd noticeably. Mr. Butler was talking to a reporter from the local paper. He smiled broadly when he saw Kim and Jamal.

"Well, hello kids! It's so nice to see you. I'm glad that you were able to come. Ms. Delgado, I would like you to meet Mr. Taylor from the local paper." Mr. Butler made a sweeping gesture to include all of the students. "And these are the students who were on the field trip that I was telling you about."

"Nice to meet you. I'm curious, why are so many school children attending this event?" Mr. Taylor directed the question to Ms. Delgado.

Before she could answer Kim spoke up. "Mr. Taylor, you need a copy of our newsletter. It explains all about our project." The crowd of students passed forward a newsletter.

Mr. Taylor did a quick scan of the contents. "This will be great background for my story. Who's your editor?" The newsletter staff looked at one another. They had never talked about it.

"Matt," Erica said decidedly and pointed to him. "He's done more work on this than anyone else." The others nodded in agreement. Matt felt his cheeks get warm. He wasn't used to this much attention.

Taking a deep breath, he made his way forward to meet the reporter.

Mr. Taylor shook hands with him. "If you wouldn't mind I would like to get some more information from you about your project. Would that be all right with you Ms. Delgado?"

Ms. Delgado smiled. "Matt may have a few questions for you as well. He has really become a good investigative reporter during this project!"

Matt and Mr. Taylor moved away from the crowd of noisy students. Mr. Taylor asked questions and took notes in his notebook. The newspaper photographer arrived and began taking photographs of the festivities.

Ms. Harris, the president of the Chamber of Commerce, stood at a makeshift podium. "Thank you for coming. It's nice to see so many people here today. Mr. Butler and his family have operated this dry cleaning business in our community for many years. The improvements that he has made will make a difference. The new process will reduce pollution and provide customers with the high level of quality cleaning that Butler's is famous for. We wish you continued success." There was loud applause as Mr. Butler took the podium.

"Thank you for your kind words. It's great to see everyone. Special thanks to the students in Ms. Delgado's class at the school." The crowd applauded, Ms. Delgado waved in recognition. "When I first considered making changes to my store, one of my business advisors said that nobody was going to care about pollution issues and that they would go to another store that charges less money. I made the decision to install the new system anyway because it was the best thing to do, but I still had some misgivings. Then Ms. Delgado's students were in



the neighborhood asking what business owners were doing to help protect the air in our community. Imagine how pleased I was to answer them! One of the best parts of their project is the newsletter. Now we know what our good neighbors are doing to help protect the air and the environment in our community. You know what else? I got rid of my business advisor." The adults laughed and everyone clapped.

The photographer snapped pictures as Mr. Butler cut the ribbon stretched across the doorway of his store. Erica's mom stepped up to the counter carrying her clothing to be cleaned. "No charge for my first customer!" Mr. Butler said. He grinned broadly as he filled out the claim ticket. People took turns, crowding into the store to see the new equipment. Outside on the sidewalk, a table was set up for punch and cookies. As the students enjoyed the treat, Mr. Taylor interviewed some members of the class.

A woman shook Ms. Delgado hand. "You have no idea how much positive discussion has been started in our small businesses because of your newsletter!"

"Let me introduce you to Matt, our editor," Ms. Delgado said.

"It's nice to meet you young man. Keep those issues coming!"

"We will," Matt promised.

Chapter #12

The following Monday, the classroom was buzzing with conversation. It was hard for Ms. Delgado to quiet everybody down.

“Did anyone have a chance to read this weekend’s paper?” Ms. Delgado unfolded a copy of the weekend edition. The school project and the grand re-opening was the front-page story. “Wow, what a project we’ve had!” She pretended to wipe sweat from her brow. “Each of you has done an excellent job on this unit, but even after all your hard work we still have more pushpins than happy face stickers on our map. What do you think about that?” The students thought for a few moments.

“I think it was a little unrealistic to believe we would hear from everyone,” Erica said.

“Yeah, but look at all the places and people we did hear from,” said Kim.

“I think that people know more about air pollution than before our project,” Nathan said.

“Before our project, we just kind of assumed things and took clean air for granted,” Jamal said. “I never thought that what I did would matter.”

“When we started our project, I didn’t think anyone would take a bunch of kids seriously, but a lot of people did,” Jasmine said.

“I think it’s good that we wrote the newsletter so that everyone could learn about the things that people are doing,” Maria continued, “and I learned that it’s okay to ask questions, even if it makes people mad.”

“What’s going to happen to the newsletter now that our unit is over? We’re still hearing from people in the community. Is anyone still interested in working on it?” Ms. Delgado asked.

“As long as we have stuff to put in the newsletter, I’ll stay after school on Wednesdays to put it out,” offered Matt.

“I will, too,” Jamal said. “It’s important to keep it up. We have a lot of new readers.”

“And just look at our fish tank!” Ms. Delgado was smiling. She turned on the light. The tank was crystal clear.

“We could probably even put fish in there now,” Nathan said.

“And, indeed, we shall!” Ms. Delgado held up a plastic bag with several fish swimming in it. “Nathan, would you do the honors of putting our fish in their new home?” Ms. Delgado asked.

Nathan made a face, “Can you get someone else to do it? I don’t really like fish.”

“I’ll do it!” Maria and Kim volunteered waving their hands in the air. They added the fish to the tank.

“What made the water so green?” Jamal asked.

“It was a type of algae called volvox. It was probably on the rocks that I took from the other aquarium. Volvox is so small that it passed right through the spaces in our filter material. The drops that I added to the filter made the holes small enough to trap the algae. When I came in this morning the water was clear. I tested it and it was fine for the fish,” Ms. Delgado said.

“So, our filter did a pretty good job after all!”



Jasmine said.

“If only it were that easy to clean our air,” Matt said watching the fish explore the aquarium.

Ms. Delgado smiled, “I think we’ve made an important start.”

The rest of the morning was spent naming the fish and preparing the classroom for the next unit. It was time to take down the posters and the charts. The pushpin map was left up on the bulletin board. The poster of community participants was moved to the display case in the school’s main hallway. Papers were sorted and placed in file folders. Containers and pieces of equipment were stowed in the appropriate places. The classroom became once again as a blank slate. Ms. Delgado announced that a new science unit was about to begin, but no matter how much the students begged, she wouldn’t give one clue as to what it was about.

Matt liked having time to clear everything out and get rid of old papers. He came across the notes he had taken during his interview with the golf course manager and the draft of the first newsletter. In the margins of his papers were notes he scribbled and the websites he had used for his articles. He looked briefly at the recycling bin that many students were filling as they cleaned out their desks. Matt dug through his desk and found an unused folder. He slid his papers inside the folder and labeled it Stuff to Keep. He placed the folder in his desk and closed the top. It was almost time for recess. Matt looked out the window. The sun was shining on the empty playground.

“Hey! The kickball yard’s been re-done. When did that happen?”

“They started that two weeks ago. Where have you been?” Nathan said, shaking his head in disbelief.

“Today’s a good day to try it out,” Jamal said.

“It is a good day for kickball. It’s also a green air quality day, too,” Ms. Delgado said. The boys looked at her.

“What does that mean?” Matt asked.

“Ah, that’s another science unit,” Ms. Delgado said and smiled mysteriously. She tossed Matt a kickball. As the boys headed for the playground, Matt wondered what Ms. Delgado had planned for them next.

GLOSSARY OF TERMS

A

adverse health effects

A negative impact on human health that results from exposure to pollutants, ranging from mild and temporary eye and throat irritation, and chronic conditions such as asthma, to permanent or serious conditions such as birth defects and cancer.

air

So called 'pure' air is a mixture of gases containing approximately seventy-eight percent nitrogen, twenty-one percent oxygen, and one percent carbon dioxide and other gases.

air monitor

A piece of sensitive scientific equipment used to measure pollutants present in the air. Air monitoring is mostly conducted by government agencies and industry.

airborne toxic

A harmful chemical air pollutant that can cause adverse health effects. Also known as an air toxic or a hazardous air pollutant. See adverse health effects

antifreeze

A substance added to water to prevent freezing.

area source

A stationary source of air pollution producing less than ten tons per year of one hazardous air pollutant or less than twenty-five tons per year of all HAPs. Examples include road dust, farm dust, fireplaces, dry cleaners, etc. A pollutant that cannot be traced to a point or mobile source is attributed to an area source.

asthma

A chronic inflammatory disorder of the lungs. Symptoms include wheezing, breathlessness, chest tightness, and cough.

atmosphere

An envelope of gases that surround a planet. Earth's atmosphere is divided into layers. Beginning with the layer closest to the earth they are the troposphere, stratosphere, mesosphere, and thermosphere. See air

B

benzene

(běn•zēn) A volatile liquid that evaporates quickly into the air and catches on fire easily. This chemical is a toxic and is known to cause cancer. It is found in cigarette smoke, in fuels such as gasoline, and in some paint products. You can reduce your exposure to benzene by not smoking, avoiding fumes from gasoline, and by not using products containing it.

biodegradable

A material capable of being decomposed into a harmless substance by the action of microorganisms.

brownfield

An under used or abandoned property that is contaminated or believed to be contaminated with a hazardous substance that has the potential to cause serious health problems.

C

Clean Air Act

A congressional act passed in 1970 and amended in 1974, 1977, and 1990. It forms the basis for our national air pollution control effort. Basic elements of this act include national standards for major air pollutants, acid rain control measures, and enforcement provisions. The Clean Air Act replaced the Air Pollution Control Act of 1955. Over the years this legislation has been strengthened and expanded.

D

DDT

DDT (1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane) is an insecticide sprayed on crops and used to control insects that carry diseases like malaria and typhus. In 1972 the sale and use of this pesticide was banned by the United States because of damage to wildlife and potential harm to human health. DDT is still used in some other countries.

deposition—deposit

To let fall.

dispersion—disperse

To spread or distribute.

E

Environmental Protection Agency

The U.S. EPA is the federal regulatory agency of the United States government charged with protecting human health and the environment. It was established in 1970 as a response to growing public demand for cleaner air, water, and land. Prior to the establishment of the EPA, the national government was not structured to make a coordinated response to pollutants which could have harmed human health and degraded the environment.

ethylene glycol

(eth•ĕ lĕn•glĭ kōl) This clear, sweet tasting liquid is used in antifreeze and de-icing solutions. Exposure to large amounts can result in damage to the kidneys, liver, heart, and nervous system. Ingesting large quantities can cause death.

F

fluorescent lamp

Light bulbs used for commercial and home lighting. A fluorescent lamp produces ultraviolet light that reacts with a coating on the inside of the glass tube. This reaction changes the ultraviolet light to visible light. All fluorescent lamps contain mercury and need to be disposed of properly.

H

hazardous air pollutant (HAP)

The EPA identified these pollutants as being capable of damaging human health. HAPs are also known as air toxics or airborne toxics.

health risk

A risk to health that is calculated by the type of substance you are exposed to (how toxic it is), the concentration of the toxic (how much you are exposed to), and the duration of the exposure (what time you are exposed for). Onset of symptoms can be acute, occurring immediately after exposure or delayed for many years as in chronic exposure. Severity of risk from hazardous air pollutants range from temporary conditions such as skin rash, cough and throat irritation to chronic conditions such as asthma and chronic bronchitis, to severe or permanent conditions such as cancer, kidney and liver damage, nervous system damage, miscarriages, birth defects, and death. Children, older adults, and those with certain medical conditions are more likely to experience adverse health effects from pollutants.

heart disease

An abnormal condition of the heart or of the heart and circulatory system.

I

Integrated Pest Management

An approach that manages pest damage by the most economical means and with the least hazard to people, property, and the environment.

L

landfill

A system of trash and garbage disposal that allows for the waste to be buried between layers of earth. Landfills built after the 1990s must meet stricter safety and design standards than previously required.

lubricant

A substance used to reduce friction between moving parts.

M

mercury

A heavy silver-white poisonous metallic element that is liquid at room temperature. It evaporates easily. Mercury is especially dangerous to unborn children and to young children. Mercury is found in many home products such as some thermometers, thermostats, and fluorescent lamps. Mercury enters the environment in the form of airborne pollution produced by incinerators and electric power plants that burn coal. When mercury particles reach the marine environment they enter the food chain. The EPA and Food and Drug Administration (FDA) have issued guidelines to limit the amount of fish people can safely eat.

methylene chloride

(meth•ĕ•lĕn klor•īd) A colorless liquid with a mild sweet odor. Another name for this chemical is dichloromethane. It is suspected to cause cancer in humans. Methylene chloride is used as a solvent and as a paint thinner. It is found in paint strippers, spray paints, and adhesive removers available for home use. People can be exposed to methylene chloride by breathing vapors from paint strippers and other products that contain it. To reduce your exposure, look for a safer substitute for the product. Use products containing methylene chloride outdoors or in ventilated areas and cap product tightly to avoid evaporation when not in use. Reduce your exposure by not using products that contain this chemical.

mobile source

Vehicles are mobile sources of air pollution. They are sub-divided into on-road and off-road vehicles. Some on-road sources include automobiles, motorcycles and trucks. Some off-road sources include tractors, bulldozers, boats and airplanes.

motor oil

A petroleum or synthetic oil used to lubricate inside an engine. See lubricant

P

perc See tetrachloroethylene

perchloroethylene

(per•klor•ō•eth•el•ēn)(per•klor•ō•eth•el•ēn) Is also referred to as perc. See tetrachloroethylene

pesticide

Chemicals that are used to kill unwanted pests such as rodents, insects, and molds. These chemicals can be divided into four groups: Insecticides to control insects, herbicides to control weeds, fungicides to control molds and fungus, and rodenticides to control rodents.

point source

Point sources are stationary, specific points of origin where air pollutants are emitted into the atmosphere. One example is a factory smokestack. Point source refers to a source that produces greater than 10 tons of one hazardous air pollutant or greater than 25 tons of all HAPs produced, combined, and emitted per year.

Poison Control Center

These centers provide emergency services throughout the United States to provide medical assistance and advice in cases of accidental poisoning. The national number for Poison Control is 1 **800-222-1222**

pollutant

Pollutants can be natural or man-made and are any unwanted substance or contamination.

precipitation

Water vapor that has condensed, such as fog, dew, rain, ice, or snow.

propylene glycol

(prō•pe-lēn •glī•kōl) This is a clear, odorless, tasteless liquid used in antifreeze and de-icing solutions. Propylene glycol, in small amounts, is also approved as a food additive and is used in cosmetics and baked goods.

R

Ringelmann Chart

A chart used to visually estimate how much light is blocked by a plume of smoke.

S

scrubber

An air pollution control device that uses liquid to remove minute droplets and particles that pollute an air stream, such as smoke in power plant smokestacks. Gases are removed by an additional process.

sewer

A system of underground pipes designed to carry surface water or other liquids. Some sewers empty to a stream or wetland area. Sanitary sewers handle wastewater that contains human and other wastes. Storm sewers handle water runoff from streets and roofs. In some communities, one sewer system handles all wastewater, which is treated before it is discharged to a stream or wetland.

shroud

A burial cloth or winding sheet used to cover and protect the bodies of the dead before burial. It can also mean something that conceals or obscures objects from view.

solvent

A substance, usually liquid, that is used to dissolve other substances.

T

tetrachloroethylene

(tetra•klor•ō•eth•el•ēn) A chemical used for dry cleaning and metal de-greasing. It is used in other chemicals and in consumer products. It evaporates easily into the air and has a sharp, sweet odor. To reduce your exposure, look for alternatives to dry cleaning or methods that do not use this chemical. Always ensure that dry cleaned items have been properly dried before accepting them. Tetrachloroethylene is also referred to as perchloroethylene or perc.

toluene

(tāl•yew•ēn) A clear, colorless, volatile liquid with a distinctive smell. It is found in automobile exhaust and in products such as fingernail polish, paints, lacquers, etc. Toluene occurs naturally in crude oil and in the tolu tree. Toluene is a toxic that affects the nervous system. Reduce your exposure by not using products that contain this chemical. Use only in ventilated areas and cap product tightly to avoid evaporation when not in use.

transmission fluid

A lubricating fluid that is used in engines to help it shift gears. See lubricant

toxic

Substances that are poisonous, known to harm living organisms.

V

varnish

A liquid preparation, that when spread and allowed to dry on a surface forms a hard, protective, transparent coating.

volatile organic compounds (VOCs)

This is a compound or chemical that evaporates easily into the air. VOCs contribute to the formation of smog and/or may themselves be toxic. VOCs often have an odor. Some examples of products that contain VOCs include gasoline, solvents used in oil-based paint products, cleaners, cosmetics, and automobile exhaust. VOCs are also called volatile organic chemicals.

X

xylene

(zī'•lēn) This colorless, sweet-smelling liquid evaporates quickly into the air and catches fire easily. Xylene is used as a solvent and a cleaner. Small amounts of it are found in gasoline and in airplane fuel. Studies have not shown xylene to cause cancer. You can be exposed to xylene by breathing contaminated air, touching shellac, varnish, gasoline, paint removers, and rust preventatives. You can absorb it by drinking contaminated water or breathing air near waste sites. Xylene is toxic. People who breathe high levels may experience dizziness, confusion, and a change in their sense of balance. Extremely high exposures can result in damage to the liver and kidneys, unconsciousness, and death. Reduce your exposure by not using products that contain this chemical. Use only in ventilated areas and cap product tightly to avoid evaporation when not in use. Xylene is also known as xylo.