TEAM CLASSROOM IMPLEMENTATION PLAN REPORT

Project # 5: Simulation-Based Impact Analysis of Signalized Intersections

Lesson 1: "May the Force Be With You"
Lesson 2: "STOP IDLING"

Submitted To

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For
"Sustainable Engineering for Urban Needs:
Research Experiences for Middle and High School Teachers"

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ABSTRACT

The first lesson concentrates on force created due to friction between two bodies. The force of friction is active in many different forms. Many people do not know of its effects in regards to weather and the ripple effects it plays on everyday systems. Balance and equilibrium play key roles in determining these basic concepts.

The second lesson concentrates on delay and CO emissions as a growing problem for our environment and our health. Many people do not realize that an idling vehicle emits three and half times more emissions than a moving vehicle. Conducting research and collecting field data is one way we can help make changes to benefit our environment and our health.

KEY WORDS:

For Todd Bonds: Friction, forces, motion, air resistance, balance,

For Kelli Lee: CO, emissions, concentration, delay, impact, idling

Lesson 1 By Todd Bonds: “May the Force Be With You”

1. INTRODUCTION

The concepts and phenomena’s of motion and forces are constantly interacting and operating around us. They are at play in many various forms, some of which many of us are not aware of, nor do we know which types of motion and forces are at work. Students will observe and record their observation from the four different types of motion and forces interactions that will be done in a lab during class.

2. LESSON OVERVIEW

The lesson is titled “May the Force Be With You”. This will be a Science lesson in Physical Science for sixth-graders. This lesson will be divided into two days, with each class lasting about 47 minutes. The purpose of the lesson is to have students identify systems and analyze how their components work with and affect each other.

3. GOALS AND OBJECTIVES

Students will explore friction mimicking different weather conditions. Students will also analyze systems and predict outcomes based on their knowledge of the system and their understanding of the concept.

4. MATERIALS

For the lesson, students will need their text books and writing and their Science Notebooks. Students will need writing utensils. Materials needed for the labs are: plastic cups and strings to simulate vehicles; water; a ramp or some type of incline plane; fine and coarse sand paper; a large tray; a flat surface other than the classroom floor; a large plastic disk or circle; balloons and an observation sheet.

5. INSTRUCTIONAL STRATEGY

The teacher will use pre and post assessments to evaluate student progress. The teacher will also show the students a video from The Weather Channel regarding different weather patterns and their ability to cause damage. This should actuate prior knowledge. Also students will be divided into groups to share different ideas and predictions.

6. TECHNOLOGY

The only technology being used is the Smart Board so that students can view the information from the Web site www.weather.com. This is because many students today love animations, movies, and Web sites, and should stimulate interest in the activities.

7. PRE/POST ASSESSMENT QUESTIONS

1. Name something that weather can have an effect on and how?
2. What type of weather pattern can have the biggest effect on us and why?
3. Name some ways that moisture and wetness are good things and how or why are they good things.
4. Name some ways that moisture and wetness are bad thing and how or why are they bad things.
5. How does the wind play an effect on us and the environment?

8. LEARNER PARTICIPATION/ACTIVITY

The teacher will welcome students to class and begin the activity by asking students about today's weather. The teacher will then begin a formative assessment regarding the pre and post assessment questions listed below. This should take 4-6 minutes.

1. Name something that weather can have an effect on and how?
2. What type of weather pattern can have the biggest effect on us and why?
3. Name some ways that moisture and wetness are good things and how or why are they good things.
4. Name some ways that moisture and wetness are bad thing and how or why are they bad things.
5. How does the wind play an effect on us and the environment?

The teacher will then play video from www.weather.com/outlook/videos/?subcatid=293 titled "Top Hurricane Moments". This should be no longer than about 10 minutes. Students will then be divided into groups. The teacher will explain the various stations of activities regarding the assignment. The stations were set up prior to students arriving. Students will be placed into groups of varying levels. One student will be responsible for collecting observation sheets for each member of the group. Students will spend approximately 5-7 minutes at each station before rotating. There will be three runs at each station per group.

DAY 1

- Station 1 will have a string attaching a plastic cup and three blocks of varying weights on a table, and a small container of water. Students will hang the cup over the edge of the table, and attached one of the blocks. The students will fill the cup up with water until the block moves. The students will remove the current block and repeat until they have done all the blocks. Students will record observations of what is occurring with the blocks and the cup.
- Station 2 will feature the ramp/inclined plane; coarse and fine sandpaper and a large tray. There is also a small container of water at this station. The tray will be placed at the bottom of the ramp/inclined plane. Students lay the sand paper down on the tray

one at a time. Students will then pour water directly onto the ramp so that is flows onto the sandpaper. Students will record their observations, and then do the same with the other piece of sandpaper.

- Station 3 is the same as Station 2, with one major exception. There will be no ramp/inclined plane being used to pour the water on. The water will be poured directly onto the differing pieces of sandpaper. Students will record their observations.
- Station 4 will have a plastic disc and a balloon. A hole will be cut in the middle of the plastic disc. The blow hole of the balloon will be pulled the hole of the plastic disc. The balloon will be blown up and small blocks will be placed onto the disc. The balloon will be allowed to release its air. Students will record observations of the blocks and their movement.

The teacher will have the students return to their seats. The teacher will then ask the pre/post assessment questions again. Class will be dismissed.

DAY 2

Students will be informally assessed on their prior knowledge of motion of forces, especially in regards to the previous day's lessons. Students will then be asked to get out their observation sheets. Students may use their text books, or class notes or whatever they need to work on the written assignment by themselves. Students will spend about 30 minutes writing their answers to the following questions:

- What types of effects can the force of weather play on our environment?
- Pick your favorite station form yesterday, and describe the type of weather pattern that it resembled.

Students will then be asked to volunteer to verbally demonstrate their answers to the questions. Students will then be asked to paste or glue their answers into their Science Notebooks.

9. ESSENTIAL QUESTIONS AND REVIEW

How do the different weather patterns affect our environment?

10. POSSIBLE CHALLENGES:

The students of this particular school are often very difficult to keep on task. Constant reminders of classroom and assignment expectation will be necessary to keep the students working and on task. There may be some side conversations and horseplay during the movies/activities.

Lesson 2 By Kelli Lee "STOP IDLING"

1. INTRODUCTION

Delay and CO emissions are a growing problem for our environment and our health. Many people do not realize that an idling vehicle emits three and half times more emissions than a moving vehicle. Our students need to develop a problem-solving mentality to find alternative solutions to temporarily and permanently solve these growing problems of delay and CO emissions at intersections as well as school bus docks.

2. LESSON OVERVIEW

"STOP IDLING" is intended for 8th grade science to occur over one hour after school for data collection. It may be possible that the same lesson be repeated 2 or 3 times to allow as many students as possible to collect data. The purpose of the lesson is to give students experience in collecting field research data so they can analyze and eventually propose alternative solutions to the school board for our delay and CO concentration problem from the idling buses.

3. GOALS AND OBJECTIVES

The overall goal is to improve vehicular delay and CO emissions at signalized intersections; however, since we are not close enough to a busy intersection we are going to apply the same research concepts to the idling buses at the school bus dock. The students learning goal is to develop an understanding and knowledge of the Application, Careers, and Societal Impact of engineering. The SWBAT learning object: Students will collect delay and CO concentration of the idling buses at the school bus dock. The learning and understanding of this lesson should have an achievement of 80% or higher proficiency.

4. MATERIALS

The notebook will be used for students to journal data and observations as they collect data throughout the research project. The CO monitor will collect the CO concentration in particles per million for us to determine the relationships between delay and CO. The video camera will be used by students to tape the buses in case we need to refer to it for other data or observations from the original data collection. We will also use a data charts to record all data during our one hour data collection from 3:00pm to 4:00pm during peak hour of buses idling.

5. INSTRUCTIONAL STRATEGY

The students are collecting the delay and CO concentration data. This is data collection strategy which is part of research and/or inquiry. The data sheet will be created in excel or even word to help students organize the data as they collect it.

6. TECHNOLOGY

Student will be using a CO monitor and video camera. The benefits of this is they will understand how CO concentration is collected and measured. In addition, students will benefit from the use of a video camera in being able to look back on their original experience to write a report or even double check data collected for a mistake.

7. PRE/POST ASSESSMENT QUESTIONS

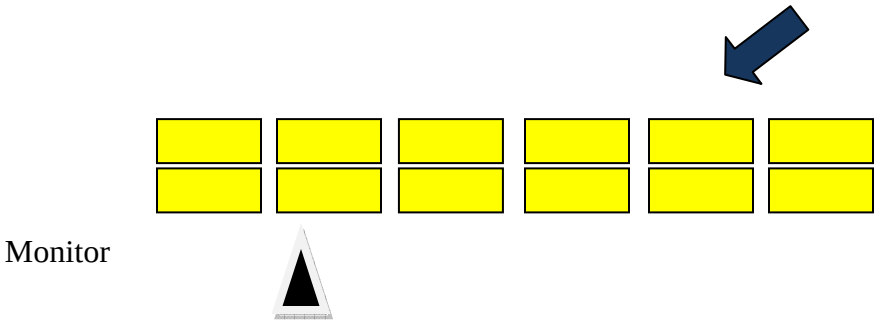
1. *CONTRAST* CO emission and CO concentration.
2. *LIST* and *EXPLAIN* how 3 other factors could affect the CO concentration data.
3. *PREDICT* patterns between delay (stopped buses) and CO concentration.
4. *EVALUATE* data collected and *SUMMARIZE* your findings.

These assessments will occur in written and whole group discussion. Written will occur first followed by group discussion

8. LEARNER PARTICIPATION/ACTIVITY

The perfect scenario would be for the whole class to stay after school to collect data; however we all know that is not always possible. So if your whole class cannot stay after school to collect data consider staying 2-4 days to give students opportunity to stay so all can take part in collecting data. IF you do this way each group will be responsible for analyzing their own data when the time come to do so. The class hour before data is collected after school:

- Flashback: Create a LIST of other factors we should consider in collecting our CO data. Write one sentence to EXPLAIN each factor on your list. (Hopefully they will come up with wind, heat, rain, overcast, etc… Only collect data on day's weather is clear.)
- Have your students look up online the weather conditions for your area in order to place the monitor.
- Video Camera: tape the whole duration of your data collection. You want to record the bus area in case you need to refer to it later.
- Below is an example of set up however this is considering wind is going in the direction of the arrow.



Camera and Students with stopwatch and data sheets

<u>Student Data Collecting Assignments:</u>

1. Camera Crew: 1-2 students
2. Stop watch and Counters: You can have several doing this just have them in groups of two or three if you are having whole class do together. One student on stop watch and others are counting per three man group.
3. No one needs to stay with CO monitor because it is not to be bothered once you start collecting data until you are done.

9. ESSENTIAL QUESTIONS AND REVIEW

1. *CONTRAST* CO emission and CO concentration.
2. *LIST* and *EXPLAIN* how 3 other factors could affect the CO concentration data.
3. *PREDICT* patterns between delay (stopped buses) and CO concentration.
4. *EVALUATE* data collected and *SUMMARIZE* your findings.
   Students will have time to answer questions individually, then we will pair/share with a partner to determine any similarities or differences in understanding. Once students have had time to think, share with partner, we will have whole class discussion.

10. POSSIBLE CHALLENGES

The possible challenges to this lesson is getting as many students as possible to collect data. It may be difficult for some teachers to find an organization or school to allow you to borrow a CO monitor.

11. ACKNOWLEDGEMENTS

Todd Bonds and Kelli Lee would like to thank Dr. Heng Wei, Associate Professor in the School of Advanced Structures, College of Engineering and Applied Science at the University of Cincinnati, Faculty Mentor and the Principal Investigator of this project; Mr. Zhixia Li, The Graduate Assistant/Mentor of the project and a doctoral candidate in Civil Engineering at the University of Cincinnati; Mr. Zhuo Yao, Ph.D. Student, Research Assistant, University of Cincinnati; Dr. Arnant Kukreti, Lead Principal Investigator, Research Experience for Teachers (RET) Director, Professor in the School of Advanced Structures, College of Engineering and Applied Science at the University of Cincinnati; Ms. Andrea Burrows, Grant Coordinator for NSF Grant # EEC0808696 “Civil Infrastructure Renewal and Rehabilitation”; Northern Kentucky University, Covington, KY Independent Schools and Grant County, KY Schools; Heather Spurlin, Grant County School, KY; Shelley Chesnut, Grant County Schools, KY and the University of Cincinnati.

APPENDIX I: LESSON PLAN TEMPLATES:

For Lesson 1 By Todd Bond:

Lesson Name: _____"May the Force Be With You" _____|_____ **Fellow Name: Todd Bonds**_____

Subject: ___Physical Science_____ **Grade Level:** ____6____ **Duration:** ___1_____

Analyze Learners: **Overview & Purpose (Energy theme)** Students will explore friction different weather conditions. • **A** – Engineering application (Explore friction during different weather conditions) • **C** – Engineering career connections (Transportation planner, Highway Design, ITS Engineer, Meteorologist) • **S** – Societal impact (Safety)	**Education Standards Addressed: Kentucky** SC-06-1.2.1 Students will describe friction and make inferences about its effects on the motion of an object. When an unbalanced force (friction) acts on an object, the change in speed or direction depends on the size and direction of the force. • DOK 3 • Addresses Science and Technology components of STEM

Select Goals & Objectives	**Teacher Guide**	**Student Guide**	
Goals (learn/understand) **And Objectives** (measurable) (Specify skills/information that will be learned.)	• Students will explore friction mimicking different weather conditions. • Students will also analyze systems and predict outcomes based on their knowledge of the system and their understanding of the concept.	• **Misconceptions** about this topic: Misconceptions about static and rolling friction	**Materials Needed** • Paper • Pencil • Plastic Cups • String • Plastic Disc • Balloons • Observation sheet • Science Notebook • Fine and Coarse sandpaper • 2 Large trays • A ramp/inclined plane
Select Instructional Strategies – (Give and/or demonstrate necessary information)	The teacher will use pre and post assessments to evaluate student progress. The teacher will also show the students a video from The Weather Channel regarding different weather patterns and their ability to cause damage. This should actuate prior knowledge. Also students will be divided into groups to share different ideas and predictions.	Students will be placed in groups of varying ability. And they will volunteer to demonstrate their knowledge verbally.	
Utilize Technology	• Computer • Smart Board	• Computer www.weather.com/outlook/videos/?subcatid=293	**Other Resources**

Require Learner Participation **Activity** (Describe the procedure and/or independent activity to reinforce this lesson)	The teacher will welcome students to class and begin the activity by asking students about today's weather. The teacher will then begin a formative assessment regarding the pre and post assessment questions listed below. This should take 4-6 minutes. • 1. Name something that weather can have an effect on and how? • 2. What type of weather pattern can have the biggest effect on us and why? • 3. Name some ways that moisture and wetness are good things and how or why are they good things. • 4. Name some ways that moisture and wetness are bad thing and how or why are they bad things. • 5. How does the wind play an effect on us and the environment? • 6. How can cars and trucks play an effect on the environment? The teacher will then play video from www.weather.com/outlook/videos/?subcatid=293 titled "Top Hurricane Moments". This should be no longer than about 10 minutes. Students will then be divided into groups. The teacher will explain the various stations of activities regarding the assignment. The stations were set up prior to students arriving. Students will be placed into groups of varying levels. One student will be responsible for collecting observation sheets for each member of the group. Students will spend approximately 5-7 minutes at each	The teacher will welcome students to class and begin the activity by asking students about today's weather. The teacher will then begin a formative assessment regarding the pre and post assessment questions listed below. This should take 4-6 minutes. • 1. Name something that weather can have an effect on and how? • 2. What type of weather pattern can have the biggest effect on us and why? • 3. Name some ways that moisture and wetness are good things and how or why are they good things. • 4. Name some ways that moisture and wetness are bad thing and how or why are they bad things. • 5. How does the wind play an effect on us and the environment? • 6. How can cars and trucks play an effect on the environment? The teacher will then play video from www.weather.com/outlook/videos/?subcatid=293 titled "Top Hurricane Moments". This should be no longer than about 10 minutes. Students will then be divided into groups. The teacher will explain the various stations of activities regarding the assignment. The stations were set up prior to students arriving. Students will be placed into groups of varying levels. One student will be responsible for collecting observation sheets for each member of the group. Students will spend approximately 5-7 minutes at each station before rotating. There will be three runs at each station per group.	

Evaluate (Assessment) (Steps to check for student understanding; Evaluate goals and Assess objectives)	• **Essential/Review questions** 1. How do the different weather patterns affect our environment? 2. Name something that weather can have an effect on and how? 3. What type of weather pattern can have the biggest effect on us and why? 4. Name some ways that moisture and wetness are good things and how or why are they good things. 5. Name some ways that moisture and wetness are bad thing and how or why are they bad things. 6. How does the wind play an effect on us and the environment?	Students will demonstrate knowledge of the following questions by writing their answers down on a piece of paper: 1. Name something that weather can have an effect on and how? 2. What type of weather pattern can have the biggest effect on us and why? 3. Name some ways that moisture and wetness are good things and how or why are they good things. 4. Name some ways that moisture and wetness are bad thing and how or why are they bad things. 5. How does the wind play an effect on us and the environment?	**Pre/Post Test Questions:** 1. Name something that weather can have an effect on and how? 2. What type of weather pattern can have the biggest effect on us and why? 3. Name some ways that moisture and wetness are good things and how or why are they good things. 4. Name some ways that moisture and wetness are bad thing and how or why are they bad things. 5. How does the wind play an effect on us and the environment?

Reflection on Lesson: (Note – Supporting documents, Poster, and video Tutorial are available on this lesson as well.)	After the lesson is taught: • What happened? • What did you learn? • How would you change your lesson next time?	**Is this a MIDDLE SCHOOL lesson? __Yes___** If not, please explain how it could be:	**Is this a HIGH SCHOOL lesson? __N___** If not, please explain how it could be: I could be use more technology to have the students do more exquisite experiments with the work, such as building a weather balloon

For Lesson 2 By Kelli Lee:

Lesson Name: _____Kelli Lee_____ Partner Name: _____Todd Bonds_____ Subject: ___Science_____ Grade Level: ____8_____ Duration: ____1 hour_____			
Analyze Learners: Overview & Purpose (Signalized Intersections: "Traffic"): 1		Education Standards Addressed: 2	
Select Goals & Objectives	Teacher Guide	Student Guide	
Goals: Objectives:	Goals: 3	Misconceptions 4	Materials Needed 5
Select Instructional Strategies –	6	6	
Utilize Technology	7	7	Other Resources: 13
Require Learner Participation Activity	8	9	
Evaluate (Assessment)	Essential/Review questions: 10	Pre and Post assessment: 11	Pre/Post Test Questions: 12
Reflection on Lesson:	16	Is this a MIDDLE SCHOOL lesson? __Yes_X__ 14	Is this a HIGH SCHOOL lesson? __NO_X__ 14

1. **ACS**
   - **a.** Application: Improve delay and CO emissions at signalized intersections
   - **b.** Careers: City Planner, Transportation Planner, ITS Engineer, Civil & Environmental Engineer, Highway Designer, Research
   - **c.** Societal Impact: Decrease delay and emissions, safety, cleaner air

2. **Kentucky Educational Standards**
   - SC-08-4.7.2 Explain the interactions of the components of the Earth system (e.g., solid Earth, oceans, atmosphere, living organisms);
   - Propose solutions to detrimental interactions. DOK 3
   - PL-08-3.3.01 Students will describe consumer actions (reuse, reduce, recycle) and explain how these actions impact the environment (e.g., conserving resources, reducing pollution, reducing solid waste, conserving energy).

3. **Research Goal**

   Improve vehicular delay and CO emissions at signalized intersections.

(Student connection using idling buses at the bus dock to make direct connection and easier access during research)

Learning Goal: Develop an understanding and knowledge of the Application, Careers, and Societal Impact of engineering.

Student Objective: Students will collect delay and CO concentration of the idling buses at the school bus dock.

4. Misconceptions

- CO emissions vs CO concentration: CO emission is what is emitted from vehicle. CO concentration is dispersed in the air where wind, temperature, pressure, etc... are all factors that affect it. Concentration is measured in particles per million (ppm)
- Moving vehicles emit more CO than an idling vehicle. False: Because an idling car emits 3.5 more times the emissions than a moving vehicle
- Traffic Composition: exclusively cars and trucks (includes bikes, peds, motorcycles, etc…)
- Intelligent Transportations Systems are intrusive.

(ITS is not intrusive, there are methods of using more ITS that are intrusive but these are not used in US. Some countries have installed the intrusive GPS "black box" in taxi cars/vans to collect the "intrusive" data)

5. Materials Needed

Notebook Journal/Paper, Pencil, CO monitor, Data Charts, Video Camera

6.Instructional Strategies

Teacher:	Student:
Data Collection	Pair/Share
Guiding/Coaching	Small/Whole group discussion

7. Technology for Teacher and Students:

Computers	Microsoft Excel
Digital Video Recorder	CO monitor

8. Procedure:

***If your whole class cannot stay after school to collect data consider stay 2-4 days to give students opportunity to stay so all can take part in collecting data. IF you do this way each group will be responsible for analyzing their own data when the time come to do so.*

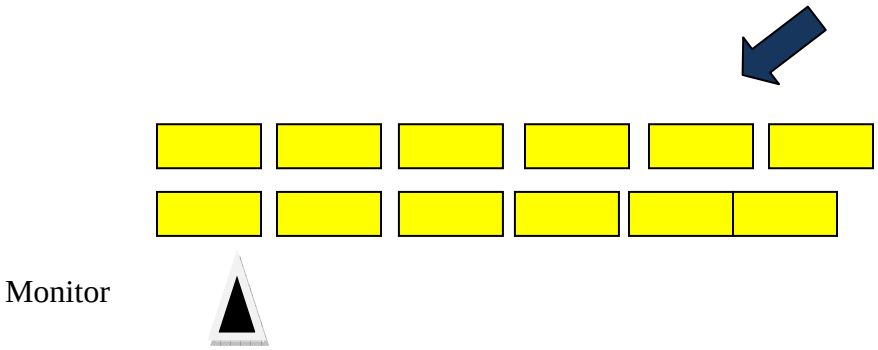
The class hour before data is collected after school:

Flashback: Create a LIST of other factors we should consider in collecting our CO data. Write one sentence to EXPLAIN each factor on your list. (Hopefully they will come up with wind, heat, rain, overcast, etc… Only collect data on day's weather is clear.)

Have your students look up online the weather conditions for your area in order to place the monitor.

Video Camera: tape the whole duration of your data collection. You want to record the bus area in case you need to refer to it later.

Below is an example of set up however this is considering wind is going in the direction of the arrow.



Camera and Students with stopwatch and data sheets

9. **Student Data Collecting Assignments:**
   1. Camera Crew: 1-2 students
   2. Stop watch and Counters: You can have several doing this just have them in groups of two or three if you are having whole class do together. One student on stop watch and others are counting per three man group.
   3. No one needs to stay with CO monitor because it is not to be bothered once you start collecting data until you are done.

10. **Essential Questions:**
    1. How does delay and CO concentrations impact the environment around us?
    2. *CONTRAST* CO emission and CO concentration.
    3. *LIST* and *EXPLAIN* how 3 other factors could affect the CO concentration data.
    4. *PREDICT* patterns between delay (stopped buses) and CO concentration.
    5. *EVALUATE* data collected and *SUMMARIZE* your findings.

11. Pre/Post Assessment:

1. *CONTRAST* CO emission and CO concentration.
2. *LIST* and *EXPLAIN* how 3 other factors could affect the CO concentration data.
3. *PREDICT* patterns between delay (stopped buses) and CO concentration.
4. *EVALUATE* data collected and *SUMMARIZE* your findings.

12. Pre/Post Questions:

1. *CONTRAST* CO emission and CO concentration.
2. *LIST* and *EXPLAIN* how 3 other factors could affect the CO concentration data.
3. *PREDICT* patterns between delay (stopped buses) and CO concentration.
4. *EVALUATE* data collected and *SUMMARIZE* your findings.

13. Other Resources:

Prior Knowledge:

- General History of Engineering (including use of Bill Nye: "Engineering" video from United Streaming)
- Understanding of Different Areas of Engineering
- 7 Modern Wonders of the World and their connections to engineering
- Careers based in each area of engineering
- History of the Traffic Light and Signalized intersections
- Methods used to measure delay and CO data
- PowerPoint and 3 minute: Video on Simulation Based Impact Analysis of Signalized Intersections
- Analysis of Delay and CO graphs to find evidence of relationships and patterns with number of vehicles delayed and CO concentration
- Brainstorming session to get students to come up with Idling Buses at the school bus dock to find the impact of Delay and CO emissions

14. Is this a middle school lesson?

This is a middle school level lesson however it can easily be adapted for high school by increasing components tested, adding a formal research paper, less direct help from teacher(s), etc….

Elementary schools have conducted similar projects by using the Kentucky Green and Healthy Schools Transportation Inventory as a guide so it can be adapted for an elementary class.

The background information concentrated on the Signalized intersections of the Traffic research conducted by Kelli Lee and Todd Bonds through the UC RET Program. However, this lesson has been develop

APENDIX II: WORKSHEETS

For Lesson 1 By Todd Bonds:

www.weather.com/outlook/videos/?subcatid=293 ;

Station 1		Station 2		Station 3		Station 4	
What we did	Observations	What we did	Observations	What we did	Observations	What we did	Observations

For Lesson 2 By Kelli Lee:

Minute (over 1 hour)	Number of Buses	Minute	Number of Buses

APPENDIX III: LESSON PLAN DEVELOPMENT SCHEDULE

For Lesson 1 By Todd Bonds:

Day One: Intro to lesson and begin stations, video

Day Two: Finish stations, complete 30 minute writing assignments

For Lesson 2 By Kelli Lee:

One day unless all students cannot stay after then same lesson may be completed 2 or 3 different times but all will only take one hour.