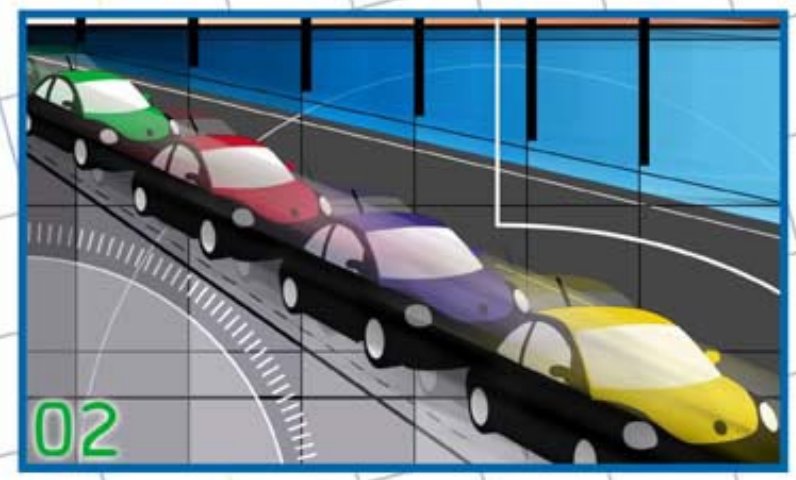
Traffic

on the Information Superhighway



Unit 1

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A publication of The University of Hawai'i's
Curriculum Research & Development Group

Introduction and Overview

Introduction

Traffic on the Information Superhighway is a two-part integrated mathematics unit that focuses on data collection and statistical analysis. The unit, which is suitable for students in grades 6–8, is aligned with the National Council of Teachers of Mathematics (NCTM) (2000) *Principles and Standards for School Mathematics*. It is based on a specific Internet site that provides data on traffic flow in a large city. The data available at the site is updated continuously, providing students with an opportunity to collect, organize, and represent data, to pose researchable questions, to make hypotheses, to draw conclusions, and to communicate to others what they have learned.

Traffic on the Information Superhighway is divided into two parts, *Unit One* and *Unit Two*. The two parts are complementary although not dependent on each other. In *Traffic: Unit One* (this unit), students become familiar with the Internet site and topic, choose and create appropriate graphs representing traffic data, and analyze and compare data sets using measures of center and spread. In *Traffic: Unit Two* students pose research questions, design and implement an investigation, and create, share, and evaluate results. The last section of *Unit Two* gives students an opportunity to find a new real-time data site on the Internet and to create their own investigations using the data from that site.

Overview: Traffic: Unit One

Traffic: Unit One is divided into two sections, each of which is divided into several lessons. Lessons may take more than one class period depending on students' familiarity with the Internet, spreadsheets, data collection, and data analysis. *Unit One* should take approximately two weeks to complete.

In the first section, *A Test Drive*, the students become familiar with the Internet site, learn the type of data it contains, gather data, and decide how that data might be used. In the first lesson, *Looking At Traffic Flow*, students explore the Internet site to see what information is available and what other sites are linked to it. In the second lesson, *Sharing Our First Road Trip*, students share with their peers what they found at the Internet site, discuss the meaning of the items in the data table at the traffic site, and enter data into a spreadsheet program.

In the second section, *A Different View of Traffic*, the students focus on data collection, learn about variables, and use graphs and measures of center to analyze data . In the first lesson, *Pulling Into Traffic,* students learn about the concept of variables and they use a spreadsheet program to create graphs. In *When Should I Leave?*, the second lesson, students input and manipulate two or more data sets in a spreadsheet and generate graphs of the data sets. The third lesson, *Finding the Middle of the Road,* introduces students to measures of center (mean, median, mode) and spread (range).

Overview: Traffic: Unit Two

In *Traffic: Unit Two* students learn to evaluate and pose research questions, design and carry out their own investigation based on the Traffic site, and present the results of their investigation. *Unit Two* may be used with students who have not completed *Unit One,* provided they have sufficient background in creating graphs and calculating measures of center and spread. The two sections can be used independently throughout the year: *Unit One* can be used early in the school year and *Unit Two* later in the school year as topics arise in the curriculum. Or *Unit One* can be used early in the middle grades and *Unit Two* in a subsequent school year. The entire unit could also be used in an ongoing way throughout the school year as content topics arise.

The following chart provides time-allocation estimates for the lessons. Time spent on the computer is in addition to class time listed. The time needed to complete both sections will vary depending on students' familiarity with the Internet, spreadsheets, and the research process. Lessons may take more than one class day. Most lessons contain material for a variety of student achievement levels. Teachers will need to review the text and choose material appropriate for their students.

Unit Time Allocations

Section 1 - A Test Drive: An introduction to the Internet site and traffic data

Lesson	Mathematical Description	Class Time (minutes)	Computer Time (minutes)	Total
Lesson I Looking at Traffic Flow	Introduction to the unit; explore the Internet traffic site.	20	30	50
Lesson II Sharing Our First Road Trip	Discussion of traffic data and variables; enter data into a spreadsheet.	40	15	55

Section 2 - A Different View of Traffic: An introduction to data analysis including graphs, spreadsheets and measures of center and spread

Lesson	Mathematical Description	Class Time (minutes)	Computer Time (minutes)	Total
Lesson III Pulling Into Traffic	Create graphs; discuss choosing appropriate graphs	30	30	60
Lesson IV When Should I Leave?	Explore pairs of variables and multiple data sets; create graphs displaying more than one data set.	20	30	50
Lesson V Finding the Middle of the Road	Discuss, explore and calculate measures of central tendency (mean, median, mode) and measure of spread (range).	50	50	100

Unit Goals by Lesson

	Lesson				
	1	2	3	4	5
Use Internet sources and a spreadsheet program to assist in gathering, analyzing, organizing, and presenting data.					
Choose, create, and utilize various graphical representations of data appropriately and effectively.					
Interpret graphical representations of data.					
Compute, describe, and interpret mean, median, and mode as measures of the center of a data set; know which measure is best to use in particular situations; and understand how each does and does not represent the data.					
Compute, describe, and interpret the spread of a data set using the range.					
Compare data representations to determine which aspects of the data they highlight or obscure.					
Analyze associations among variables by comparing the centers, spreads, and graphical representations of related data sets.					
Formulate conclusions and make recommendations based on data analysis.					
Use data to answer questions posed, and understand the limitations of those answers.					
Organize and consolidate mathematical thinking to facilitate communication with others.					
Express mathematical ideas coherently and clearly to peers and teachers.					
Extend their mathematical knowledge by considering the thinking, ideas, and strategies of others.					

Guidelines for Teaching the Traffic: Unit One

Unit Structure

The unit is divided into two sections, each of which is divided into two or three lessons (see chart on page ix). Some lessons may take more than one class period depending on the students' familiarity with the Internet, spreadsheets, data collection and analysis.

The following information is provided for each lesson: materials needed (PREPARING FOR THE TRIP), student objectives (DESTINATION), lesson launch (STARTING THE ENGINE), task sequence (DRIVING DOWN THE ROAD), assessment ideas (CHECKING THE OIL), and lesson closure (PARKING THE CAR). Also included are lesson suggestions, questions for discussion, definitions of mathematical terms, potential areas for review and extension (REST STOP), and suggestions for homework. A brief description of the lesson (LESSON OVERVIEW) is also provided for easy reference.

As students work on the unit, they will be required to collect data, answer questions, and record their thoughts and conclusions. For each lesson, student guide (SG) sheets are provided as a place for students to record their work. Prior to the lesson, the teacher should photocopy these sheets (or an adaptation of them) for each student to use.

Material is provided for a variety of student achievement levels and emphasis. Teachers should choose material and assign homework that is appropriate for their students and their class curriculum.

Assessment

Assessment of student learning is embedded in the unit and should be an integral part of ongoing classroom activity. It is essential that during the teaching of the lessons a variety of assessment techniques be used to gain an understanding of each student's knowledge of and ability to use mathematics and technology. Each lesson has a list of questions for homework, discussion, and/or quizzes. Teachers do not need to assign all of the questions. The goal is to provide enough questions to allow for flexibility and teacher choice. If teacher assessment shows that students lack knowledge in a particular area, classroom discussion can be enriched by using questions from the suggested list. Note that some questions have more than one correct answer. Several of the more difficult questions can be used as extension or enrichment for advanced students.

Lesson I

Looking at Traffic Flow

OVERVIEW (Brief Description of the Lesson)
Students will explore the traffic Internet site and begin to understand the data presented there.

PREPARING FOR THE TRIP (Materials)
- student guide (SG-1): "Looking at Traffic Flow" for each student
- computer with Internet connection and an Internet browser such as Netscape or Internet Explorer for student use
- computer with Internet connection and projection capability for demonstration and discussion (optional for the teacher to use)

DESTINATION (Student Objectives)
The student will
- acquire and interpret information from on-line sources.

STARTING THE ENGINE (Lesson Launch)
Students should be given an overview of the entire *Traffic: Unit One* and what they will be expected to do in the unit. They will be asked to collect, organize, and summarize data, make hypotheses or conjectures, draw conclusions from the data, and communicate what they have learned. Students will access the Internet to gather data and will use a spreadsheet to organize and represent data.

Explain to students that the purpose of the first component is to explore the Internet traffic site and learn about the types of traffic data available.

One way to introduce this unit is to ask students to think about the Internet and the information it provides to people. Explain how accessing one site can connect them to many related sites. In this lesson students will visit the Minnesota Department of Transportation's traffic site, explore it, and then examine sites that are linked to it. After telling students the name of the site, ask them what information they think might be available at this site and sites linked to it.

DRIVING DOWN THE ROAD (Task Sequence)
Give each student a copy of the student guide (SG-1) to help them through this lesson. Students should explore the Traffic site using an Internet browser and the student guide. Depending on the number of computers available, students can work individually or in small groups.

Technology Tip

Linked sites are those that can be easily accessed by clicking on icons, text, or graphics located at the current site. Words that are underlined generally identify linked sites. Sometimes when clicking on a link, the browser opens a window on top of the current window. When this happens, the back button will not work. The student will need to click the close box in the upper right-hand corner to return to the previous screen. For example, when students go to the map page from the traffic site, they need to click the close box to return to the traffic page.

Teaching Tip

Depending on student familiarity with the Internet, the teacher might want to explain how to use the Internet and the functions of the browser (forward, back, links, search, bookmarks, etc.).

In the Twin Cities area, Interstate 35 splits into two highways: 35E runs north/south through St. Paul and 35W runs north/south through Minneapolis. Tell the students that the E and W are part of the name of each highway and do not indicate the direction of the traffic. Students can see a visual display of the highway system by clicking on the traffic map link at the site.

Allow students enough time (at least 30 minutes) to explore the site and record in their student guides what information and data are available.

REST STOP **-** Read about time zones and compute time differences between various time zones. Be sure that students understand Minnesota is in the Central Time Zone and that they know what time zone they live in.

CHECKING THE OIL (Assessing Ideas)
Sources of information on student progress and understanding.

- observation of students
- responses to student guide
- questions from the "Homework, Assessment, or Discussion" section

PARKING THE CAR (Lesson Closure)
Help students summarize the lesson by discussing their responses on the student guides, questions from the suggestion list that follows, and the following points:

- the site is dynamic, that is, it is updated continuously
- the traffic data at the site provide current information, not data from a previous hour, day, or month
- live data are referred to as real-time data
- each time students click on the reload button, they will receive current information from the site

In Lesson I, students become familiar with the traffic web site. In Lesson II, they will learn in detail what each item in the traffic table represents.

Assign homework.

Teaching Tip

One way to illustrate a dynamic site (real time) is by using playing cards like UNO cards. Start flipping the cards so they land face down on the table. Ask a student to take a card from the table and give its name. Continue to flip through the cards. Have the student take a second card and give its name. This illustrates how the cards on the table are continuously changing. The cards you are flipping represent the dynamic site and the cards the student takes represent the data on the screen. The data on the screen won't change unless the student tells the computer to reload, just as the students' cards won't change unless they take a new card from the table. Both the cards being flipped and the actual traffic at the site continue to change.

SUGGESTIONS FOR HOMEWORK, ASSESSMENT, OR DISCUSSION
Teachers can assign one or more of the following [it is highly recommended students answer and discuss question 4]:

1. Write a paragraph summarizing the structure of the traffic site and the information found on it.

2. Speculate about who visits this site and how they might use the data.

3. Describe information you would add to the traffic site.

4. Use the data table below to answer the following questions. Note that the sensors begin south of downtown, go through downtown, and end north of downtown. That is, sensor 828 is the southernmost sensor, 619 is in the downtown area, and 630 is the northernmost sensor.

   Note that the two mph columns give two different ways of computing average speed. The two ways are discussed in detail in the next lesson.

Northbound Interstate 35E

Sensor Number	Location	30 sec av speed (mph)	6 min av speed (mph)
828	Highway 110	67.3	60.2
831	Highway 13	60.9	59.0
832	Shepard Rd	67.5	74.2
834	Randolph Ave	60.0	59.2
837	St. Clair Ave	60.0	60.2
839	Kellogg Blvd	58.2	64.3
619	I-94	53.1	56.2
622	Cayuga St	53.0	54.9
624	Maryland Ave	61.1	61.0
625	Wheelock Pkwy	64.7	61.9
626	Larpenteur Ave	57.5	59.8
627	Roselawn Ave	75.2	71.2
629	Highway 36	56.0	55.9
630	Little Canada Rd	50.0	48.4

   a) Where on the highway does traffic speed up? Are your answers the same whether you consider the 30-second average or the 6-minute rolling average?

   b) Sensor 831 is 3 miles from sensor 832. Using the 30-second average, estimate how long it will take to drive from sensor 831 to 832. Using the 6-minute rolling average, estimate how long this drive will take.

   c) Sensor 832 is 25 miles from sensor 625. Using both the 30-second and 6-minute rolling averages, estimate how long it will take to drive from sensor 832 to 625.

   d) Sam has two different routes he can take to work. If he uses the first route, he drives 5 miles eastbound on Cayuga Street, takes Interstate 35E for 14 miles until he reaches Highway 36, and then takes Highway 36 for 1 mile to his office. On the second route, he drives 8 miles on Maryland Avenue, takes Interstate 35E for 11 miles until Highway 36, and takes Highway 36 for 1 mile to his office. Assuming he can drive an average of 35 mph on both Cayuga Street and Maryland Avenue, which route is faster? Justify your answer.

   e) At sensor 627, the 30-second average speed is greater than the 6-minute rolling average speed. What does this suggest about traffic speed at sensor 627?

5. Write a question that can be answered using the data table in problem number four.

6. Create a story about the traffic web site. For example, describe someone who uses this site and how it affects his or her life; or write a science-fiction story; or describe the people who created this site and how they might have created it.

7. Examine the traffic flow (number of cars) data. What do you think are the effects of traffic on the environment? On people?

8. Find another site on the Internet with dynamic data. Record the information it contains and how to find the site. Write a summary of the data at this site.