

Impact of Traffic Lights on Traffic Flow

Students analyze the impact of traffic light synchronization on traffic flow. For grades 7-12.

INTRODUCTION

Culminating Activity:

You are a traffic engineer working for the City of Fresno in Fresno, CA. Due to heavy construction on Shaw Avenue between Fresno Street and First Street, eastbound traffic is being routed to Gettysburg Avenue and westbound traffic is being routed to Barstow Avenue. This means that traffic on these streets will increase by a factor of 3. Explain in a business memo how to optimize the timing of the stoplights on these two streets for a new maximum traffic flow.

Checking for Understanding & Engagement

- What role will you be placed in for this lesson?
- What problem does the culminating activity center on?
- What aspect of this activity interests you the most?

NOTE: Throughout the lesson students will log their confidence and concerns using a Metacog Log, as described on page 112 of *The Art and Science of Lesson Design* by John Walkup and Stephon Squire.

Objectives (Students Will Be Able To...)

- Students will optimize the timing of the stoplights on two streets to maximize traffic flow.
- Students will write a business memo.

ACTIVITIES IN THIS LESSON

Engagement

Group Work

Activity

This lesson plan incorporates the 5E method developed by BCSC and described on p. 110 of *The Art and Science of Lesson Design*. This activity is Step 1, Engagement.

Engagement—connect past and present learning experiences, expose prior conceptions, and organize students' thinking toward the learning outcomes of current activities.

Students play the game called [Gridlock Buster](#), which is useful for teaching students about signal timing and traffic flow.

Checking for Understanding & Engagement

- What was hard about playing Gridlock Buster?
- Did you learn anything playing Gridlock Buster?
- In your own words, describe what we mean by *traffic light synchronization*.
- Describe the various factors that affect when a traffic light should turn green.

The class then discusses what signal timing patterns students have encountered. The teacher then uses rehearsal strategies to teach students three basic signal patterns.

Checking for Understanding & Engagement

- Draw a diagram of one signal pattern.
- What are some signal patterns you have encountered?

Exploration

Group Work

Activity

This activity is Step 2, Exploration:

Exploration—assign lab activities that help students use prior knowledge to generate new ideas, explore questions and possibilities, and design and conduct a preliminary investigation.

The instructor prompts students to examine the Google Maps street layout of Fresno, CA with respect to the changes in traffic pattern described in the culminating activity. Students can view the existing traffic lights using the Street View feature of Google Maps.

The teacher then assigns students a reading exercise centered on the following articles:

- Wikipedia entry for traffic optimization.
- Wikipedia entry for induction loop.
- Wikipedia entry for traffic light control and coordination.

This part then involves the instructor using elaboration strategies to teach students the different parts of a traffic signal. Rehearsal cognitive strategies are used to help students remember what inductive loop detectors are and how they operate.

Checking for Understanding & Engagement

- Describe in your own words what is meant by an inductive loop.
- Name one part of a traffic signal.
- By what mechanism do loop detectors operate? (induction)

Explanation

Group Work

Activity

This activity is Step 3, Explanation:

Explanation—focus students’ attention on a particular aspect of their engagement and exploration experiences and provide them opportunities to demonstrate their conceptual understanding, process skills, or behaviors.

This part involves teaching students how traffic stoplights can be used to help traffic flow more smoothly. Rehearsal cognitive strategies are used to help students remember the difference between pre-timed and actuated stoplights. Elaboration strategies are used to help students understand the function of a traffic management center.

Working in informal groups, students complete a graphic organizer that summarizes their strategy for modifying the traffic light synchronization on Gettysburg and Barstow Avenues.

Checking for Understanding & Engagement

- How do loop detectors guide stoplight timing?
- Describe stoplight coordination in your own words.
- Explain how signal timing helps or hinders traffic flow.
- Why do you think signal timing matters?

Elaboration

Group Work

Activity

This activity describes Step 4 of the 5E method, Elaboration:

Elaboration—challenge and extend students’ conceptual understanding and skills through additional activities that compel students to apply their understanding of the concept.

Students examine the layout of the region near Barstow, Shaw, and Gettysburg Avenues in Fresno, CA. Working in groups, they evaluate the impact that street closures, and a tripling of traffic on Barstow and Gettysburg Avenues will have on traffic congestion. They then discuss how changes in the synchronization will impact traffic congestion.

Checking for Understanding & Engagement

- Why are detectors important for signal timing?
- What would be the impact of coordinating stoplight timing?
- Draw a diagram of one signal pattern.
- Which of signal patterns we learned seems best and why?

Evaluation

Group Work

Activity

This activity describes Step 5 of the 5E method, Evaluation:

Evaluation—encourage students to assess their understanding and abilities and provide opportunities to evaluate their progress toward achieving the educational objectives.

Students answer the following questions to raise their engagement levels and promote metacognition.

Checking for Understanding & Engagement

- What are the benefits of actuated stoplights?
- What are pros and cons of pre-timed stoplights?
- Why does signal timing matter?

- Which parts of your graphic organizer are you confident about? Which parts concern you?
- Did you disagree with your teammates on any part of the graphic organizer when completing it?
- Which signal pattern we have learned seems best and why?
- What was the most important part of this lesson and why?
- What part of this lesson was most difficult and why?

Career Exploration

Group Work

Activity

This part involves an overview of traffic engineering as a career. Rehearsal strategies are used to help students remember traffic engineer pay scales and hours and that there is a career for traffic planning and operations.

The teacher uses elaboration cognitive strategies to help students understand the benefits and drawbacks of being a traffic engineer. The teacher will do a think-aloud to show the students how they would explain jargon in simple terms.

To complete this activity, students can peruse the Wikipedia entry for transportation engineering, then the CareerExplorer for the transportation planner career. Glassdoor.com provides salaries for transportation engineers, of which traffic engineers are a subcategory.

Students read an online article about traffic management centers. (A field trip to a local traffic management center would be ideal, if feasible.)

Checking for Understanding & Engagement

- Who hires transportation engineers?
- How much do transportation engineers make?
- What kind of skills do transportation engineers use?
- Tell me one important job function of a transportation engineer.
- Describe in your own words the traffic management center.
- Describe the function of a traffic management center.
- Would you consider a career as a traffic engineer and why or why not?

Vocabulary Development

Lecture

Activity

Using the Frayer Model, the instructor develops student vocabulary centered on the terms *synchronous*, *actuated*, *optimize*, *induction*, and their derivatives (such as *synchronize*, *optimization*), with most attention devoted to their spelling.

Checking for Understanding & Engagement

- Say *synchronous* out loud.
- Write a sentence containing the words *inductive* and *actuated*.
- Write a sentence containing the words *synchronization* and *optimization*.
- Which word gives you the most trouble to spell? Which word is hardest to pronounce?

SUMMATIVE ASSESSMENT

Assessment Type: Writing Samples

This part involves teaching students the elements of a business memo. Rehearsal cognitive strategies are used to help students remember that business memos require a proper structure. Elaboration cognitive strategies are used to help students write a business memo.

Using an online tutorial provided by the Writing Center at George Mason University, students develop a memo explaining the manner in which they think the timing of traffic lights in Fresno near Gettysburg and Barstow Avenues should be modified.

Instructor will grade each student's business memo for structure, content, and organization. Low-level spelling and grammar are only marked to the sixth line of the memo and not incorporated into the student's final score.

Checking for Understanding & Engagement

- Name a standard element of a business memo heading
- What is the purpose of a business memo?
- What is the difference between a business memo and a letter?

Resources and Materials

- [Traffic Lights -- There's a Better Way](#)

Lesson Times

Engagement: 15 minutes

Exploration: 15 minutes

Explanation: 25 minutes

Elaboration: 20 minutes

Evaluation: 15 minutes

Career Exploration: 15 minutes

Vocabulary Development: 10 minutes

Industries / Subjects / Grades

Industries / Pathways

- Transportation
- Operations

K-12 Subjects

- English-Language Arts

Grade Levels

- 7, 8, 9, 10, 11, 12

Standards and Objectives

Standards

California's 2013 CTE Standards

- **CTE.T.A.7.2** Recognize the need for traffic signals, signs, and markings.
- **CTE.T.KPAS.5.2** Solve predictable and unpredictable work-related problems using various types of reasoning (inductive, deductive) as appropriate.
- **CTE.T.KPAS.5.1** Identify and ask significant questions that clarify various points of view to solve problems.
- **CTE.T.KPAS.5.3** Use systems thinking to analyze how various components interact with each other to produce outcomes in a complex work environment.

Author: Trenton Clutter

First Authored: December 18, 2019

Last Revised: December 18, 2019