

# MODULE 1: CRASH PREVENTION

## LESSON 4: TRAFFIC CONGESTION

### GRADE LEVEL: 6 - 8

When a roadway crash occurs, normal traffic routes can be disrupted, leading to delay, congestion, frustration, and potentially other secondary crashes. The time it takes to clear incidents relates to the ability of first responders, medics, and other emergency service providers to access the incident site and remove debris, vehicles, and those who were injured. The types of technologies currently used to inform drivers of upcoming road conditions and instruct road users to take specific precautions are introduced to students in this lesson plan.

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# Lesson 4 – Traffic Congestion

## Using Intelligent Transportation Systems (ITS) to Improve Incident Response Time

**Contributed by:** Nanosonic, Leidos, Giles County Public Schools

<b>Grade Level:</b> 6 - 8	<b>Lesson in this Module:</b> 4 of 4
<b>Time Required:</b> 60 minutes	<b>Lesson Dependency:</b> None
<b>Keywords:</b> transportation engineering; intelligent transportation systems; crash avoidance; congestion	

### Related Curriculum

<b>Subject Areas</b>	Science; technology; engineering; mathematics
<b>Curricular Units</b>	Intelligent transportation systems
<b>Activities</b>	Discussion on congestion; crash congestion case studies

### Educational Standards

This lesson plan and its associated activities are correlated to the national standards in the each of the core discipline areas of STEM: Next Generation Science Standards, American Association for the Advancement of Science Standards, Standards for Technological Literacy, International Society for Technology in Education Standards, Common Core Mathematics Standards, and the National Council of Teachers of Mathematics Standards.

## Pre-Requisite Knowledge

Lessons 1 through 3 of this Module.

## Learning Objectives

- Students will understand the causes of congestion as it relates to motor-vehicle crashes.
- Students will learn how this congestion affects emergency medical services.
- Students will understand how ITS and connected vehicle (CV) systems improve traffic flow after a crash occurs allowing EMS to arrive in a timely manner.
- Students will work together in cooperative learning groups to simulate real-world problems and solutions.

## Introduction/Motivation

As drivers, we have come to expect direct and immediate access to our frequently-visited locations. Most times, this expectation is met; however, disruptions can occur that impede this ability. When a roadway crash occurs, normal traffic routes can be disrupted, leading to delay, congestion, frustration, and potentially other secondary crashes. The time it takes to clear incidents and corresponding congestion relates to the ability of first responders, medics, and other emergency service providers to access the incident site and remove debris, vehicles, and those who were injured. The types of technologies currently used to inform drivers of upcoming road conditions and instruct road users to take specific precautions are introduced to students in this lesson plan.

## Lesson Background & Concepts for Teachers

Crashes, stalled vehicles, debris or spilled loads in the roadway are all examples of traffic incidents that contribute to traffic congestion on the highways. Traffic congestion caused by incidents affects the mobility and safety of all travelers. Imagine the effect of a traffic crash occurring on an interstate with three lanes, blocking one or two of the lanes, or even worse, all three lanes. Major incidents can very quickly cause traffic back-ups for miles. Problems multiply when the first incident causes other secondary incidents such as crashes, stalled vehicles, overheating, and running out of fuel. On some major roads in the United States, there are permanent signs installed along the highway designating a diversion route to help motorists navigate around and cut back on congestion in the event of an incident.



**ITS Detection Equipment**

(Image courtesy of: [pspc.harris.com/market/Transportation/ITS.aspx](http://pspc.harris.com/market/Transportation/ITS.aspx))

As you can imagine, the longer lanes are blocked and traffic is not moving freely, the likelihood of additional crashes increases, so it is important to have quick response to the incidents in order to clear the roadway. Law enforcement, emergency medical services (EMS), and fire and rescue are typically the first to respond to traffic incidents, although transportation agencies and the towing industry also play an important supportive role.



**Transportation Management Center (TMC)**  
(Image courtesy of: [www.itsinternational.com](http://www.itsinternational.com))

Besides someone calling 911 to report a crash, there are ways that technology can play a role in helping to quickly alert the first responders to an incident. One way is a system that is installed in some vehicles that can detect whether a crash or other malfunction has occurred and can automatically send notification to emergency personnel. Transportation agencies may also have ITS cameras or other detection equipment set up along the roadway which can help them identify traffic congestion and incidents. If a crash is identified, their traffic management centers (TMC) can then quickly report to emergency management agencies, such as law enforcement and EMS. TMCs can also adjust variable message signs to alert drivers of an incident and offer alternate routes, as well as changing variable speed limit signs to slow traffic in advance of the incident. Variable speed limits can reduce crash frequency, severity and the likelihood of secondary crashes by reducing the speed of vehicles as they approach an incident, traffic queue, or stopped traffic. More consistent speeds improve safety by helping to prevent rear-end and lane-changing collisions due to sudden stops.

Once notification has been sent to the emergency management agencies, getting to the scene of the incident can be a challenge. Traffic is probably already starting to back up and picking the fastest route is imperative. Traveler information systems that show the flow of traffic on different roadways can be beneficial to determining a quick route. There are currently many mobile applications available as well as some being offered directly through the State DOT.

Coordination between emergency responders, transportation agencies, and even private industry such as towing, is vital to managing and limiting the congestion and safety effects of traffic incidents. Technology can assist in providing accurate and timely information to help identify congested routes or incidents ahead and prepare motorists to slow down or take alternate routes.

## Vocabulary/Definitions

Vocabulary Word	Definition
<b>Intelligent Transportation System (ITS)</b>	Advanced applications which aim to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated, and 'smarter' use of transport networks.
<b>Traffic Management Center (TMC)</b>	Location that serves as a 24/7 central command post that monitors and control ITS technologies in order to provide motorists with reliable traveler information and coordination with incident responders by utilizing real-time traffic information.
<b>Variable message sign</b>	Traffic control device whose message can be changed to provide motorists with information about traffic congestion, traffic crashes, maintenance operations, adverse weather conditions, roadway conditions, or other highway features; also referred to as changeable message sign (CMS) or dynamic message sign (DMS)
<b>Variable speed limit</b>	Variable speed limits are speed limits that change based on road, traffic, and weather conditions. Electronic signs slow down traffic ahead of congestion or bad weather to smooth out flow, diminish stop and go conditions and reduce crashes.
<b>Traveler Information System</b>	Any system that collects, analyzes, and presents information to help travelers make decisions about route choices, estimate travel times, and avoid congestion

## Associated Activities

- **Activity 1 – Pre-class Activity**
- Teacher simulates traffic congestion by going out into the hallway during class-change times. By “accidentally” blocking their door while students are waiting to enter, a queue forms and grows as students make their way toward the classroom. This acts as an introduction to the lesson.

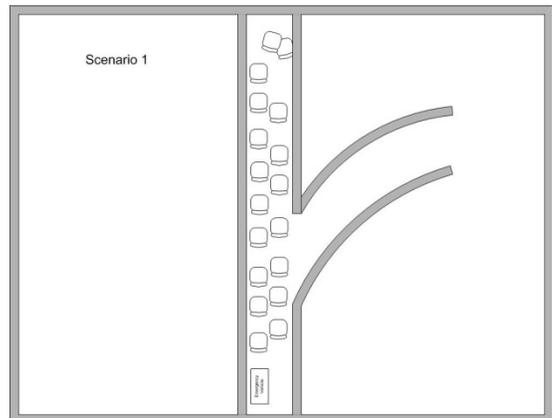
- **Activity 2 – Discussion on Hallway Congestion**

- Why was there extra congestion during this class change? (Teacher blocked door)
- How does this make you feel?
- What would've happened if there had been an emergency in the classroom and the nurse had to get into the classroom quickly?
- How can you relate this experience to transportation? Specifically, what happens when there is a crash on the highway and emergency vehicles need to get through?

- **Activity 2 – Congestion Role Play Activity**

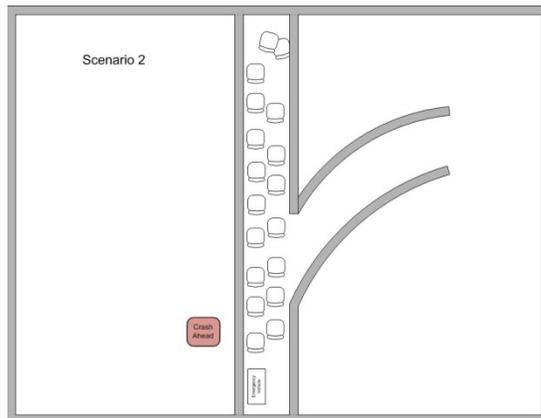
- Pre-assign the role of the emergency medical services (1-3 students pushing a desk), the changeable message sign holder (1 student), the roadside device (1 student), the crashed vehicles (2 students), optional videographer (1 student)
- Consider recording this activity with a video recording device so the students can observe the “traffic flow” in each scenario.
- Full-page images of the classroom setup are included in the appendix of this lesson plan.
- Scenario 1: Congestion with no ITS

- Place tape on the ground to simulate a roadway that is two and a half chair-widths wide.
- Pretend that there is a crash at the front of the road. (this blocks 1.5 chair widths)
- Each student sits in their chair (facing forward).
- Without communicating (no talking or gesturing), students need to make way for “emergency vehicle” personnel.



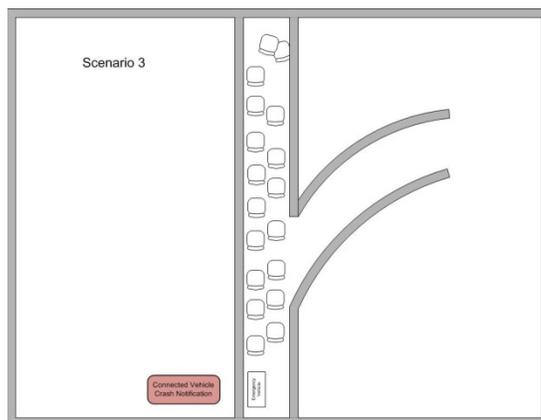
- Scenario 2: Congestion with Intelligent Transportation Systems

- Same scene (car crash at the front of the road)
- Hold up a sign that says “Crash Ahead” and allow students to choose a route that will get them to the finish line the fastest.
- This will demonstrate changeable message signs and their ability to reroute traffic in the case of a crash.



- Scenario 3: Congestion with Connected Vehicle Technology

- Same scene (car crash at the front of the road)
- One student is designated as the connected vehicle roadside device. This student is tasked with notifying students that a crash has occurred and that an emergency service vehicle is approaching from behind. The student indicates which way vehicles should move in order to make way for the emergency vehicle to pass by and assist the crashed car.



- Discussion on Outcomes

- Which way allowed the EMS to arrive fastest?
- Can you brainstorm any other methods for helping the EMS to arrive sooner?
  - Summarize your findings and post them on the educational social media site called Edmodo.

## Lesson Closure

- Students should conclude that the CV system and ITS technologies aid in reducing congestion after a crash and permits EMS to arrive on the scene in a timely manner.

## Extensions/Multimedia

- Contact your local traffic management center and arrange a field trip
- Sample websites with live traffic information:
  - Google Maps: <https://support.google.com/maps/answer/3093389?hl=en>
  - Mapquest: <http://www.mapquest.com/traffic/>
  - Waze: <https://www.waze.com/livemap>
  - INRIX traffic app for mobile devices: <http://www.inrix.com/inrix-traffic-app/>
  - Or search your state or neighboring states to find out if they have a live traffic map specific to your area.
- Utilize Edmodo ([www.edmodo.com](http://www.edmodo.com)) to provide further questioning and discussion between students and teacher. Edmodo is safe social learning website made specifically for teachers and students. It is a way to collaborate on assignments, homework, projects, and after-school STEM programs and is used as a communication tool to provide additional questioning and feedback from teachers and students.

**Appendix - Full Images of Classroom Setup for Congestion Activity**

