PREPARATION

Time	1-2 hours of setup + 1 hour of instruction
Place	An outdoor area or very large indoor area is needed.
Students	We'll need about 40 students for the activity to run optimally.
Assistant	We recommend one assistant (teacher or student) to help coordinate the activity. They should read and implement the last paragraph of this guide with you.

The goal is to simulate real traffic as closely as you can manage.

PART 1 - MANUAL TIMING

Set up the outdoor area to create roads and an intersection. You may consider using tape, ropes, tubes, or other materials as you see fit. If possible, create white or gold dividing lines spaced equally far apart in the center of each road so that each of the four roads form two lanes. These lanes should be durable enough to withstand some light kicks or trampling given that students will later be moving around unpredictably and broken parts may ruin the activity.

Provide slips of paper and pens to each student so they can write down their delay times after each round. They should have 4 measurements by the end of the activity. These will later be logged into the "Lesson 1.1 Graph" Excel spreadsheet.

You'll need 12 minutes to simulate manual signal timing. This session will be subdivided into 4 rounds of play, each lasting 3 minutes. A timer set to sound an alarm every 3 min may help.

You'll need 12 minutes to simulate fixed-time signaling. This session will be subdivided into 4 rounds of play, each lasting 3 minutes. A timer set to sound an alarm every 3 min may help.

Assign at least 5 students to each road. They may choose whether they are in the left or right lane. But if students are turning into an adjacent lane, follow road laws. This means going to the left lane to turn left and the right lane to turn right.

The traffic operator will act as the traffic signal in the center of the intersection. Initially, they will need to choose manual timing and guide traffic to the best of their ability.

Early manual traffic sign

Makeshift traffic signal by modern volunteers

The signal can be created out of art supplies like construction paper, posters, and glue to that it resembles either a four way sign (see image on left) with GO and STOP or a traffic signal with red and green circles stacked vertically. Create the traffic light so that only one circular light is shown at a time to each road. The North-South signals should be the same and the East-West signals should be the same throughout the activity. Be creative!

Give each student on the road a stopwatch or let them use their phone to time how long they spent at a red light. Tell students that it is critical to keep track of their delay when waiting at a red light and write down the number at the end of the activity. Provide students pens and index cards. When the light turns green, students will need to pause their stopwatch. At the end of the activity, the sum of the delay that student experienced will be the "total delay" for the manual timing demonstration. The sum of all students' delay (in seconds) for each round will need to be entered into the "Lesson 1.1 Graph" Excel spreadsheet. The graph should update automatically.

PART 2 - FIXED-SIGNAL TIMING

Now repeat this procedure using fixed-time signaling. Select a fixed amount of time between light changes, such as 20 or 30 seconds each. Once again, each student on the road should keep track of their delay using a stopwatch/phone app and an index card.

PART 3 - DATA ANALYSIS

Instructor: If a computer is available, use the "Lesson 1.1 Graph" Excel spreadsheet. Graphing can also be done manually.

Gather students' data and record it in the spreadsheet. That graph will update.

Instructor: Discuss the results with students.

Which group is *consistently* experiencing fewer delays? Hopefully, it is the fixed-time signaling condition. That's the *expected result* given how traffic engineering operates today.
If the fixed-time condition is better:

Ask: Why is it better? The answer is because it is more consistent and balances the road congestion across the intersection.

If the manual timing condition is better:

Say: The simulation didn't work as expected. Usually the fixed-time condition is supposed to be better. But that's okay. In science and engineering, this is called a *failure to replicate* the original results and it happens often. What's important is to consider why it didn't replicate. Can you think of any reasons?

[DISCUSS AS YOU SEE FIT]

Optional: Consider also averaging results for the whole group and determining which group waits less *on average*.

NOTES FOR ASSISTANT

If there are too many students to participate, or who must sit out from the activity, then have them take notes and have them discuss what they observed.