

Real-World Takeaways

- A rear-view mirror should be angled slightly toward the driver in order to see the area directly behind the car.
- Side-view mirrors will provide the most helpful visibility if they're positioned so that you cannot see the edge of your own car but so that you can see an adjacent car just out of the area reflected in the rear-view mirror.

Mathematical Objectives

- Make formal geometric constructions including perpendicular bisectors, parallel lines, and angle reflections

Lesson at a Glance
90 min.

		Lesson at a Glance	90 min.
Launch		Watch a commercial for an add-on mirror for cars intended to eliminate blind spots. Discuss the goal and function of car mirrors.	5 min.
Part One	1	Model a driver's visible region reflected in a rear-view mirror positioned straight back by constructing perpendicular lines and reflecting angles, then explain what adjustments would improve the driver's visibility.	40 min.
Part Two	2	Construct the appropriate positions for side view mirrors to create the safest visible region.	45 min.
	3	Watch a short video suggesting a good process for appropriately setting side view mirrors. Describe intuitively and geometrically why this reduces blind spots.	15 min.

- L Students watch a commercial for Total View, a small mirror that attaches to a car's side-view mirror and – according to the announcer – “eliminates blind spots.”

Discussion Questions

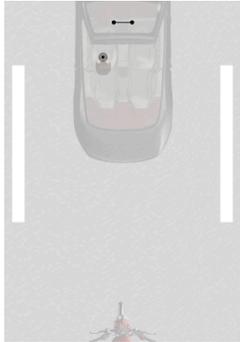
1. *What problem are drivers trying to solve with Total View?*
2. *What are blind spots and why are they so dangerous?*
3. *How can drivers avoid blind spots?*
4. *If cars already come with rear and side-view mirrors, why is something like Total View even necessary?*

Key Takeaways

- Blind spots are areas behind and beside of a car that a driver cannot see. These are dangerous and can cause accidents.
- Even though cars come with three mirrors, eliminating blind spots requires that drivers adjust these mirrors correctly.

- 1 When you're driving, it's important to be aware of what's around you. Imagine a driver positions his rear-view mirror as shown in the diagram below. Construct a model showing the region he'll be able to see behind him.

Do you think this is a good way to position the mirror? If not, how would you suggest the driver adjust it and why?

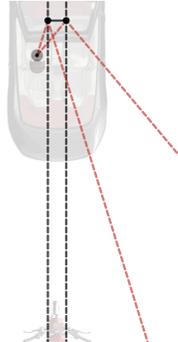


Original



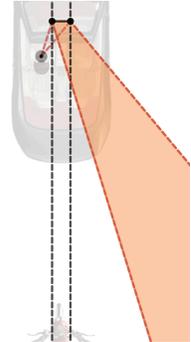
Step 1

A ray-of-sight travels from the driver's eye to all the points along the mirror (including the leftmost and rightmost points)



Step 2

Each ray bounces off the mirror at the same angle that it entered; it reflects over a line perpendicular to the mirror at the point of intersection



Step 3

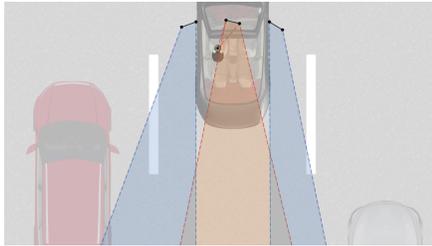
The driver will be able to see the region between the innermost and outermost reflected rays

Teacher Tip

We made the diagram on the student handout as large as possible. However, it's still fairly small, especially when printed on a standard-sized 8.5" x 11" sheet of paper. Even if students use protractors to measure the angles of incidence and reflection, it's unlikely that their sketches will be perfectly accurate. That's fine, as long as students can describe the process and the relationship between the mirror's orientation and the reflected region.

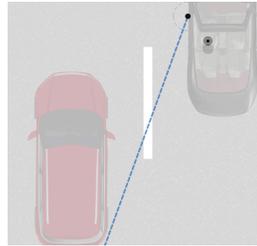
That said, the larger you can print the diagram, the better. Consider using 11" x 17" paper if possible. Also, you might want to print extra copies in case students need to start their sketches over.

- 2 In addition to a rear-view mirror, cars also have side-view mirrors. Many drivers position these to see the edges of the car, as shown in the inset below. However, this results in dangerous blind spots. On the diagram below, construct a safer positioning of the left and right mirrors, and shade in the regions that will now be visible to the driver. (Note: the dashed semi-circles represent the mirror radius.)



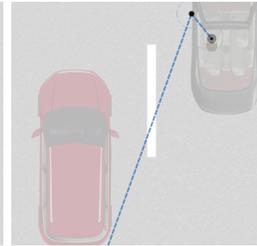
INSET IMAGE

The following steps show the process for adjusting the driver-side mirror. Students should also adjust the passenger mirror.



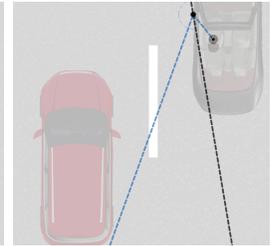
Step 1

Draw the innermost edge of the desired visible region



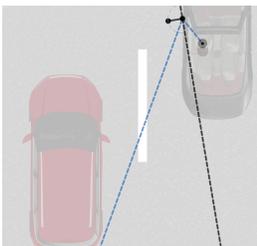
Step 2

Draw the ray from the driver's eye to the innermost point on the mirror



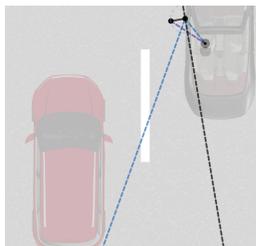
Step 3

Construct the perpendicular bisector through the angle formed by the two rays



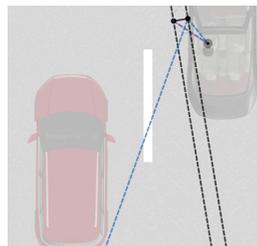
Step 4

Draw the side-view mirror, which will be perpendicular to the perpendicular bisector



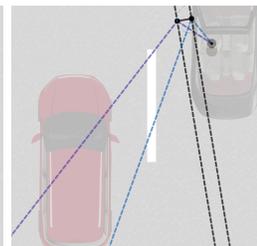
Step 5

Draw the ray from the driver's head to the outermost point on the side-view mirror



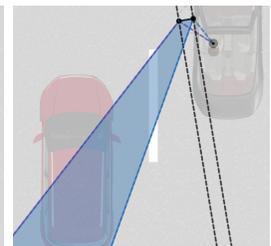
Step 6

Through this point, construct the line perpendicular to the mirror



Step 7

Use the law of reflection to construct the ray from the outermost point on the mirror



Step 8

Shade in the region between the reflected rays; this should include the car in the left lane (i.e. it should reduce the driver-side blind spot)

Teacher Tip

When it comes to side-view mirrors, the farther away the driver is, the narrower the reflected region will be. For this reason, modern cars use passenger-side mirrors that are slightly curved, increasing the visible region. However, drawing reflected rays is much more difficult with curved surfaces, and all of the mirrors in this lesson are depicted as flat. To compensate for this, the passenger mirror is slightly larger than it would be on an actual car.

- 3 Watch the video about how to properly adjust the side mirrors, then describe the process in your own words. Geometrically, why does this method help to reduce the blind spots in the left and right lanes?

Correct steps for adjusting a car's side mirrors:

Driver-Side Mirror

1. Place head against driver-side window
2. Adjust driver side-view mirror so that it barely shows the left side of the car
3. Move head back to regular position. The driver mirror will now show the region that picks up where the rear-view mirror leaves off, i.e. it will reduce the blind spot

Passenger-Side Mirror

1. Move head to center of the car above the console
2. Adjust passenger side-view mirror so that it barely shows the right side of the car
3. Move head back to regular position. The passenger mirror will now show the region that picks up where the rear-view mirror leaves off

There are two ways you can change the region that's reflected in a mirror: You can move the mirror or you can move your head. When you use the process above to set the side-view mirrors, you start with your head pretty close to the mirror, then set the mirror to reflect the side of the car. When you then move your head back towards the normal driving position, what you're really doing is moving your head away from the mirror. This increases the angle of reflection...which causes the visible region to swing outwards...which reduces the blind spots in the left and right lanes.

Teacher Tip

Traffic accidents are one of the leading causes of death in the United States each year, and with teens especially so. Consider taking students to the parking lot and having them practice adjusting the mirrors on an actual car. (If your school offers drivers' ed, they may have vehicles you can use. Otherwise perhaps you could find some other faculty members to unlock their cars and act as chaperones.)