CHAPTER 1

Understanding by Design*

The *Understanding by Design* template focuses on the three stages of backward design:

- **Identify desired results**
- **Determine acceptable evidence**
- **Plan learning experiences**

What overarching understandings are desired?

Traffic safety requires knowledge of physics.

- Motion can be described in terms of position, velocity and acceleration.
- Motion can be described both algebraically and graphically.
- Complex phenomena can be mathematically modeled.
- All measurements have uncertainties (no measurement is exact).

What are the overarching "essential" questions?

- How can physics knowledge help you to be a safe driver?
- How can driving be described using the concepts of position, velocity, and acceleration?
- What is the effect of reaction time on driving?
- How can something as complicated as the traffic at an intersection be modeled using a limited number of variables?
- How are measurements crucial for understanding the motion of a vehicle?

What will students understand as a result of this chapter?

- A person has a measurable reaction time.
- Poor reaction time can lead to more accidents.
- All measurements have uncertainties or random errors.
- Repeated measurements can vary in accuracy and precision.
- Random errors can be attributed to the measurement and/or the measuring instrument.
- Average velocity = total distance traveled over a given time ($v = \Delta d/\Delta t$).
- The slope of a displacement vs. time graph is equal to the velocity.
- Average velocity = total distance traveled over a given time ($v = \Delta d/\Delta t$).
- The slope of a velocity vs. time graph is equal to the acceleration.
- Braking distance is dependent on the negative acceleration of the vehicle (brakes, road surface) and reaction time $(d = v^2/2a)$.
- Models can be used to mathematically describe what happens at a yellow light.
- An intersection with a yellow light has a STOP Zone and a GO Zone.
- A safe intersection has an overlap between the GO and STOP Zones.
- An unsafe intersection has positions which are neither in the STOP Zone or the GO Zone.
- Turning a vehicle is an acceleration of the vehicle.
- A force toward the center of a circle is required to turn a vehicle.

What "essential" questions will focus this chapter?

- What is human reaction time and how does it affect driving?
- If five people measure the same event, how do we expect their measurements will differ?
- How is velocity defined and how is it measured?
- How can motion be represented graphically?
- How is braking distance dependent on speed?
- How can an intersection with a yellow light be modeled mathematically?
- What factors describe the motion of a vehicle making a turn?

* Grant Wiggins and Jay McTighe, *Understanding by Design* (Merril/Prentice Hall, 1998), 181.