Unit 3: *Uniform Motion*

This unit will take approximately 4-5 weeks. The pace is always determined by the ability of your students. Some segments of the unit can be skipped or used as enrichment, while other segments include more challenging content for use with advanced students.
This timeline is based on 55-minute periods.

Outline	Teacher Notes
Day 1 ***Today's Objective*:** This introduces a context for learning about uniform motion. ***Activity:*** Framing Questions - Whiteboard ***Lab:*** Bag of Cars. Whiteboard each car's motion.	Whiteboard Framing Questions, but don't spend a lot of time. You want students to begin thinking about motion. Identify different kinds of motion. Have students begin developing vocabulary for identifying different types of motion.
Day 2 ***Today's Objective*:** To qualitatively describe the motion of bubbles in a bubble tube. ***Lab*:** Conduct Pre-Lab discussion of Bubble Lab ***Due*:** Bag of Cars	Begin Bubble Tube Lab Each group gets 2 tubes (1 cool color, 1 warm color) Whiteboard pre-lab and have students design an experiment to collect data. The key is to come up with a design where time is the independent variable. Eliminate bad ideas for collecting data by either letting students try them, or discuss why they won't work.
Day 3 ***Today's Objective*:** To quantitatively identify the motion of bubbles in a bubble tube through data collection and a graph. ***Lab:*** Bubble Lab ***Due*:** Bubble Lab	Direct students toward making a time vs. position graph. Online metronome works well here. Find the slope of the best-fit line.
Day 4 ***Today's Objective*:** To identify speed and relate it to slope, and differentiate between distance and change in position. ***Activity*:** Reading Page: Distance and Change in Position ***Practice*** 3.1 Position, Distance and Change in Position	Review slope and what it means (units) Discuss difference between distance and change in position. Supply some examples in class. Be sure to look at the teacher guide for description of problems that are similar, so that you can have students do some problems in class and assign others as homework.

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Day 5 ***Today's Objective*:** Students draw a graph from given data, calculate slope and interpret its meaning. ***Practice:*** 3.2 Do this practice in class and have students whiteboard their answers. ***Due*:** Problems from Practice 3.1	The purpose of this activity is to practice the concepts learned in the bubble tube lab. *Quiz #1:* This should include problems with finding slope, and problems like those in Practice 3.1.
Day 6 ***Today's Objective***: Dimensional Analysis: convert units of measurement so that students can compare the speeds of different objects from graphs that have different axes. ***Activity:*** Reading Page: Unit Conversion ***Practice:*** 3.3 (start in class and assign the rest for homework.) ***Due***: Problems from Practice 3.2	Review the Quiz Supply the students with a problem that has 2 graphs of constant velocity, but with different units. Identify which is faster. Show students how to convert units (Unit Conversion).
Day 7 ***Today's Objective***: To review how to convert many different units to a common unit so that students can compare speeds. ***Activity:*** Whiteboard the homework 3.3 ***Due***: Problems from Practice 3.3	This may take all hour. Be thorough in your questioning and use Socratic Dialogue to help you out.
If students need more practice with calculating slope and unit conversion, continue with Practice 3.4	Assess student success here. Decide whether or not to move on, or provide more practice.
Day 8 ***Today's Objective***: To get students to derive the mathematical expression for speed from the collected data (if they are not yet comfortable with this formula after the Bubble Tube Lab) ***Activity:*** Discussion, review the lab ***Due***: Battery Car Lab	If your students have been successful in formulating an equation that connects velocity, displacement and time (or speed, distance and time) from the Bubble Tube Lab, you can skip part 1 of the Battery Car Lab and just do Part 2, which focuses on motion diagrams.
Day 9 Optional ***Today's Objective***: To describe motion in a motion diagram, and to convert this information to an x(t) graph. ***Lab:*** Battery Car Lab ***Due***: None	Whatever method you use to collect data, the end result is to generate a motion diagram. This diagram should be accurate enough to generate an x(t) graph. The graph should be qualitative, but can be quantitative

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	depending on the abilities of your students.
Day 10 ***Today's Objective***: To translate observed motion into motion diagrams that include stopping and traveling in a negative direction. ***Activity:*** Reading Page: Motion Diagrams ***Practice:*** 3.5 Motion Diagrams ***Due***: None	Students need help understanding the difference between velocity and speed. Motion diagrams will help. ***Quiz #2:*** This quiz should include problems like those found in the 3.2 and 3.3 homework. Depending on the abilities of the students, it could also include unit conversion.
Day 11 ***Today's Objective***: To translate motion to words, motion diagrams and graphs for uniform motion. ***Activity:*** Whiteboard homework Practice 3.5 Student Summary Page: Slow and Fast ***Due***: Problems from Practice 3.5	Review the quiz. Assess students on how well they can translate words to motion diagrams to graphs to mathematical problems. Whiteboard the homework Next, start with a word problem and work from there.
Day 12 ***Today's Objective***: Differentiate between speed and velocity, and between distance and position. ***Activity:*** Reading Page: The Speed-Distance-Time Relation Assign some of the sample problems. ***Practice:*** 3.6 Word Problems - Speed ***Due***: None	Do some of the word problems from Practice 3.6 in class; assign a few other problems as homework. The direction of motion becomes important here. Use the teacher guide to help with which problems to assign.
Day 13 ***Today's Objective***: To get students to apply the knowledge they've gained and apply it to word problems. ***Activity:*** Whiteboard the homework ***Pre-Lab:*** Detecting Motion Lab ***Due***: Problems from Practice 3.6	Whiteboard the homework Have students learn how to use the motion detectors, and how the data shows up on the computer. Show students how to zero the sensors, and what this means. Direction is important here!
Day 14 ***Today's Objective***: Students will be trying to match a description of motion by walking. Their *predictions* will indicate their level of understanding.	Important: Students' predictions will help you identify whether they truly understand uniform motion. Make sure students are successful with the lab activity before assigning the homework.

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Lab: Detecting Motion Lab. ***Practice:*** 3.7 Simulating Motion ***Due***: Detecting Motion Lab	
Day 15 ***Today's Objective***: Given one of these: verbal description, motion diagram, word problem, x(t) or v(t) graph for uniform motion, students should be able translate the given information to all other representations. ***Due***: Problems from Practice 3.7	***Quiz #3*:** Include questions like those found in the homework from Practices 3.5 and 3.6. You could include some representations from the Detecting Motion lab.
Optional: Average Speed. This is a class period activity designed on how to calculate average speed from an x(t) graph and from word problems.	Skip the segment on Average Speed unless you have students who are ready for more challenges and are eager to learn.
Day 16 ***Today's Objective***: To provide more practice in "translating" one representation of motion to several others. ***Activity:*** Practice graphing. ***Practice:*** 3.9 Words and Graphs ***Due***: None	Review the homework 3.7 Review the Quiz. Show how the motion shown in an x(t) graph can be "translated" to a corresponding v(t) graph. For low level classes, try to avoid providing x(t) graphs with positions in the –x portion of the graph.
Day 17 ***Today's Objective***: Students return to previously learned concepts and solidify them. This includes the motion of 2 objects on the same graph. ***Lab:*** Motion of Two Bikers – Conceptual Lab. ***Due***: Problems from Practice 3.9	Start with examples of two motions on one graph. Then begin with the first page of the lab. Assign the 2nd page as homework.
Day 18 ***Today's Objective***: To get students to see that calculating the area under a curve from a v(t) graph is no different than rearranging the equation for velocity. ***Activity:*** Whiteboard Two Bikers lab. ***Practice*** 3.10 Words, Graphs and Motion Diagrams ***Due***: Two Bikers	Show students how to re-arrange the formula to generate displacement. Show how to find the area under a curve from the v(t) graph to find displacement ***This may sound remedial, but it is important for the next unit.*** Use teacher guide to assign specific problems (3.10)
	Advanced classes may want to derive the mathematical equation $x_f=vt+x_i$ *(from y=mx+b) to solve some of these problems. You can*

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	set the two cars final position equivalent to each other and solve for time from there.
Day 19 ***Today's Objective***: Students will practice and solidify the concepts and skills you've learned so far. ***Activity:*** Whiteboard the homework from Practice 3.10 ***Practice*** 3.11 Equivalent Representations ***Due***: Problems from Practice 3.10	Whiteboard the homework. Use teacher guide to assign specific problems from Practice 3.11.
Day 20 ***Today's Objective***: Convert information about an object's uniform motion among verbal, pictorial, graphical and mathematical representations. ***Due***: 3.11	Review the homework. ***Quiz #4:*** This quiz should include problems like those found in the 3.9 and 3.10 practice. It's a good idea to include problems like those found in the Two Biker Lab or Practice 3.10 (problem 6b).
This is a good time to discuss everything you've learned so far. There is a Student Summary Page to write these down.	If students have been writing down new concepts as they learned them, you may skip the Summary page.
Day 21 ***Today's Objective***: This activity seeks to bring together several concepts learned throughout the unit. ***Lab:*** Toy Car Application Lab ***Due***: None	Don't give the students both cars at the same time. Label the cars with numbers or letters so they don't get them mixed up. Have students identify where they should meet in any means they choose, but to be able to explain how they arrived at their decision.
Day 22 ***Today's Objective***: Finish lab. ***Lab:*** Continue with Toy Car Application Lab ***Due***: Toy Car Application Lab	This lab usually takes 2 class periods. Place the cars from 3-5 meters apart. If the students have done a good job, their predicted "crash" location should only be a few centimeters from the actual crash location.
Day 23 ***Today's Objective***: Revisit the Framing Questions ***Due***: None	Review the unit material
Day 24 ***Today's Objective***: Unit Assessment	**Unit 3: Uniform Motion Test**