

One and Two-Dimensional Motion

5E Lesson

The 5E model is a scientifically proven method to improve student engagement and learning in your classroom

- ✓ Engagement
- ✓ Exploration
- ✓ Explanation
- ✓ Elaborate
- ✓ Evaluate



Complete Teacher Instructions

One and Two-Dimensional Motion 5E Lesson

Grades 9-12	One and Two-Dimensional Motion	Ongoing Lesson
Lesson Objective: Students will: - Investigate motion in one and two dimensions - Be able to read and create graphs depicting motion - Solve problems involving uniform and non-uniform linear motion in one and two dimensions - Use kinematic equations to solve problems related to the horizontal and vertical motion - Gain an understanding of scalar vs. vector quantities as well as position vs. time - Learn how to solve two-dimensional problems using vectors/components		
Possible Student Misconceptions: - Speed and velocity are the same thing - Distance and displacement are the same thing		
Materials: 1 device (smartphone, Chromebook, laptop, tablet, or computer) per 3 students - A means of projecting a PowerPoint presentation - Internet access - Common classroom materials (protractor, ruler, string, timer, measuring tape)		
Teacher Notes: - All videos can be accessed directly from the PowerPoint. To retrieve them, click on the video icon while in slideshow mode and it will automatically open for you. If it does not, right-click on the image and click Edit Hyperlink or something similar. - I've created a video walkthrough if needed. It can be accessed here - https://youtu.be/oCIKIP9SaDQ - I don't believe in long lessons. If you feel your students are losing their focus, stop the PowerPoint and give them a 5-minute break. If you'd like to show a video collection here - http://www.teachwithfergy.com/science are tons of brain-break videos to choose from all grouped by category.		

One and Two-Dimensional Motion – 5E Lesson

Engagement Phase Motion - Take your students into the hall or some other open space - Have them complete the worksheet – “Engagement - Speed!”	Duration: 15-30 min. Teacher Role – Facilitate learning and guide student understanding Goals ☐ Connect student's experiences ☐ Create interest ☐ Ask questions ☐ Understand the object of the lesson
Exploration Phase Exploration – Lab Station Activity In groups of 2-3, have your students complete <i>Exploration – Lab Station Activity</i>. Once they're done, they will submit their passport to you.	Duration: 1 hour Teacher Role – Facilitate learning and guide student understanding Goals ☐ Students receive real experience with the topic ☐ Students use and develop creative thinking skills ☐ Students make observations, record results, and make connections
Explanation Phase Explanation – One Dimensional Motion & Two-Dimensional Motion Lessons - There are two lessons, both are found in the folder – “Explanation – Lessons” - These lessons are designed to be completed over two - three days - There are many embedded videos and plenty of opportunity to engage, interact and check for your students' understanding throughout both lessons - The One-Dimensional Motion lesson covers the following topics: ✓ Motion Terms ✓ SI Units ✓ Scalar Quantities ✓ Average and Instantaneous Speed ✓ $v = d/t$ ✓ Linear Motion ✓ Velocity ✓ Position and Displacement ✓ Position-Time and Velocity-Time Graphs	Duration: 2-3.5 hours Teacher Role – Explain concepts by presenting material found in the presentation.

- The Two-Dimensional Motion lesson covers the following topics ✓ Uniform vs. Non-Uniform Motion ✓ Vectors ✓ Breaking Vectors into their x and y-components ✓ Vector Component Addition ✓ Practice	Goals ☐ Students develop understanding of the content ☐ Observations and experiences are discussed and critiqued ☐ Students develop vocabulary ☐ Students are able to connect the content presented to previous experiences
Teacher Notes: - Some math knowledge is required to solve the problems - All videos can be accessed directly from the PowerPoint. To retrieve them, click on the video icon while in slideshow mode and it will automatically open for you. If they don't open, right-click the image and select Edit Hyperlink or something similar. - I've created a video walkthrough if needed. It can be accessed here - https://youtu.be/oCIKIP9SaDQ - I have also enclosed a .PDF version of both the teacher and student versions	
Elaborate Phase Elaborate – Mapping using Vectors Your students will complete – “ <i>Elaborate – Mapping Using Vectors</i> ”. This activity will require your students to move beyond what was covered directly in the lesson and allow them to demonstrate their understanding	Duration: 1-3 hours Teacher Role – Facilitate learning and keep students focused Goal ☐ Students use their newly obtained knowledge to propose solutions and extend their learning to new situations
Teacher Notes: I have my students work individually but it can be done in small groups if you'd prefer	
Evaluate Phase Evaluate Folder - The evaluation is two sets of homework/practice questions - Each question set comes with a .PDF as well as a video walkthrough which fully explains how to do each question step-by-step - The question sets can be found in the folder titled “Evaluate”	Duration: 1-2 hours Teacher Role – Distribute and collect evaluation Goal ☐ Students are given the opportunity to demonstrate their understanding and evaluate their own progress
Teacher Notes: - Feel free to upload the videos to your class site if you'd like - These worksheets can be completed for homework or as an in-class activity	

Each phase is clearly described

Two Complete Lessons

Check Your Understanding

A cyclist takes 25.1 s to cover the displacement of 115 m [E] from d_1 to d_2 .

- Calculate the cyclist's average velocity.
- If the cyclist maintains the same average velocity for 1.00 h, what is the total displacement?
- If the cyclist turns around at d_2 and travels 565 m [W] to position d_3 in 72.5 s, what is the average velocity for the entire motion?

$$\vec{v}_{av} = \frac{\Delta \vec{d}}{\Delta t}$$

Answer: a) 4.58 m/s [E] b) 16.5 km [E] c) 4.61 m/s [W]

← Make sure your students are on track

Student copies with blanks

Videos embedded right into your slideshow

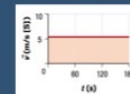
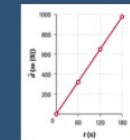
Velocity and Other Vector Quantities

- _____
- The direction is given in [square brackets].
 - I.e. Displacement, and velocity
 - I.e. 20 km/h [E]



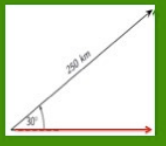
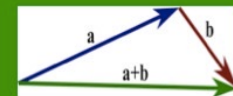
One-Dimensional Motion

- Motion Terms
- SI Units
- Scalar Quantities
- Average and Instantaneous Speed
- $v = d/t$
- Linear Motion
- Velocity
- Position and Displacement
- Position-Time and Velocity-Time Graphs
- Lots of Practice Questions to determine understanding



Two-Dimensional Motion and Vectors

- Uniform vs. Non-Uniform Motion
- Vectors
- Breaking Vectors into their x and y-components
- Vector Component Addition
- Practice



Interactive and Engaging Activities including my Lab Station Activity

One and Two-Dimensional Motion Lab Station Activity



7 Lab Station Activities to get your kids
out of their seats and engaged in their
learning

Mapping Using Vectors

Your Task:

- You will be creating a set of directions to the landmark or location of your choice in or around where you go to school
 - o Note: This activity works best with straighter routes so choose a landmark or location within a city. If your school isn't in a city, choose a starting point within one instead
 - o Note: Each landmark/location can only be used once and must be at least 5 km (3.1 miles) away
- Using a 2D map printed off the Internet (Google Maps is a good choice), you must create a set of directions using distance vector components that will allow you to get from your school to your landmark/location
 - o Note: Your map must be zoomed properly so that you can see your starting and ending locations
 - o Note: You must first determine the scale of your map (i.e. 1 cm = 0.8 km). You can do this by using information from the mapping program and a ruler.
- Since they are vector components, you must include the magnitude (distance travelled) and direction (i.e. N 15° W)
 - o Most routes will have some sort of curve. Since this activity works best with straight lines, you must break your curve into straight sections as shown below



- Each component needs to be numbered. (i.e. 1. Travel 8.5 km (N 15° W))

You will submit:

- Your map with the route clearly outlined
 - A written set of directions (numbered) below the map
 - The answer to the following questions
- 1) If you are walking at 3 m/s along your route, how long will it take you to get there?
 - 2) If instead of walking you could fly in a perfectly straight line, how long would it take you to get there?

Mapping Using Vectors

Speed! Activity

Speed!

Get Ready!

Step 1: Gather your materials! Each team needs 3 members → 1 timer, 2 participant(s), 1 meter stick/tape measure, 1 section of masking tape, and 1 pencil

Step 2: Create your track!

Find an open space (track if it's available) and measure off a certain distance (10 meters for example). Use two pieces of tape to mark the beginning, and end of your track. Mark each distance (0 m, 10 m) on the tape with a marker.

Step 3: Go for it! Each team member will need to perform the following tasks for each distance:
Hopping Walking backwards Walking (regular rate) Slow Jog

Your team will need people with timers or watches at the middle and end points. Record the time it takes to perform each task.

Collect That Data! (Create a chart for each group member separate sheet of paper)

Record your data from the experiment in a chart then use the information to calculate the speed for each task and distance. Round answers to the nearest hundredth if needed. Under the chart, do any calculations needed for speed and record your answers in the chart. Note: to find average speed, divide the distance (m) by the time (s) → $s = d/t$

TASK	DISTANCE	TIME (s)	Average Speed (m/s)
Hopping	Total:		
Walking Backwards	Total:		
Walking Normal	Total:		
Jogging	Total:		

Think About It! Answer to the best of your ability for ONE participant.

1. Which task and distance resulted in the fastest speed?

Task = _____ Distance = _____ Speed = _____

2. Which task and distance resulted in the slowest speed?

Task = _____ Distance = _____ Speed = _____

3. How far could you jog in 10.6 minutes based on your average speed?

4. How long would it take you to hop 30.5 meters based on your average speed?

5. How far could you travel walking backwards in 15 minutes based on your average speed?

6. How long would it take you to jog (regular rate) 12 kilometers (1 km = 1000 m) based on your average speed?

7. How accurate do you think the answers to numbers 3-6 are? Why or why not?

Get away from tired practices and unengaged students



Provide a Scientifically-Proven means of instruction



Incorporate Technology and Increase Collaboration

