Date: 17.04.2014
Teacher: Ceren Özbay
Number of Students: 16
Grade Level: 9- Y
Time Frame: 40 minutes

Vectors

1. Goal(s)
   - To develop an understanding of the topic Vectors

2A. Specific Objectives (measurable)
   - Students will understand the concept of a vector and be able to perform basic vector operations (addition, subtraction, scalar multiplication).
   - Students will be able to draw vectors on the coordinate plane and graphically add, subtract, and multiply by a scalar.
   - Students will be able to decompose vectors into components along the directions of given axes in two-dimensions.
   - Students will be able to combine vector components into a magnitude and direction.

2B. Ministry of National Education (MoNE) Objectives
9.5. Vektörler /9.5.1. Vektör Kavramı ve Vektörlerle İşlemler/9.5.1.1. Vektör kavramını açıklar./ 9.5.1.2. İki vektörün toplamını ve vektörün bir gerçek sayıyla çarpımını cebirsel ve geometrik olarak gösterir.

3. Rationale
Vectors play an important role in physics: velocity, acceleration, and force all can be interpreted as vectors since they have both a magnitude and a direction.

4. Materials
   - Board.
   - At least two different colored board markers.
   - One worksheet to each student. (öss questions)
   - Projector
   - Computer

5. Resources
   - TED textbook

6. Getting Ready for the Lesson (Preparation Information)
   - Teacher should make sure that she gets the worksheets.
   - Teacher will check the computer.
   - Teacher will be sure that board markers are working.
   - Teacher will remind students they are supposed the do the rest of questions on the questions as homework.

7. Prior Background Knowledge (Prerequisite Skills)
It is assumed the students' have a basic understanding of graphing concepts including the following:
   - Cartesian Coordinate System - also known as the Cartesian plane or the rectangular coordinate system (as opposed to the spherical or cylindrical coordinate system.) consists of two perpendicular real number lines, the x and the y axis. Because the

plane consists of two crossed real number lines, it is often known as or .

- Origin – the point of intersection between the two axes
- Quadrants – the four sections the axes divide the plane into are known as quadrants
- Ordered Pairs – indicate a point on the plane by giving an x-coordinate (the first coordinate) and a y-coordinate (the second coordinate.)

It is also assumed students are capable of plotting points on the plane

Lesson Procedures

Transition: Good morning class! Today, we are going to learn vectors.

8A. Engage (5 minutes)

- Ask to students "Why do we need Vectors?"
- Get some answers and add :

"We notice that some physical quantities have a direction associated with them as well as a quantity. For example, when we talk about how fast something is moving, we often want to know the direction in which it is moving: i.e. the car is moving south at 25 meters per second. We need to describe quantities like these with both an amount (also called the magnitude) and a direction or angle."

- A quantity that has both magnitude and direction is a vector.
- A quantity without direction is a scalar.

  add more if necessarily :

  "Vectors allow us to represent velocities: For example, say we are flying an airplane into a head wind. As the plane flies, the wind is slowing the velocity of the plane, so how can we know how we are progressing relative to the ground? Vectors help answer that. Similarly, forces, accelerations, magnetic fields from several sources, all are added like vectors. Engineers who put up a bridge or a building and want to make sure all forces balance so the bridge or building won't fall down need vectors"

Transition: Let's have a look at the question.

B. Explore (10 min.)

- Project the question:

A swimmer is able to swim with a speed of 5 m/s in a pool (this is her "water speed".) This same swimmer goes swimming in a river which has a current flowing to the East with a constant speed of 3 m/s. Assume her water speed is always 5 m/s.

a. What would be her resultant velocity if she tries to swim due East with the current? (Include a vector sketch.)

b. What would be her resultant velocity if she were to try to swim due West against the current? (Include a vector sketch.)

- Students will try to solve the question.
- Walk around and ask "how did you get this answers?" and help students.
- Let students solve the question.
- If somebody solves the question, let her /his solve it on the board.

Transition: have you realized any features?

C. Explain (10 min.)

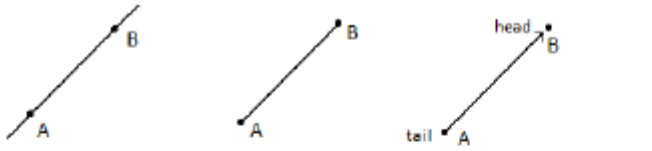
- Reflect the page and teach the topic.

5.1. Vector

Vector

A *vector* in the plane is a directed line segment.

Point of Interest
The word vector is derived from the Latin 'vehere' meaning 'to carry'.

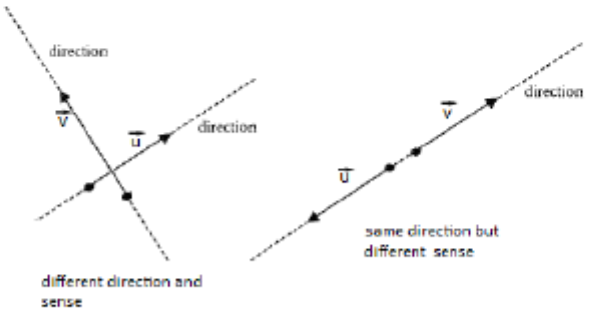


line containing A and B | line segment AB | directed line segment $\overrightarrow{AB}$

If the points of the line segment are ordered so that they proceed from A to B, a directed line segment from A to B is obtained, which is denoted by $\overrightarrow{AB}$. In a directed line segment $\overrightarrow{AB}$, A is called tail and B head.

Note:
A quantity which is specified by just its magnitude is called a *scalar* (e.g. distance, speed).

A vector is a quantity that has length (magnitude) and direction (e.g. displacement, velocity) and sense.



Length (Magnitude of Vectors)

The *length* or magnitude of the vector $\overrightarrow{AB}$, is the length of the line segment AB and is denoted by $|\overrightarrow{AB}|$.

Unit Vector

A vector of length 1 is called a *unit vector*.

- Ask students what unit vector and zero vector mean.
- Draw unit vector on the board.

Unit Vector

A vector of length 1 is called a ***unit vector***.

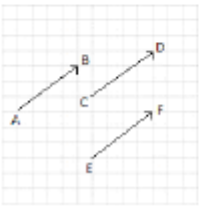
Zero Vector

The vector which is of zero length is called the ***zero vector***, and is denoted by $\vec{0}$.

Note:
Unlike other vectors, zero vector has no direction.

Equal Vectors

Two vectors are ***equal*** or the same if they have the same length and direction.

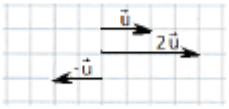


$\overrightarrow{AB} = \overrightarrow{CD} = \overrightarrow{EF}$

2.1. Operations on Vectors (Geometric)

Scalar Multiples of a Vector

A vector is multiplied by a positive real number by multiplying its length by the number. A vector is multiplied by a negative number by reversing the vector's direction and multiplying the length by the number's absolute value.



Note:

$\overrightarrow{AB} = -\overrightarrow{BA}$

Addition of Vectors:

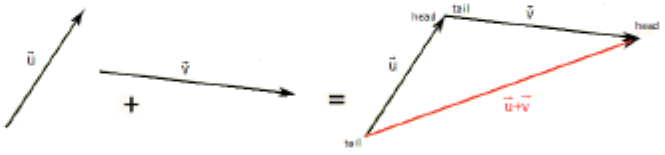
a) Head-to-Tail Rule:

To add vector v to vector u, move vector v so that its tail touches to the head of u. The sum u+v is the vector from the tail of u to the head of v.

Note:

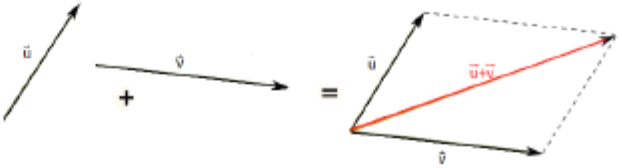
$\overrightarrow{AB} + \overrightarrow{BD} = \overrightarrow{AD}$

$\overrightarrow{AB} + \overrightarrow{BD} + \overrightarrow{DC} + \overrightarrow{CA} = \overrightarrow{AA}$



b) Parallelogram Rule:

To add vector v to vector u, move vector v so that its tail touches to the tail of u. Draw a representative of v from the head of u and a representative of u from the tail of v.
The sum u+v is the vector from the tail of u to the head of the representative of v.



Note that, u-v is the vector obtained by adding –v to u.

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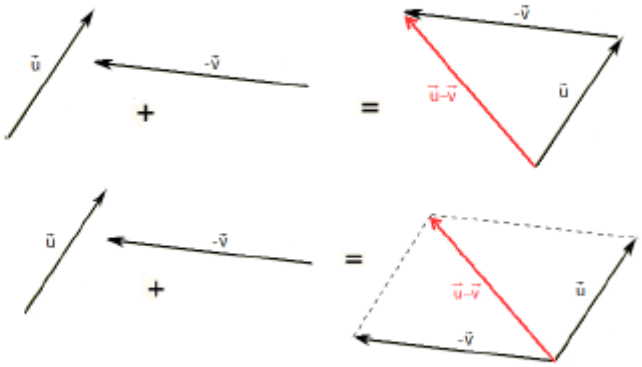


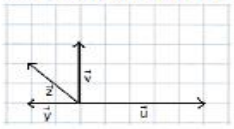
- Asks for justification and clarification from students.

Transition: If you have no questions, let's solve more problems.

D. Extend (15 min)

- Reflect the questions:

Ex(1): The vectors $\vec{u}$, $\vec{v}$ and $\vec{z}$ are given in the figure. Sketch



a) $\vec{u}+\vec{v}$

a) $\vec{u}+\vec{v}+\vec{z}$

b) $\vec{u}+\vec{y}$

a) $\vec{u}-\vec{y}$

c) $\vec{u}+\vec{z}$

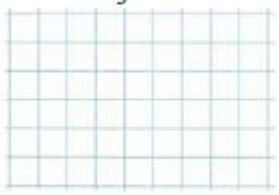
a) $\vec{u}-\vec{z}$

d) $\vec{v}+\vec{z}$

a) $\vec{v}-\vec{z}$

e) $2\vec{y}+\frac{1}{3}\vec{v}$

a) $\frac{3}{5}\vec{u}-\vec{v}+2\vec{z}$



- Students will try to solve questions about vectors on their workbooks
    - Walk around and ask "how did you get this answers?"
    - Check the students whether they solve the problems or not.
    - answers will be checked on the board by writing the questions on the board

Transition: good job! Thank you, class. Have a nice day!

E. Evaluate (During the whole lesson):

- Assesses students' knowledge and skills through oral questions.
- Observe the students during the lesson.
- Take notes students' name if they have a problem when they solve questions.

9. Closure & Relevance for Future Learning

- Ask students to explain what they learn today.
- Then, Want students to write 3 key words that they have learned this lesson a piece of paper.
- Assign students to do the rest of the questions on the workbook.

11. Modifications

- If students cannot remember previous lesson, give them some clues.
- If students do not give answer to your questions, wait 20 seconds more.
- Choose simple questions firstly to solve on the board.
- ÖSS questions can be distributed.