

NTTI MEDIA RICH LESSON**PART 1**

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NAME

“Victoria Secrets”

TITLE

Vectors

TOPIC

55 minutes with an extended-plan for a 90-minute block

TIME ALLOTMENT

OVERVIEW:

Vectors are used in architecture, engineering, and the space program. They are a part of our every day lives. It is important to introduce students to this concept and its applications as soon as possible in order to prepare them for a job market that is becoming more and more competitive.

This lesson is designed as a part of a series to teach conceptual Algebra or Geometry at the middle or high school level. It can also be used as an introduction to an Algebra or Geometry class for accelerated students at the middle grade level. The lesson focuses on the concept of vectors in two-dimensions, its representation and applications. By the end of the lesson, the students will demonstrate the ability to explain the definition of a vector in two-dimensions, how to represent such a vector using algebraic notation, and how vectors are used in real-life applications.

SUBJECT MATTER:

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Mathematics

GRADE LEVEL:

Grades 7 through 12, Pre-Algebra, Algebra I, or Geometry

LEARNING OBJECTIVES:

The students will be able to:

- Identify and use vectors in a coordinate plane.
- Represent a vector using algebraic notation.
- Graphically and algebraically split a vector into its “x” and “y” components.
- Apply vectors to real-life application.

STANDARDS:

National Council of Teachers of Mathematics (NCTM):

Algebra:

Use Mathematical models to represent and understand quantitative relationships.

Model and solve contextualized problems using various representations, such as graphs, tables and equations.

Geometry:

Use visualization, spatial reasoning, and geometric modeling to solve problems.

- Draw geometric objects with specified properties, such as side lengths or angle measures;
- Use visual tools such as networks to represent and solve problems;
- Use geometric models to represent and explain numerical and algebraic relationships.
- Recognize and apply geometric ideas and relationships in areas outside the mathematics classroom, such as art, science, and everyday life.

Georgia Quality Core Curriculum (QCCs):

Algebra:



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1. Solves problems that involve selecting appropriate approaches and tools, estimating, and judging the reasonableness of results throughout elementary algebra.
2. Solves problems that relate concepts to other concepts and to practical applications, using tools such as scientific or graphing calculators and computers to express results in various forms, including scientific notation.

Geometry:

1. Solve problems and practical applications using appropriate approaches and tools (including calculators and computers) and judges the reasonableness of results.
2. Uses algebraic skills and concepts to solve geometric problems throughout geometry.
3. Uses coordinate methods to explore, make conjectures or prove properties of geometric figures, using tools such as algebra, graphing, and appropriate technology.

MEDIA COMPONENTS:

Video: Lines and Planes # 101, “Chasing the Line” [produced by Films for the Humanities & Sciences and distributed by TVO].
“Introduces the concepts of a vector and the scalar multiple of a vector”.
Mathematics, Grades 9-12

This is a senior algebra series that explores the connections between geometry and algebra. Using vivid computer animation, the series defines the line in terms of its vector equation. The concepts of dot product and cross product as operators are introduced and their geometric significance is illustrated.

<http://www.tvo.org/>

Supplementary Materials:

Geometry Journey #102: “Points, Lines and Rays” [produced by Edu2000 America Inc. and distributed by GPN].
“A visual tour of the building blocks of geometry: points and lines”.
Mathematics, Grades 5-12

This series covers the full curriculum of plane geometry, including the properties of basic shapes, mathematics reasoning and proof,



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areas of planar figures, lateral surfaces, volumes of 3D shapes, and non-Euclidean geometry.

<http://www.gpn.unl.edu/>

Vectors #101: "Follow That Arrow" [produced by Films for the Humanities & Sciences and distributed by TVO].

"Characteristics of vectors and the rules that govern their behavior are introduced, and the concepts of magnitude and direction are developed with computer animation".

Mathematics, Grades 10-Adult

Using computer animation, this series investigates vectors. The definition of a vector is developed with several examples. Vectors at right angles to each other are added, and by means of the Pythagorean theorem and the tangent ratio, the magnitude and direction of the resultants are found. Resolving vectors into their components is also explored.

Applied Mathematics: Introduction to Vectors

Dr. Jacques-Andre Landry, McGill University, Faculty of Agricultural and Environmental Sciences, Department of Agricultural and Biosystems Engineering.

http://www.agrenv.mcgill.ca/agreng/applmath/10/Vector_1.htm

MATERIALS:

- Geo Boards (classroom set and a plastic geo board for the overhead)
- Overhead Projector
- String
- Paper
- Ruler
- Colored Pencils
- Markers
- Graph Paper
- Rubber Bands
- TV/VCR
- Video Tape
- Graphing Calculator
- Overhead Attachment to Graphing Calculator

PREPARATION FOR TEACHERS:

This lesson must assume that students already have a basic understanding of linear equations, especially the concept of slope. The geo boards must have a



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vector set up using a rubber band. Also, arrange the room ahead of time so that it represents a coordinate plane that will be used at the end as a closure activity. Make sure that you write the objectives for the lesson on the board or in a highly visible place.

INTRODUCTORY ACTIVITY:

Setting the Stage/Engage (Maximum of 20 minutes)

Step 1:

Begin the discussion by asking a student to state the objectives for the lesson.

Step 2:

Ask the students if anyone knows what a vector in two-dimensions is and how they are used in real-life applications.

Step 3:

Enter a linear equation into the graphing calculator and ask them to identify the slopes of the following equations:

1. $Y = 3/4X + 3$
2. $Y = 2/3X + 1$
3. $Y = 2X + 3$

Step 4:

Continue with the discussion by asking the class the following questions in order to connect to previous knowledge related to the slope of a line and how it is represented. Ask the students:

1. "What is slope?"
2. "How is it represented?"
3. "How is it related to the direction of the line?"
4. "How do use slope to find other points on the line once you have identified the y-intercept?"

Step 5:

Emphasize to your students that the slope of a line is one of the many representations of vectors, which is the focus of today's lesson. As the discussion ends, hand out the geo boards with a vector set up ahead of time or



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do it as you hand them out. Give students two other rubber bands. Encourage the students to work in pairs. When each student has a board and rubber bands, model the breaking down of a vector into its components using the rubber bands and the overhead geo board (A transparency and markers can be used in place of an overhead geo board.).

Step 6:

Show students how it is represented algebraically in order to make the transference. Make sure to point out that the representation is an ordered pair and caution them not to confuse it with the representation of a point.

Step 7:

Give each group of students a few minutes to complete the task. Ask several groups to demonstrate in front of the class using the plastic geo board or their own boards.

If you do not have geo boards, you may substitute it with graph paper or transparencies.

LEARNING ACTIVITY:

Using the video on “Chasing the Line” (Maximum of 20 minutes)

Step 1:

Before you start the video, students must get out a sheet of paper and pencil. Tell students that they must write down any words that they don't know until the video segment ends. **START** the tape. **STOP** the tape after the aliens become 2D and they start “chasing the line.” **PAUSE** the tape as new words or vocabulary are introduced. Provide your students with a **FOCUS FOR MEDIA INTERACTION**. Here is a list of words to discuss after the segment ends:

1. Third Dimension (3D)
2. Second Dimension (2D)
3. Cartesian Plane
4. Vector
5. Speed
6. Direction

Step 2:



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Ask the students what they think the words mean and help them to construct the definitions. Have students write down the definitions. **REWIND** the tape and have the students check their answers. An alternative would be to have the words on one side and the definitions on the other side in random order. The students would draw the lines from the words to the corresponding definitions. *[Another variation would be to have students create a word web using transparencies and markers. Put the students into groups of three and allow them five minutes to create the web. Ask each group to present their web using the overhead projector and ask students questions about the words. This task can be done more effectively using Inspiration software: This software would allow the class to use the computer to develop the web. The students can also be asked to present their webs using an LCD projector.]*

CULMINATING AND INTERACTIVE ACTIVITY:

Scavenger Hunt (Maximum of 15 minutes)

Step 1:

The students will be given a worksheet that has a grid constructed on it with letters placed randomly at various points on the grid. The students will be given a list of directions that asks them to start at a point and they must translate from that point to another point using the given vector. Students record the letter for that point and then they must translate to another point according to the next vector and they record the next letter of the word. Students continue in this manner until they spell out the word “magnitude.”

Step 2:

Ask the students to create their own vector scavenger hunt using the grid provided. They must think of one of the words discussed earlier and must find the letters for that word on the sheet. They then must create the vector directions for spelling that word. After this is done, students give the directions to another student or group who must then solve the puzzle.

CROSS-CURRICULAR EXTENSIONS:

Science: The introductory activity that involves the splitting of a vector into its vertical and horizontal components is connected to physics. This can lead to the concept of vector sums.

Language Arts: The students create a crossword puzzle that incorporates all of the vocabulary words from this lesson. They use graph paper and pencils. They may also use puzzle maker from the web site.



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COMMUNITY AND REAL LIFE CONNECTIONS:

Architecture and Civil Engineering: The vector sum is used to design buildings and bridges that are stable. Pictures of bridges can be used to illustrate the concept of a vector sum and how it balances the bridge and distributes the load.

EXTENDED LEARNING ACTIVITY 1:

To provide a challenge for gifted class or to differentiate instruction for accelerated students.

Step 1:

START the video when the two aliens are “chasing the line” and the words “magnitude” and “direction” are shown. **MUTE** the sound if needed for conceptual understanding. The students should be familiar with the vocabulary by this time. **STOP** the tape before the presentation of how vectors are used to construct lines parametrically.

Step 2:

Put the students in groups of two or three and ask them to create a narrative that describes the content of the segment. **REWIND** the tape and show it again to allow students to take notes. Give students ten to fifteen minutes to create the narrative and have them present their narratives. Make sure that you tell the students that they must write the narrative down to incorporate language arts into the lesson. Provide the class with a **FOCUS FOR MEDIA INTERACTION**, asking students to critique one another and the teacher provides the following questions as a guide for the students.

1. Does the narrative describe the content?
2. How well does the group present the material?
3. Does the narrative fit the video segment?

CLOSURE ACTIVITY:

(Maximum of 15 minutes)

This activity involves the use of the desks set up as a coordinate grid. Pair up students and ask them to define a vector between them. Each student of the pair will also hold one end of the string. Ask each pair of students to tell the class their vector(s). Make sure you say that each pair can describe two vectors. After



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this activity, have a student state the objectives for today's lesson and ask the class if the activities accomplished them.

STUDENT MATERIALS:

Handout 1: Vector Scavenger Hunt

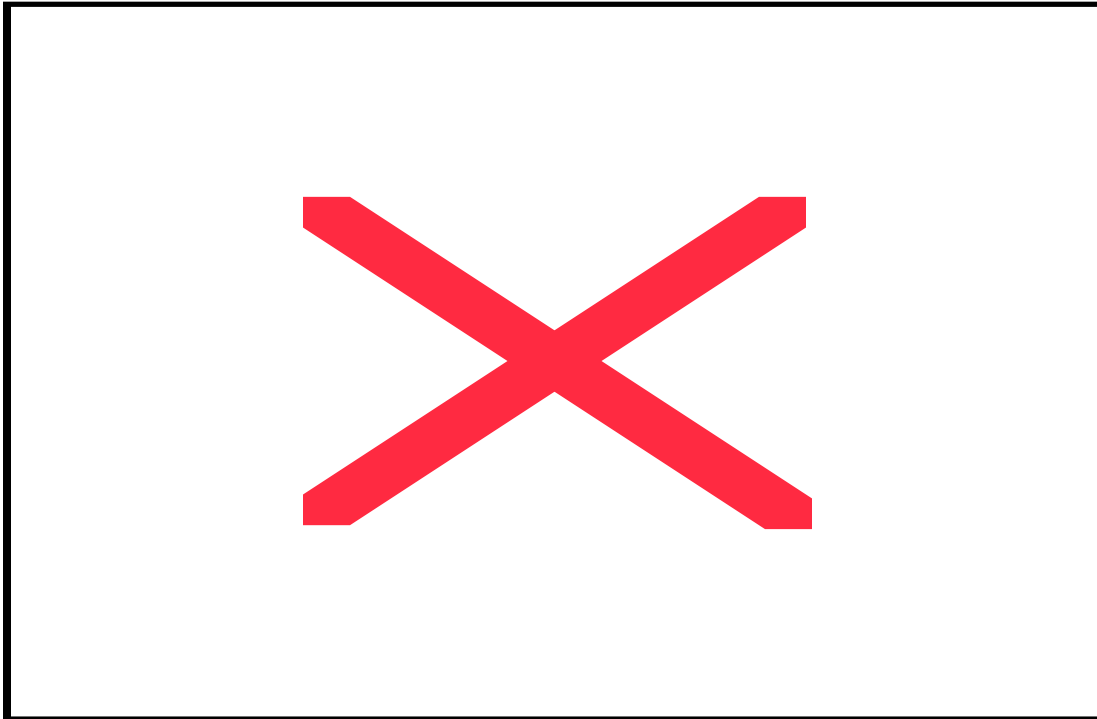
HANDOUT 1

Vector Scavenger Hunt



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Part 1:

Directions: Starting from the origin, you must construct one of the words given in the box using vector translation. Here is an example:

Vector	Letter
1. (-4, 8)	P
2. (1, -2)	O
3. (-1, -1)	I
4. (7, 2)	N
5. (-1, -2)	T

These vector directions construct the word, “point.” If you start from the origin, the first vector tells you to move to the left 4 spaces and up 8 spaces. This brings you to the letter, “P.” Starting from “P,” the next vector tells you to move to the right 1 space and down 2 spaces. This translates you to the letter, “O.” You will continue in this manner until you have found the entire word. Do not always start back at the origin. Use the same coordinate grid above to find the next word in the following puzzle.



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Vector	Letter
1. (1, 6)	_____
2. (0, -2)	_____
3. (5, -2)	_____
4. (-3, 5)	_____
5. (-7, -2)	_____
6. (6, 0)	_____
7. (-8, -1)	_____
8. (2, -2)	_____
9. (-2, -3)	_____

Part 2:

Directions: Construct your own scavenger hunt using the coordinate grid and the words in the box to the right. You can make up your own grid if you want to. Construct a list of vectors for finding each word and ask a person next to you to solve at least two of them. Share your results and see if some of the directions are different.

Vector Vocabulary List
1. Third Dimension
2. Second Dimension
3. Cartesian Plane
4. Vector
5. Speed
6. Direction



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