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| **Lesson Title** | CSI Investigation: Crime Series |
| **Length of Lesson** | 2 days |
| **Created By** | Kylie Nash |
| **Subject** | Math |
| **Grade Level** | $10^{th}$ – $12^{th}$ (Geometry) |
| **State Standards** | $9^{th}$ -$12^{th}$ Geometry 4a. |
| **DOK Level** | DOK 2 |
| **DOK Application** | Compare, Make Predictions, Identify Patterns, Collect, Calculate, Understand, Solve |
| **National Standards** | $9^{th}$- $12^{th}$ Geometry |
| **Graduate Research Element** | Navigational and path planning is major topic within Human Factors and Ergonomics |

**Student Learning Goal:**

State Standards for $9^{th}$ – $12^{th}$ Geometry
1c. Solve real world or application problems that involve square roots and the
   Pythagorean Theorem.

4b. Explain apply the appropriate formula length, midpoint and slope of a segment in a
   coordinate  plane

National Standards for $9^{th}$ -$12^{th}$ Geometry Standard:
- Use trigonometric relationships to determine lengths and angle measures.
- Use geometric ideas to solve problems in, and gain insights into, other disciplines
  and other areas of interest such as art and architecture.
- Investigate conjectures and solve problems involving two- and three-dimensional
  objects represented with Cartesian coordinates

Students learn how to apply formulas to solve problems related to topics leaned in class.
Students practice calculating and solving the Pythagorean Theorem, with different
component missing. Use the Pythagorean Theorem to solve real-world problems.
Students learn how to apply formulas to solve problems related to topics leaned in class.
Students practice calculating and solving the distance formula in a coordinate plane.
Students will also understand the connection between the Pythagorean Theorem and the
distance formula and calculate the distance between two points in a coordinate plane.

**Materials Needed (supplies, hand-outs, resources):**
Handouts, writing utensils, rulers, handouts, protractors, coordinate plane paper.

**Lesson Performance Task/Assessment:**
Students will be able to solve problems using the Pythagorean Theorem and the distance
equation on a real world problem. Students will be able to use appropriate equations to

calculate different measurements in order to make predictions about applications problems.

**Lesson Relevance to Performance Task and Students:**
Allowing students to apply techniques learned and practiced from the textbook on a real world application will help strengthen math skills, critical thinking skills and engineering design concepts to students as well as how math, specifically geometry can be applied to real world applications. Students will be able to draw conclusions from the data they have manipulated and calculated. These lessons and performance tasks will strengthen the students, interest, knowledge and understanding of mathematical concepts through hands on activities to synthesize and interpret concepts learned in the classroom.

**Anticipatory Set/Capture Interest:**
Day 1
Students will be told that they are detectives for the city trying to solve a mystery. The case is determining if a crime was committed or an accident occurred in a local small town. The instructor will lead the discussion by introducing a short conversation about the students' favorite investigation shows (CSI, Bones, Criminal Minds, Law and Order, House, or any other current popular show). Students can provide examples of shows they remember that could or did involve the Pythagorean Theorem (students need prior knowledge of properties of the Pythagorean Theorem). Students will then be told how they will use similar techniques to solve a crime similar to what they see on TV.

Discussion Questions:
- What is the formula for the Pythagorean theorem?
- What is the sentence definition of the Pythagorean theorem?
- What are some real-world applications of the Pythagorean theorem?

Day 2
Students will be told that they are detectives for the city trying to solve a mystery. The case is determining if a suspect is the bank robber that the police are suspicious of robbing the local bank. The instructor will lead the discussion by talking about newspaper articles where GPS triangulation was used to solve crimes. Students can provide examples of crimes where they remember or think GPS can be used to solve crime.

Discussion Questions:
- What is the distance formula?
- What are some real-world applications of the distance formula?

**Guided Practice:**
Day 1
The instructor will discuss the equations used for calculating the Pythagorean Theorem and distance formula. The instructor will go over examples and practice problems calculating these equations. The teachers and students will work through some examples for calculating different these equations on the board or from the textbook. The instructors may also use the supplemental handout (GPS_Worksheet.docx) to give students some practice with the next day's lesson. Once the students have finished collecting data the instructor will discuss how this application can be applied to other real world applications.

Discussion Questions:
- How are the Pythagorean Theorem and the distance formula related?
- Answer any questions related to the worksheet.

Day 2
The instructor will discuss the any topics left over from the Day 1, and refresh students on the equations used for calculating the Pythagorean Theorem and distance formula. The will go through the PowerPoint presentation for about 15 minutes (CSI Investigation with GPS.ppt). The presentation should be interactive allowing students to ask questions throughout. The instructor should give the handout (CSI_GPS.docx). The instructor should explain the worksheet and discuss how cell phone triangulation ties in to GPS and Day 1's lesson and inform the students that they will have to explain their answer choices.

**Independent Practice:**
Day 1
The students will get practice calculating the Pythagorean Theorem and distance formula on the board or from the textbook. Students will complete the handout individually with help from classmates or instructor (GPS_Worksheet.docx) to give students some practice with the next day's lesson. Once the students have finished collecting data the instructor will discuss how this application can be applied to other real world applications.

Day 2
The students will listen to the PowerPoint presentation discuss the any topics left over from the Day 1and work the handout (CSI_GPS.docx) to be worked individually. Once everyone has finished the students can tell who they think committed the crime and explain mathematically how they arrived at their answer choice.

**Remediation and/or Enrichment:**
Remediation:
Shorten the length of the activity, by excluding all activities from Day 1; partner help throughout the activity, individual assistance, individual IEP.

Enrichment/Extension:

1)  Students could be added to get students to find a lost person in the woods using who verbally relays information about his location to the rescue workers and volunteers. Students will use landmarks and grid coordinates to locate the lost person.

2)  Lay coordinate grid over a map of the local town or city and let students construct a journey to different places and landmarks making GPS positions.  Let another group of students reconstruct the path they other group took and landmarks visited.

**Check(s) for Understanding:**

1.  Who robbed the Bank? Explain how you arrived at your answer choice.

2. Why are the other suspects ruled out?

3. What parts of the activity did you feel were the most important to help complete the activity? Why?

4. What parts of the activity did you feel were the least important to helped complete the activity? Why?

5. Do you have a better understanding and improved knowledge of how triangulation and GPS coordinates measure distances? How does the concept of triangulation correlate with the Pythagorean Theorem and the Distance Formula?

Discuss some real world applications (who, what, when, where and how) that would benefit from understanding and triangulation.

**Possible Alternate Subject Integrations:**
Social Studies– Examining the relationship between state locations, technology and society.

Geography- Create maps and various landmarks.

**Teacher Notes:**
    **Reference Sources:**
        1. http://*www.projectmaths.ie/documents/t-l_distance_formula.pdf*
        2.http://octopus.gma.org/space1/where.html
        3.http://www.chicos.caltech.edu/classroom/GPS/GPSActivity1.html
        4.http://gelessons.com/lessons/studentcontrol/k12math/xtremetriangles/
        index.html