**533 Module B – Lesson 4: T-GEM  
Create a T-GEM Lesson for a Challenging Concept**

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| **Challenging Concept:   Alberta Grade 12  Math Curriculum:  Applied Math 30  Topic 5: Vectors**  **Specific Outcome:  3D Vector Analysis** | Understanding vectors in 3 dimensions is difficult for students when they have difficulty drawing the 3D figure on 2D paper. Visuals and simulations help students understand the relationships of how 3D vectors are a combination of rectangles and/or squares that each depicts Right Triangles including Right Triangle Calculations (the Pythagorean Theorem) and Basic Trigonometry Functions of Sine Cosine & Tangent. |

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| **General Outcome:** Solve problems involving polygons and vectors, including both 3-D and 2-D applications. | **General Outcome Legend:**  **C** Communication  **PS** Problem Solving  **CN** Connections  **R** Reasoning  **E** Estimation and  Mental Mathematics  **T** Technology  **V** Visualization | **Outcome Standards:**  The standards statements include the correspondence between Topic 5 of Applied Mathematics 30 and the Vectors section of  Physics 20. | **Resources:**  Graphing Calculators  Cabri Jr. App for the   Graphing Calculator Laptop Cart – Reserve   Internet  SMART Board & Lessons SMART Notebook   Gallery Items &   Simulations Absolute Value Workbook: Applied Math 30  Youtube Video  Java Applets |

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| Background Knowledge  Teacher provides background content information (Khan, 2007). | 1. Students have the calculator application Cabri Junior installed on their calculators 2. Students are familiar with the Cabri Jr. Calculator App & website 3. Students are familiar with where to access their math applications and simulations on their provided laptop 4. Students are familiar with using SMART Notebook Applications and online simulations and apps from prior units and lessons 5. Students have received the related lessons via SMART Notebook Lessons 6. Student laptops equipped with SMART Notebook program and the Cabri Junior program as well as Math websites bookmarked in favorites. |

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| **GEM**  **STAGE** | **Curriculum Outcomes**  **& Teacher Strategy** | **Student Activities** | **Technology** | |
| **Generate Relationships**  Present Review of Prior Learning that Connects to the New Lesson | Connections to  Prior Learning:  1. Investigation of the   Pythagorean Theorem  [C, CN]  Solve problems that   involve operations on   right triangles and   right triangle   calculations with   numerical and variable   values.  Teacher  - Ask students to hypothesize why the relationships work before they do the calculator or online simulations  -Guide students to  recall relationships of how to solve right triangles using a variety of different strategies (pencil and paper, online programs and calculator programs) including collaboration with peers in groups | **Investigation #1:**  Pythagorean Theorem Review  c2 = a2 + b2  And a2 = c2 – b2  And b2 = c2 – a2  **Investigation #2:**  Pythagorean Theorem Cabri Jr. Investigations on the Calculator  Students  -In groups they will  complete the calculator and online simulations. Then, they will observe, discuss & predict the triangle relationships with the equations in their workbook, the Cabri Jr. Program and visual representations of the online simulations  Workbook p.170 – 174 | SMART Notebook  Lesson & Application  Simulations    Cabri Jr. Investigations  [**http://education.ti.com/educationportal/sites/US/productDetail/us\_cabrijr\_83\_84.html**](http://education.ti.com/educationportal/sites/US/productDetail/us_cabrijr_83_84.html)  [**http://www.analyzemath.com/Calculators/Quadrant\_Cal.html**](http://www.analyzemath.com/Calculators/Quadrant_Cal.html)  [**http://www.analyzemath.com/Geometry\_calculators/pythagorean.html**](http://www.analyzemath.com/Geometry_calculators/pythagorean.html)  [**http://www.walter-fendt.de/m14e/pyth2.htm**](http://www.walter-fendt.de/m14e/pyth2.htm) | |
| **Evaluate Relationships** | 2. Investigation of   Vector Addition  & Review of Right  Triangle Trigonometry  Ratios: SOHCAHTOA  & review of non-right   triangle trigonometry  Teacher  - Ask students to compare group results after all comparisons have been completed | Vector Addition  & Review of Right Triangle Trigonometry Ratios: SOHCAHTOA & SIN & COSINE Law  Students  -In groups they will complete the online simulations. Then, they will discuss, explore and evaluate predictions via comparisons of their workbook results to the all of the online simulations in Investigations 1 & 2  Workbook p.180 – 185 | **Vector Addition**  [**http://phet.colorado.edu/en/simulation/vector-addition**](http://phet.colorado.edu/en/simulation/vector-addition)  [**http://www.engineeringtoolbox.com/vector-addition-d\_320.html**](http://www.engineeringtoolbox.com/vector-addition-d_320.html) | |
| **Modify**  **Relationships** | 2. Outcome: 5.3  Vector Components -   Determine the magnitude   and direction of a  resultant vector, using   triangle or parallelogram   methods  [CN, R, T, V]  Teacher  - Ask students to go back to their original questions that they solved incorrectly and make changes according to group consensus.  -Ask students to compare their original misconceptions with others misconceptions to identify patterns | **Investigation #3:**  Pythagorean Theorem & SIN & COSINE Law & Components of a Vector  Students  -In groups they will complete the online simulations. Then, they will compare workbook drawing representations to the simulation & modify original assumptions and workbook drawings upon consensus with their group collaboration & discussion  Workbook p.187 – 195  Workbook p.200 – 212  Workbook p.218 – 224 | **Vector Components**  [**http://zonalandeducation.com/mstm/physics/mechanics/vectors/components/vectorComponents.html**](http://zonalandeducation.com/mstm/physics/mechanics/vectors/components/vectorComponents.html)  **Video-Solving Non-Right Triangles:** [**http://www.youtube.com/watch?v=X2KG4Dk3wnY**](http://www.youtube.com/watch?v=X2KG4Dk3wnY) | |
| **Modify**  **Relationships** | 3. Vector Components  Outcome: 5.4  Model and solve problems in 2-D and simple 3-D, using vector diagrams & technology.  [CN, PS, T, V]  Teacher  - Ask students to go back to their original questions that they solved incorrectly and make changes according to group consensus. | **Investigation #4:**  Pythagorean Theorem  3-D Vectors  Students  -In groups they will complete the online simulations. Then, they will modify and change their original model / drawing of where they expected the resultant vector of a 3D vector problem to end according to simulation results and their group collaboration.  Workbook p.227 – 235 | **Components of a  3D Vector**  [**http://www.walter-fendt.de/m14e/vector3d.htm**](http://www.walter-fendt.de/m14e/vector3d.htm)  **Vector Equation of a Line & Resultants in 3D Space**  [**http://www.walter-fendt.de/m14e/line3d.htm**](http://www.walter-fendt.de/m14e/line3d.htm) | |
| **References** | | | |
| Absolute Value Workbook – Applied Math 30 <http://www.lrc.education.gov.ab.ca/pro/resources/item.htm?item-no=624561> | | | |
| Cabri Jr. Program - <http://education.ti.com/educationportal/sites/US/productDetail/us_cabrijr_83_84.html> | | | |
| Khan, S. (2007). Model-based inquiries in chemistry. *Science Education, 91*(6), 877-905. | | | |
| Khan, S. (2010). New pedagogies for teaching with computer simulations. *Journal of Science Education and Technology, 20*(3), 215-232. | | | |
| SMART Notebook Collaboration Software  <http://smarttech.com/us/Solutions/Education+Solutions/Products+for+education/Software/SMART+Notebook+collaborative+learning+software> | | | |