**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 CalculatorsCabri Jr. App for the  Graphing CalculatorLaptop Cart – Reserve  InternetSMART Board & LessonsSMART Notebook  Gallery Items &  SimulationsAbsolute Value Workbook:Applied Math 30Youtube VideoJava Applets |

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| Background KnowledgeTeacher 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 TheoremCabri Jr. Investigations on the CalculatorStudents-In groups they willcomplete 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 simulationsWorkbook p.170 – 174 | SMART Notebook Lesson & Application SimulationsCabri 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 RightTriangle TrigonometryRatios: SOHCAHTOA & SIN & COSINE LawStudents-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 & 2Workbook 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 VectorStudents-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 & discussionWorkbook p.187 – 195 Workbook p.200 – 212Workbook 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 ComponentsOutcome: 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 VectorsStudents-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](http://smarttech.com/us/Solutions/Education%2BSolutions/Products%2Bfor%2Beducation/Software/SMART%2BNotebook%2Bcollaborative%2Blearning%2Bsoftware) |