**EMTH 300 - Backwards Lesson Plan**

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Saskatchewan Workplace and Apprenticeship Mathematics 10

WNCP Strand: Geometry

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| **Stage 1 – Desired Results** | |
| **Established Goals:**  **General Outcome:** Develop number sense, spatial sense, logical thinking and mathematics as a human endeavor.  **Specific Outcome:**  WA 10.6 – Apply understanding of the Pythagorean theorem to solve problems.  **Achievement Indicators:**   * 10.6 a **[IA]** - Model, including the use of drawing, concrete materials, and technology, the meaning, role, and use of the Pythagorean Theorem, using examples and non-examples. * 10.6 d **[ID]** - Relate, using examples, ratios equivalent to 3:4:5 and other Pythagorean Triples to the Pythagorean Theorem. * 10.6 e **[IE]** - Develop, generalize, apply, and explain strategies to verify if a corner of a 3-D object is square (90°) or if a parallelogram is a rectangle. * 10.6 h **[IH]** - Create, solve and verify the reasonableness of solutions to problems relevant to self, family, or community, for which the Pythagorean Theorem can be used. | |
| **Prior Knowledge:**   * Math 8 (General understanding of the Pythagorean theorem) * WA10.6b, WA10.6c, WA10.6g, WA10.1 * SketchUp Basics (used previously) | **Adaptive Dimension:**   * Depending on level of prerequisite knowledge, project instructions may need to be adjusted. * Adapt as necessary to various physical and intellectual disabilities. Involve all students in activities, regardless of any possible disability. * If certain students/groups need extra time, allow them extra time if needed without consequence. * Journal is not graded on grammar skills, but rather on literacy/grammar criteria, emphasize reflection and thought processes. (ie. Don’t care much about spelling, punctuation, grammar, etc). * For more specific ideas - http://www.saskschools.ca/curr\_content/adhs/whatis.html |
| **What’s Next:**   * WA 10.10 – Use project to find pricing of materials and costs associated with building the structure. |
| **Understandings:**  *Students will understand…*   * The design process  (from sketching, to computer modeling, to scale models) **[CN, V, T]** * How 3:4:5 and 1:1:sqrt(2) triangles can be used. **[CN, R]** * The definition a square corner **[ME]** | **Essential Questions:**   * **[EQ1]** What are some advantages of using the 3:4:5 triplet? **[ID][PS, R]** *Expected response: Easier to use because of lack of a square root, simple to apply proportional reasoning to* * **[EQ2]** How can/did the Pythagorean theorem help with your design? **[IA] [CN, PS, R, V]** *Expected response: Various responses.* * **[EQ3]** What is the importance of the principle square root? **[ME, R]** *Expected response: The absolute value found is the distance (or length) of the hypotenuse.* * **[EQ4]** What properties make a corner square? **[IE] [CN, R]**  *Expected response: All faces are perpendicular to each other.* |
| **Knowledge:**  *Students will know…*   * Various properties of special right triangles (3:4:5, etc) **[C][CN][R] [ID]** * The application of the principle square root in right triangles in Pythagorean Theorem **[R]** * How to apply knowledge of triangles to a design to solve a problem **[CN, PS, R, V]** * How proportional reasoning applies to triangles **[CN, R]** * The definition of a square corner **[IE]** | **Skills:**  *Students will be able to…*   * Sketch a design, represent the particular sketch in SketchUp and build a scale model according to their designs (using proportional reasoning). **[CN, R, V, T]** * Find and use principle square roots in their calculations **[ME, PS, R]** * Justify choices in design, displaying their decision making abilities **[CN, R]** |

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| **Stage 2 – Assessment Evidence** | |
| **Performance Tasks:**   * **[PT1]** Drawing the sketch (enough information included to move onto SketchUp Model) **[CN, PS, R, V] [IA]** * **[PT2]** Modeling in SketchUp (spatial reasoning, created from paper sketch). **[V, T] [IA]** * **[PT3]** Building scale model (show calculations of real size to scale size, proportional reasoning) **[CN, PS, R, V, T] [IA]** * **[PT4]** Explain significance and practicality of 3:4:5 triple **[CN, R] [ID]** * **G.R.A.S.P.S.:**   + *Real world* ***g****oal -* create a home for a living thing **[V, T]**   + *Meaningful* ***r****ole for student-* it is their “pet” and their responsibility **[CN]**   + ***A****uthentic/simulated real world audience* - NASA (teacher) and peers (space mates) to convince it is a good idea **[C, CN]**   + *Contextualized* ***s****ituations involving real world application -* pet needs to come with you to space but needs a home for itself. **[CN, PS, R, V]**   + *Student generated culminating* ***p****roducts and* ***p****erformances* - drawing, sketchup, and scale model **[CN, V, T]**   + *Consensus driven performance* ***s****tandards/criteria for judging success.*- keeping within requirements, creativity, justification for choices made, “something journal” (calculations, etc.) **[CN, R]** | **Other Evidence:**   * **[OE]** Each student keeps a “\_\_\_\_\_\_ Journal” recording step by step processes used, including problems encountered (important),”breakthroughs made, calculations used, how you felt you contributed, questions you have and attempts to answer them, anything else that the student feels is important. **[CN, PS, R] [IH]** |

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| **Stage 3 – Learning Plan** |
| **Set:**   * Review of prior knowledge through specific questions addressed orally. **[C, CN]** * If confusion/problems exist, address them as needed. **[C] [EQ3]**   + ie. Discuss principle square roots (remember to address that it is always positive, or an absolute value, and sometimes just called a square root, despite the dual meaning of words) |
| **Development:**   * Discuss the significance of a 3:4:5 triple **[C, CN, R, V]** **[EQ1] [ID]** * Assign groups, based on student “experts” in different areas (groups of ~3) **[C]**   + ie. Students with different strengths assigned to same groups. * Pull type of “pet” out of a hat. Name it. (ie. giraffe, elephant, fish, iguana, etc. as many as the class needs) * Give the project sheet (attached).   + Explain requirements, expectations, journals, as well as answer questions that are asked. **[C]** * Students will decide on what to call all of their journals. (Gives students ownership of journals. Could be math journal, fun journal, etc. students decide) **[PS, R]** * Allow students to brainstorm ideas for structure in their groups **[C, CN, PS, R]** * See paper sketch before allowing to create 3D model in SketchUp **[C, CN]** **[IA]** * Students will email SketchUp 3d model to teacher/upload to class wiki **[C, V, T] [IA]** * Students create a scale model, emphasize calculations needed to find scale model measurements **[V] [IA]**   Students will present, in 3 minutes or less, their model. They will include where the required components are, at least one problem they encountered, and where they were able to be creative. **[C, CN, ME, PS, R]** |
| **Closure:**   * Students will complete their final entry in their journal. (Serves as an exit slip). **[C, CN, PS, R]**   + What was the most critical aspect of your design? **[EQ2] [IA] [IH]**   + How did proportional reasoning help you with your design?   + What question did you ask and learn about in your journal?   + What makes a corner “square”? **[EQ4] [IE]** |

**Project**

You and your teammates (chosen by your teacher) have already been given a pet.  Because of your great work in Workplace and Apprenticeship Math over the past 2 weeks, NASA has contacted your teacher and invited your team to come work on a classified project in space.  However, you cannot leave your team pet here on earth, so you must take it with you.  Because there is only limited room in the area where you will be living, you must design a separate structure for your pet to live in.  NASA has outlined the following requirements for your design:

* You must submit a pencil sketch of your design (a rough draft), a 3-D model created in Google Sketch-Up, and a scale model version of your design.  The scale model can be made of anything you choose (Lego, toothpicks, paper, whatever you can thinking of). **[IA] [CN, V, T]**
* You must include at least 2 “square” corners and 2 “non-square” corners.  You will need to define what makes a corner “square”. **[IE] [C, V]**
* You must include at least two different 3:4:5 right triangles and one 1:1:√(2) right triangle**[ID] [CN, PS, R]**
* You must include at least two non-right triangles **[IA] [PS, R]**
* There must be enough room for your pet to move and live comfortably. (However, do not make the structure too large, NASA would want to minimize the costs of building this structure) **[IH] [PS, R, V]**
* Justify each component of your design, and why it is needed/important. NASA does not want useless components being built. **[IH] [PS, R, V]**
* You will present (~3 minutes) your final scale model to the other teams at the end of the project. Your teacher will give you the criteria you must include in your presentation **[C, CN]**

**Journal**

* You will be required to document all steps of your design process just like good designers do.  Each individual will maintain his or her own journal. **[C, CN, V]**
* You should document all calculations that were needed in creating your design. **[CN]**
* You must record any questions you have while creating your design. Include how you attempted to answer them, and the answer you found. **[C, CN]**
* You must document how well you feel the time you’ve been provided with was used, how effective your individual contributions have been to the entire team, and your team worked as a whole. **[C, CN]**
* You will be given a final journal entry to complete after the presentation of your design **[C, CN, V]**