Mini-Unit Outline
Understanding By Design Model
(Revised: October 2020)

Title of Unit	Let's Learn About: Pythagorean Theorem!	**Grade Level**	8
Subject	Mathematics	**Time Frame**	Approx. 1 week or 5 60 minute classes (not including work time for last lesson plans group work time and presentations)
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****CLICK HERE FOR YOUTUBE VIDEO****

Stage 1 - Identify Desired Results

Saskatchewan Curricular Learning Outcome(s) and indicators (full text please):
What relevant goal(s) will this unit address?

SS8.1

Demonstrate understanding of the Pythagorean Theorem concretely or pictorially and symbolically and by solving problems.

[CN, PS, R, T, V]

Indicators for this outcome

(a) Generalize the results of an investigation of the expression for $a^2 + b^2 = c^2$ (where a, b, and c are the lengths of the sides of a right triangle, c being the longest):

- concretely (by cutting up areas represented by a^2 and $b^2$and fitting the two areas onto c^2)
- pictorially (by using technology)
- symbolically (by confirming that $a^2 + b^2 = c^2$ for a right triangle).

(b) Explore right and non-right triangles, using technology, and generalize the relationship between the type of triangle and the Pythagorean Theorem (i.e., if the sides of a triangle satisfy the Pythagorean equation, then the triangle is a right triangle which is known as the Converse of the Pythagorean Theorem)

(c) Explore right triangles, using technology, using the Pythagorean Theorem to identify Pythagorean triples (e.g., 3, 4, 5 or 5, 12, 13), hypothesize about the nature of triangles with side lengths that are multiples of the Pythagorean triples, and verify the hypothesis.

(d) Create and solve problems involving the Pythagorean Theorem, Pythagorean triples, or the Converse of the Pythagorean Theorem.

(e) Give a presentation that explains a historical or personal use or story of the Pythagorean Theorem (e.g., Pythagoras and his denial of irrational numbers, the use of the 3:4:5 right triangle ratio in the Pyramids, squaring off the corner of a sandbox being built for a sibling, or determining the straight line distance between two towns to be travelled on a snowmobile).

Knowledge: What math knowledge will students acquire as a result of this unit? (think of nouns – chunks of knowledge, definitions, etc.)	**Skills:** What math skills will students acquire as a result of this unit? (think of verbs – what will you be able to observe students <u>doing</u>)
Students will know... - *Expression:* $a^2 + b^2 = c^2$ - Pythagorean Theorem - Labeling sides a, b, and c of a triangle - Right triangles - Lengths of the sides of a right triangle - Non-right triangles - Relationship between the type of triangle and Pythagorean Theorem - Sides of a triangle satisfy Pythagorean Theorem - Pythagorean triples - nature of triangles with side lengths that are multiples of the Pythagorean triples - Hypothesis - Converse of the Pythagorean Theorem - historical or personal use or story of the Pythagorean Theorem - Pythagoras and his denial of irrational numbers - the use of the 3:4:5 right triangle ratio in the Pyramids - squaring off the corner of a sandbox being built for a sibling - determining the straight line distance between two towns to be travelled on a snowmobile	*Students will be able to…* - Demonstrate understanding of Pythagorean Theorem - Concretely, pictorially, symbolically - Solving problems - Generalize results of investigation - Cutting up areas represented by and fitting the two areas onto - Using technology - confirming - Explore - Identify - Verify hypothesis - Create and solve problems - Give a presentation

Stage 2 – Assessment Evidence (excerpt)

Evidence

Through what evidence – student work samples, observations, quizzes, tests, self-assessment or other means – will students demonstrate achievement of the desired results of this unit?
- Exit slips with questions due before the next class - Submitting a group assignment question regarding Pythagorean triples - Small groups creating Pythagorean theorem word problems. - Giving a presentation that explains a historical or personal use or story of the Pythagorean Theorem

Stage 3 - Learning Plan (Stage 3)

What events will help students experience and explore the big ideas and essential questions in the unit? How will you equip them with needed skills and knowledge?	Peer and group work, large classroom discussions, and presentations will help students understand the big ideas and essential questions in this unit. By having individual, small group, and large group work students can have different Oppurtunites and ways to learn throughout this lesson. It will also engage the students as they will not simply work on textbook questions alone. I will equip them with the needed skills and knowledge by having a mini-lesson or lecture before the experience and exploring time for students to learn the topic in-depth and review what was previously learned.
How will you cause students to reflect and rethink? How will you guide them in rehearsing, revising, and refining their work?	I will cause students to reflect and think by creating engaging activities to push their thinking and apply what they have learned to real-world scenarios. Asking students reflection questions such as what are some ways that the Pythagorean theorem could be applied to real-world scenarios? I will guide them in rehearsing, revising, and refining their work by encouraging students to ask questions, learn from their peers, practice applying their learning, and presenting their findings to their classmates.
How will you organize and sequence the learning activities to optimize the engagement and achievement of ALL students?	For this unit plan, I go in order of the SK curriculum indicators for this outcome. Each lesson is based on an indicator for this outcome. I have organized it so the first couple of lessons are more about lecturing and teaching the students about the Pythagorean Theorem. However, I incorporate engaging activities such as classroom discussion and peer work which will engage all students. The next activities allow students to apply and expand their thinking based on the topics they have learned about the Pythagorean Theorem. For example, small group investigations about the Pythagorean triples, small group presentations and research about a topic regarding the Pythagorean Theorem and creating word problems about the Pythagorean Theorem. All of these activities allow students to display their thinking and also work with their peers. Students need to see how other people understand mathematics and see their perspective.

How will we get there?
Instructional Plan – activities:

Consider using: Mini-lessons Multiple Intelligences Models	**Activities/Lesson 1** **Source of activity:** Exit Slip/ Additional Work **Objective(s) and Indicator(s) (alphanumeric code):**

Manipulatives Rich problems Math journals Games Stations Literature Integration with other subject areas Projects Homework **Resources:** Teacher's guide Textbook Technology Equipment Books **Strategies:** T-chart Think/Pair/Share KWL Drama Connections	(a) Generalize the results of an investigation of the expression $a^2 + b^2 = c^2$ (where a, b, and c are the lengths of the sides of a right triangle, c being the longest): • concretely (by cutting up areas represented by a^2 and b^2 and fitting the two areas onto c^2 • pictorially (by using technology) • symbolically (by confirming that $a^2 + b^2 = c^2$ for a right triangle). **Hook:** Have a map with three points on the map (creating a right triangle). Set it up as if you were trying to figure out the quickest way possible to get to one of the points. Ask the students questions as well as have them displayed on the board. Examples: • Is it quicker to get from side a to b or to just go from side c? Explain. • What type of angle do we notice side a and b create? • What do you notice about side c compared to sides a and b? If students are feeling shy, ask them to discuss in partners or small groups, then reconvene as a class. **Brief description of activity:** The teacher will explain the Pythagorean Theorem to the class. Explain: • What the hypotenuse is and why it must be labelled as "c" • What the Pythagorean theorem is and its formula • Why it only works with a right triangle • Given any two of a,b, or c we can determine the answer using the Pythagorean theorem Show an example on a right triangle and the "a" and "b" values are given. Explain and show how to determine "c". Show an example on a right triangle and the "c" and "b" values are given. Explain and show how to determine "a". Given three values, determine which place them on a right triangle. (the largest must be "c"). During this, the teacher will provide a handout with some of the notes provided. For example, for some of the definitions, students must fill in the blanks. This will promote active listening.

	Assessment: The teacher will hand out an exit slip with questions regarding what was taught and discussed. Above is an example on one that could be used. However, this one is very long and detailed, so I would refine it down to less questions. **Activities/Lesson 2** Source of activity: Desmos **Objective(s) and Indicator(s) (alphanumeric code):** (b) Explore right and non-right triangles, using technology, and generalize the relationship between the type of triangle and the Pythagorean Theorem (i.e., if the sides of a triangle satisfy the Pythagorean equation, then the triangle is a right triangle which is known as the Converse of the Pythagorean Theorem) **Hook:** Explain to students those shapes, in this case triangles, surrounds us without us even knowing. Display images of architecture, patterns, signs, sandwiches, pizzas, bridges, pyramids, and more! Explain that there are many different types of triangles. highlight from the last lesson that the Pythagorean Theorem is only applicable for right triangles and today we will look at the difference between right and non-right triangles. **Brief description of activity**: Teacher will explain examples of right and non-right triangles using a projector or smart board. The teacher will explain right, obtuse, and acute triangles with visual representations. The teacher will do another example of using the Pythagorean Theorem to re-examine what the students learned in the previous lesson. The Teacher will also explain how we can use the Pythagorean Theorem to determine an acute and obtuse triangle. This is the converse of the Pythagorean Theorem. • Acute: $a^2 + b^2 > c^2$ • Obtuse: $a^2 + b^2 < c^2$ After this, students will form small groups of 3-4 people. Once in their groups, they will use technology to form right, acute, and obtuse triangles. They will do this by using a website called Desmos and clicking the geometry section. Once students have created the three different triangles, they will show the teacher explain why each triangle is either a right, acute, or obtuse triangle. **Assessment:** Students will be given an exit slip to show the relationship between the type of triangle and the Pythagorean Theorem by using the Converse of the Pythagorean Theorem. They will also have to identify whether each triangle is an acute, obtuse, and right triangle. The students will also

	determine what a set of three given values and values are on either a right, obtuse, or acute triangle by labelling these values. **Activities/Lesson 3** Source of activity: Desmos **Objective(s) and Indicator(s) (alphanumeric code):** (c) Explore right triangles, using technology, using the Pythagorean Theorem to identify Pythagorean triples (e.g., 3, 4, 5 or 5, 12, 13), hypothesize about the nature of triangles with side lengths that are multiples of the Pythagorean triples, and verify the hypothesis. **Hook:** Start with a review of the last two lessons. Review the Pythagorean Theorem and how to determine $a^2 + b^2 = c^2$. Next introduce what Pythagorean triples mean and how we can determine if a set of three numbers is a Pythagorean triple. The teacher will do a couple examples of a Pythagorean triple and some examples of a set of three numbers that are not. **Brief description of activity:** The teacher will hand out a sticky note to each student with a given number on it which will form a Pythagorean triple. For this activity, students will have to walk around the classroom and try to make a set of Pythagorean triples. Throughout this process, the students will be hypothesizing about the nature of triangles with side lengths that are multiples of Pythagorean triples, and then they will be verifying the hypothesis. If there isn't a group of three evenly throughout the class, the teacher can adjust the activity by throwing in numbers that do not make a Pythagorean triple. **Assessment:** Once students have formed their Pythagorean triple, they will have to prove that their set of numbers makes a Pythagorean triple. They will write and solve the equations, use Desmos to represent their triangle, and properly label their triangle. Once the small groups have completed this, they will submit this to the teacher. If there is additional time in class, each group could also give a short presentation at the front of the class and prove that their numbers are a Pythagorean triple. **Activities/Lesson 4** **Source of activity:** Examples of Word Problems **Objective(s) and Indicator(s) (alphanumeric code):**

	(d) Create and solve problems involving the Pythagorean Theorem, Pythagorean triples, or the Converse of the Pythagorean Theorem. **Hook:** Begin the lesson by asking students if there are any real-world problems they could think of that the the Pythagorean Theorem, Pythagorean triples, or the Converse of the Pythagorean Theorem. After having a class discussion, show some examples to the class and solve them together. Show one example for each of the Pythagorean Theorem, Pythagorean triples, or the Converse of the Pythagorean Theorem. **Brief description of the activity:** Have the students get into pairs or groups of three. The students will make a word problem in their partner groups that covers the Pythagorean Theorem, Pythagorean triples, or the Converse of the Pythagorean Theorem. They will solve the problem and show their work. Encourage them to not do one that was already shown in class. **Assessment**: Each group will partner up with another group. The teacher will hand out each students a peer feedback form with a section of what the other groups problem was. Each group will present their problem to the other group without answering. Once the problems are presented, the students will try to solve the other groups problems. Next, the students will share how they solved it, and if they got the answer correct. Students will fill out the peer feedback form with the other groups word problem. Students will submit the word problem and solution they created, the other groups word problem they solved, and the peer feedback form to the teacher at the end of class. **Activities/Lesson 5** Source of activity: SK Curriculum and Youtube Video **Objective(s) and Indicator(s) (alphanumeric code):** (e) Give a presentation that explains a historical or personal use or story of the Pythagorean Theorem (e.g., Pythagoras and his denial of irrational numbers, the use of the 3:4:5 right triangle ratio in the Pyramids, squaring off the corner of a sandbox being built for a sibling, or determining the straight line distance between two towns to be travelled on a snowmobile). **Hook:** Explain to students that now that we know what the Pythagorean Theorem means and how to solve it, let us learn about the history behind it, and fun facts about it! Give a short presentation to the students about many different fun facts about the Pythagorean Theorem.

	Brief description of activity: Ask the students to group into pairs or groups of three. The small groups will research and give a presentation about a topic surrounding the historical or personal use of the Pythagorean Theorem. Show the YouTube video to get students thinking about some ideas for their project. Explain that the presentation should be 5-10 minutes long per group. The teacher will have a variety of topics to choose from such as: - Pythagoras and his denial of irrational numbers - the use of the 3:4:5 right triangle ratio in the Pyramids - squaring off the corner of a sandbox being built for a sibling - determining the straight-line distance between two towns to be travelled on a snowmobile - Home renovations - The ancient origins of the Pythagorean Theorem The students will be given a couple of days to prepare for their presentation. There should be some sort of visual aspect such as Google Slides or PowerPoint. **Assessment:** Each group will present their project to the class. The teacher will evaluate if they did a good presentation and if it was a relevant topic.

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