Unit – Pythagorean’s Theorem

This unit explores the importance and place of Water in the province on Saskatchewan.

Essential Questions

How does one apply the Pythagorean theorem?

Outcomes

SS8.1 – Demonstrate understanding of the Pythagorean Theorem concretely or pictorially and symbolically and by solving problems.

Indicators:

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

N8.1 – Demonstrate understanding of the square and principle square root of whole numbers concretely or pictorially and symbolically.

- Recognize, show, and explain the relationship between whole numbers and their factors using concrete or pictorial representations (e.g., using a set number of tiles, create rectangular regions and record the dimensions of those regions, and describe how those dimensions relate to the factors of the number).
• Infer and verify relationships between the factors of a perfect square and the principle square root of a perfect square.
• Determine if specific numbers are perfect squares through the use of different types of representations and reasoning, and explain the reasoning.
• Describe and apply the relationship between the principle square roots of numbers and benchmarks using a number line.
• Explain why the square root of a number shown on a calculator may be an approximation.
• Apply estimation strategies to determine approximate values for principle square roots.
• Determine the value or an approximate value of a principle square root with or without the use of technology.
• Identify a number with a principle square root between two given numbers and explain the reasoning.
• Share the story, in writing, orally, drama, dance, art, music, or other media, of the role and significance of square roots in a personally selected historical or modern application situation (e.g., Archimedes and the square root of 3, Pythagoras and the existence of square roots, role of square roots in Pythagoras’ theorem, use of square roots in determining dimensions of a square region from the area, use of square roots to determine measurements in First Nations beading patterns, use of square roots to determine dimensions of nets).

**Day Plan**

**Day 1** – Intro to square roots ch 3.1  
**Day 2** – Estimating Square Roots ch 3.3  
**Day 3** – Intro to Pythagorean’s theorem ch 3.2  
**Day 4** – Using the relationship ch 3.4  
**Day 5** – Applying the relationship ch 3.5  
**Math Test** – The end unit quiz
Lesson Plan Day 1

Name: Morgan Hunter  
Subject: Math  
Date: Tuesday March 25, 2014  
Grade: Eight

**Essential Question** (Guiding overall unit of study):

How does one apply the Pythagorean theorem?

**Purpose and Focus:**

Students will review concept of squares and square roots.

**Outcomes:** (What should students know, understand and be able to do as a result of this lesson?)

N8.1 – Demonstrate understanding of the square and principle square root of whole numbers concretely or pictorially and symbolically.

**Indicators** (Assessment Evidence): (What will students do to show what they have learned?) In student friendly language.

- Determine if specific numbers are perfect squares through the use of different types of representations and reasoning, and explain the reasoning.
- Describe and apply the relationship between the principle square roots of numbers and benchmarks using a number line.
- Apply estimation strategies to determine approximate values for principle square roots.
- Determine the value or an approximate value of a principle square root with or without the use of technology.

**Assessment Strategies**: (formative -before & during & Summative – end)

Students will do activities together as a class to find squares and square roots. Class will work together to solve questions. Students will do a few questions on their own.

**Instructional Strategies**: (specific strategies)

Direct Instruction, participatory instruction, partner work, individual work.

**Adaptive Dimension: Differentiated Learning** (What adaptations in content, process, product and learning environment will be provided to meet diverse student needs?)

If students are finding concepts difficult the teacher will take time to reteach information.
to student.

**Materials Needed**

PowerPoint

**Learning Experiences:**

**Ignition (5 min):**

On overhead – Find area of the following squares. Find the length of the side of the following squares. (answers – 25, 196, 1089).

**Bridge (10 min):**

Exploring Textbook – On own or with partner.
1. What is the title of this chapter?
2. What are the titles of the five sections in this chapter?
3. What do the “focus on” boxes tell you at the beginning of each section?
4. Is there a list of key words or vocabulary in this chapter?
5. What types of shapes are mentioned in the text?
6. Do you see anything familiar in this chapter?
7. What do you think this chapter will be about?

**Gradual Release of Responsibility (40 min):**

3.1 Squares and Square Roots (20)

*Modeling - Square*

A square is a number multiplied by itself. Write as 8x8 or $8^2$

$8^2 = 64$

$11^2 = 121$

*Shared*

Students on write boards find the square of $4^2, 9^2, 13^2, 21^2$ (16, 81, 169, 441)

*Modeling:*

How do we find the length in a square? Show an example of a square. Use Prime Factorization. This is written 36 cm$^2$ To find the square root: 36 Factor it out

*Shared:*

Give class three examples to try on their own. Circulate while students are working on questions, helping students as necessary. Of 81 = 9, 144 = 12, 225 = 15
Have students explain thinking for each one.

3.3 Estimating Square Roots (20)

Modeling:
Estimating square roots. Give example, talk through how you found it. Explain process. Show on number line. Confirm with calculator. Guess and check. How do we estimate a square root to one decimal place.

Square of 18. On number line. $4^2 = 16$, $5^2 = 25$. In between the two. 4.2

Shared:
Students attempt four questions on own. Review as class. Have each student explain thinking. 12 (3.5), 32 (5.7), 84 (8.1), 115 (10.7)

Guided:
A word problem in pairs or on own (both must write answer). Ch 3.1) Qs. 17, 18, 19, 23. Ch 3.3) 5, 10, 12.

Debrief (5 min):
Three facts and a fib.
Lesson Plan Day 2

Name: Morgan Hunter          Date: Wednesday, March 26, 204
Subject: Math               Grade: Eight

### Essential Question (Guiding overall unit of study):

How does one apply the Pythagorean theorem?

### Purpose and Focus:

Students will review concept of squares and square roots.

### Outcomes: (What should students know, understand and be able to do as a result of this lesson?)

- N8.1 – Demonstrate understanding of the square and principle square root of whole numbers concretely or pictorially and symbolically.

### Indicators (Assessment Evidence): (What will students do to show what they have learned?) In student friendly language.

- Determine if specific numbers are perfect squares through the use of different types of representations and reasoning, and explain the reasoning.
- Describe and apply the relationship between the principle square roots of numbers and benchmarks using a number line.
- Apply estimation strategies to determine approximate values for principle square roots.
- Determine the value or an approximate value of a principle square root with or without the use of technology.

### Assessment Strategies: (formative-before & during & Summative – end)

Students will do activities together as a class to find squares and square roots. Class will work together to solve questions. Students will do a few questions on their own.

### Instructional Strategies: (specific strategies)

Direct Instruction, participatory instruction, partner work, individual work.

### Adaptive Dimension: Differentiated Learning (What adaptations in content, process, product and learning environment will be provided to meet diverse student needs?)

If students are finding concepts difficult the teacher will take time to reteach information
Materials Needed

PowerPoint

Learning Experiences:

Ignition (5 min):

Three facts and fib question on overhead created by students from the day before. The lies are (3, 6, 12)

Bridge (5 min):

Many students were confused during the assignment about halves and square roots.

Gradual Release of Responsibility (40 min):

3.3 Estimating Square Roots (20)

Modeling:

So far what we’ve been focusing on is perfect squares (when one whole number is the square of another whole number. Estimating square roots. Give example, talk through how you found it. Explain process. Show on number line. Confirm with calculator. Guess and check. How do we estimate a square root to one decimal place.

Square of 18. On number line. \(4^2 = 16, 5^2 = 25\). In between the two. 4.2

Shared:

Students attempt four questions on own. Review as class. Have each student explain thinking. 12 (3.5), 32 (5.7), 84 (8.1), 115 (10.7)

Guided:

A word problem in pairs or on own (both must write answer). Ch 3.1 86) Qs. 16, 17, 18, 23. Ch 3.3 99-100) 5, 10, 12, 15

Debrief (5 min):

Finding the lengths of sides of squares.
Essential Question (Guiding overall unit of study):

How does one apply the Pythagorean theorem?

Purpose and Focus:

What is Pythagorean’s theorem?

Outcomes: (What should students know, understand and be able to do as a result of this lesson?)

SS8.1 – Demonstrate understanding of the Pythagorean Theorem concretely or pictorially and symbolically and by solving problems.

Assessment Strategies: (formative-before & during & Summative – end)

Instructional Strategies: (specific strategies)

Adaptive Dimension: Differentiated Learning (What adaptations in content, process, product and learning environment will be provided to meet diverse student needs?)

Materials Needed

Learning Experiences:

Ch 3.2

Ignition (5 minutes)

Number line questions 37 (6.1), 42 (6.5), 48 (6.9)

Bridge (10 minutes)
Explain what is the hypotenuse. Find the hypotenuse. Activity (2, 6, 9)

**Gradual Release (44 minutes)**

**Modeling**

Explain that in ancient Greece there was a mathematician called Pythagoras who realized that the sum of square of the two legs of a right triangle was equal to the square of the hypotenuse. Show example on screen colouring boxes.

This formula is $a^2+b^2=c^2$ (a and b are legs, c is the hypotenuse)

If we know the areas of the squares from a triangle we can find out if the triangle is a right triangle because this is true for every right triangle. Draw a triangle dimensions (16cm$^2$, 1 cm$^2$, 19cm$^2$) (not correct – B)

Finding missing area. Using A. We can see that $a^2+b^2=c^2$, we can also see that $c^2-b^2=a^2$

Find missing area – A) 38cm$^2$ B) 9cm$^2$

Assignment Ch 3.2, p. 92-94, Questions – 5, 12, 13, 14, 15, 17

**Debrief (2 minutes)**

Exit ticket, what did you learn in math class today? On Card.
**Lesson Plan Day 4**

**Name:** Morgan Hunter  
**Date:** Monday, March 31, 2014  
**Subject:** Math  
**Grade:** Eight

**Essential Question** (Guiding overall unit of study):

How does one apply the Pythagorean theorem?

**Purpose and Focus:**

What is Pythagorean’s theorem?

<table>
<thead>
<tr>
<th><strong>Outcomes</strong></th>
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  ○ concretely (by cutting up areas represented by $a^2$ and $b^2$ and fitting the two areas onto $c^2$)  
  ○ symbolically (by confirming that $a^2 + b^2 = c^2$ for a right triangle). |

**Assessment Strategies:** (formative-before & during & Summative – end)  
As class proceeds students will work on example questions. Students will work on questions from the text at the end of class.

**Instructional Strategies:** (specific strategies)  
Direct instruction, participatory instruction.

**Adaptive Dimension: Differentiated Learning** (What adaptations in content, process, product and learning environment will be provided to meet diverse student needs?)

Teacher will circulate and spend additional times with students who need help.

**Materials Needed**  
PowerPoint

**Learning Experiences - Ch 3.4**

**Ignition (5 minutes)**

Which is a right triangle. 2 is not a right triangle.
Bridge (10 minutes)

When to square and then to just add together, when to add when to subtract. Answers A-32cm², B-279cm², C-74cm²

Gradual Release (44 minutes)

Modeling

Finding the length of the hypotenuse.

\[ \begin{array}{c}
6 \\
9 \\
? \\
\end{array} \]

Speak out each step drawing on the thinking that students have talked about in their bridge activity. Draw the squares for each side but explain that to do this you are multiplying each side by itself or squaring it. When you get to the square formed by the hypotenuse side, explain that to find the hypotenuse side you find the square root of the area.

\[ 6^2 = 36, \ 9^2 = 81; \ 36 + 81 = 117 = 10.8 \]

Shared Practice

Together class works to solve questions from powerpoint. Green (14.8), Peach (24.7), Pink (12.96 or 13), Purple (40.4).

Independent learning

Questions from Text book. Chapter 3.4, p. 104-105, questions: 4, 5, 7, 8, 12-14

Debrief (2 minutes)

Create your own question using Pythagorean’s theorem.
Lesson Plan Day 5

Name: Morgan Hunter  
Date: Tuesday, April 1, 2014  
Subject: Math  
Grade: Eight

<table>
<thead>
<tr>
<th>Essential Question (Guiding overall unit of study):</th>
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  o concretely (by cutting up areas represented by $a^2$ and $b^2$ and fitting the two areas onto $c^2$)  
  o pictorially (by using technology)  
  o symbolically (by confirming that $a^2 + b^2 = c^2$ for a right triangle). |

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<th>Ignition (5 min):</th>
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<tr>
<td>Student questions from last lesson. And my Question. Find the missing side: Green: 7.8, Pink: 33.9; purple: 9.2; Peach: 129.6</td>
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<th>Bridge (5 min):</th>
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<tr>
<td>Practice work problem in row groups. A) 420m, b) 323m, c) maria by 97m</td>
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<tr>
<th>Gradual Release of Responsibility (45 min):</th>
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Questions from text
p. 87: 20 (use prime factorization)
  p. 94: 18
  p. 100: 15
  p. 105: 11
  p. 110-111: 4, 6, 8, 10, 12

Debrief (5 min):

Exit ticket – If you had to explain how to use Pythagorean’s theorem to a classmate who has missed class how would you explain it. (use drawings or sentences, not just the formula).
Math Exam: Chapter 3

Multiple Choice

1. \(8^2\) (1)
   a. 64  
   b. 60  
   c. 54  
   d. 72

2. \(\sqrt{81}\) (1)
   a. 7  
   b. 8.4  
   c. 9  
   d. 9.2

3. Which of the following is a right triangle? – Show your work (4)
   a. 3, 6, 8  
   b. 9, 12, 15  
   c. 6, 11, 14  
   d. 8, 9, 13

4. What is the area of the square formed from the missing side? – Show each step. (4)

   ![Diagram of a square with a side length of 9cm and a right triangle with sides 25cm and 14cm]

   a. 34cm\(^2\)  
   b. 16cm\(^2\)  
   c. 544cm\(^2\)  
   d. 706cm\(^2\)

5. What is the length of the missing side? – Show each step. (5)

   ![Diagram of a right triangle with sides 14cm and 12cm]

   a. 18.4cm  
   b. 7.2cm  
   c. 5.1cm
6. Use prime factorization (factor tree) to determine which of the following is a perfect square. –Show your work. (3)
   a. 36
   b. 33

7. Find the square root of the following? (4)
   a. 25
   b. 44
   c. 81
   d. 120

8. What is the area of the square formed by the missing side? –Show every step. (4)

9. What is the area of the square formed by the missing side? Show every step. (5)
10. What is the length of the missing side? Give answer to one decimal place. Show your work. (6)

11. What is the length of the missing side? Give answer to one decimal place. Show your work. (6)

12. What is the length of the missing side? Give answer to one decimal place. Show your work. (7)

13. George painting the trim on his house. He rests the ladder 4m up so that he can reach the trim as he paints. The ladder is placed 1m from the side of the house. How long is the ladder? –Show your work. (3)