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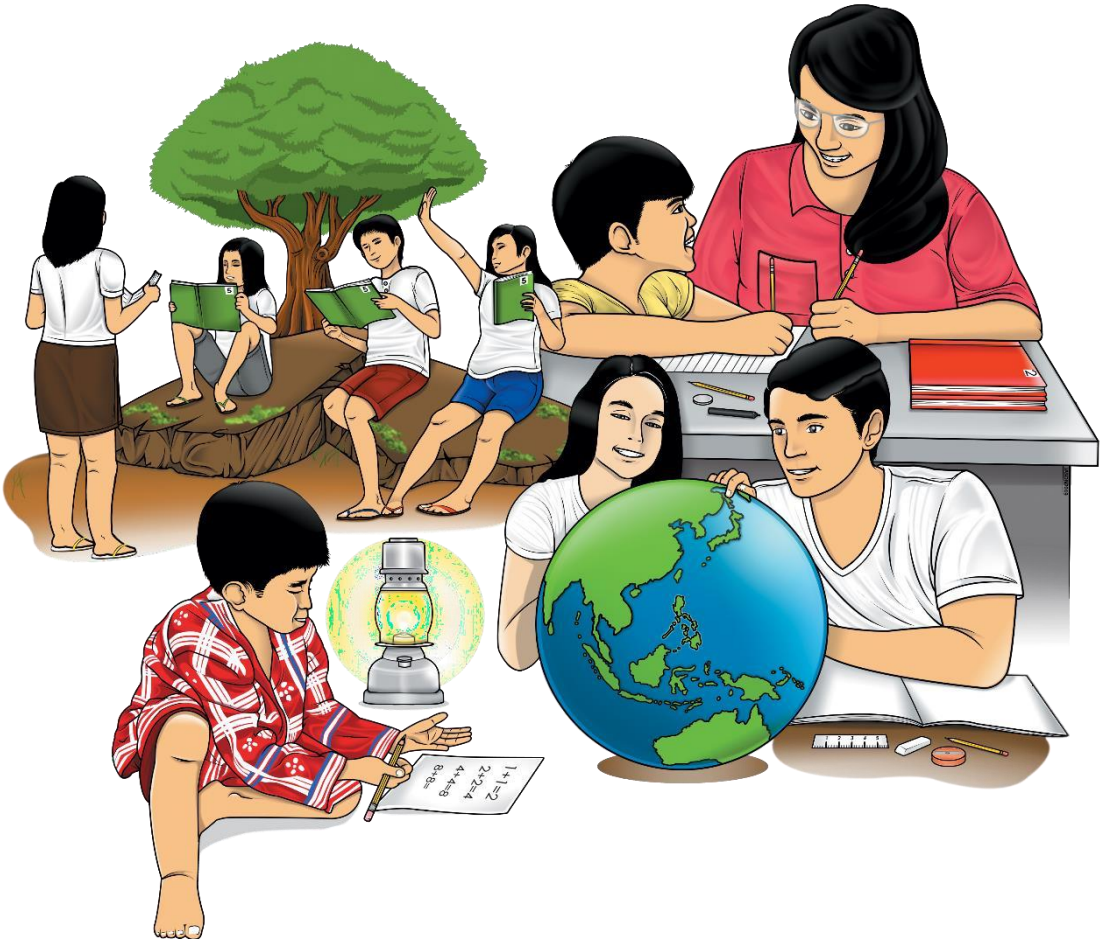
DEPARTMENT OF EDUCATION

Mathematics

Quarter 1 – Module 7: Principal Roots and Irrational Numbers



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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by- step as you discover and understand the lesson prepared for you.

Pre-test are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module, or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teachers are also provided to the facilitators and parents for strategies and reminders on how they can best help you on your home based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. Read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

This module was designed and written with you in mind. It is here to help you master the Principal Roots and Irrational Numbers. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

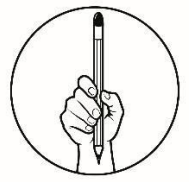
The module is divided into two lessons, namely:

- Lesson 1 – Principal Roots and its Nature (Rational or Irrational)
- Lesson 2 – Determine between what two integers the square root of a number lie.

After going through this module, you are expected to:

1. define Principal Root;
2. describe principal roots and tells whether they are rational or irrational;
3. determine between what two integers the square root of a number lie.

Learning Competency Code: M7NS-Ig-



What I Know

Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. What do you call a number that **can** be expressed in the form $\frac{a}{b}$, where a and b are integers, and b is not equal to 0?
   a. Integers c. natural
   b. Irrational d. rational
2. Which of the following refers to a number whose decimal representation is neither terminating nor repeating? This number cannot be expressed as a quotient of integers.
   a. Integers c. natural
   b. Irrational d. rational
3. What do you call the positive n^{th} root of a number?
   a. perfect square c. radical
   b. principal root d. radicand
4. What is the principal root of $\sqrt{25}$?
   a. 2 c. 25
   b. 5 d. 50
5. What is the principal root of $\sqrt{10}$?
   a. 3.162277660… c. 10
   b. 5 d. 100
6. Which of the following describes the principal root of $\sqrt{50}$?
   a. Integers c. natural
   b. Irrational d. rational
7. Which of the numbers is classified as perfect square integer?
   a. 6 c. 12
   b. 9 d. 20
8. Between what two consecutive integers does the square root of 18 lie?
   a. 3 & 4 c. 5 & 6
   b. 4 & 5 d. 16 & 25
9. Find the number whose square root lies between 5 and 6.
   a. 24 c. 26
   b. 25 d. 36
10. Find the square root of 16.
    a. 4 c. 6
    b. 5 d. 8
11. Which of the following has an irrational principal root?
    a. 4 c. 16

b. 9 d. 20

12. Which of the following square roots lies between 2 and 3.

a. $\sqrt{2}$ c. $\sqrt{5}$

b. $\sqrt{3}$ d. $\sqrt{10}$

13. Which of the following is not a perfect square integer?

a. 25 c. 63

b. 49 d. 81

14. Between what two consecutive integers does the square root of 33 lie?

a. 4 & 5 c. 6 & 7

b. 5 & 6 d. 7 & 8

15. Find the principal root of $\sqrt{121}$.

A. 10 c. 12

B. 11 d. 13

Lesson 1 Principal Roots and its Nature (Rational or Irrational)

What's In

You have performed operations on the set of rational numbers. Now let's check your prior knowledge.

A. Find the product of the following:

Given	Product
1.) 1 • 1	
2.) 2 • 2	
3.) 3 • 3	
4.) 4 • 4	
5.) 5 • 5	

Given	Product
6.) 6 • 6	
7.) 7 • 7	
8.) 8 • 8	
9.) 9 • 9	
10.) 10 • 10	

B. Tell whether the given number is a Rational or Irrational

_____1.) 25

_____ 2.) $\frac{1}{2}$

_____3.) $\sqrt{3}$

_____4.) 1.414235...

_____ 5.) 3.666...

_____6.) 8.660254...

Notes to the Teacher

The student may use the scientific calculator in their android phone to easily check the principal root of a number.

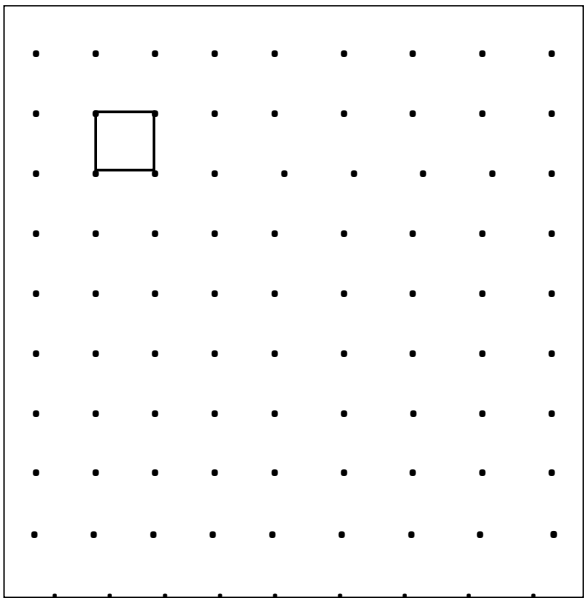
What's New

This module contains the concept of Principal Roots and how to determine whether it is rational or irrational.

Let's explore!

You have learned to use the length of a side of a square to find the area. You can use this area to find the length of a side.

The square shown on the right has a side 1 unit long. Its area is 1 square unit.



1. Make a square with area of 4 square units on the grid. What is the length of the side?

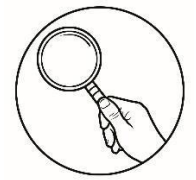
2. Make a square with area of 9 square units on the grid. What is the length of the side?

3. Make a square of an area of 2 square units.
   a. How do you know that the area of the square you have done is 2 square units?
   b. How do you know that the figure you drew is a square?
   c. Estimate the length of a side of the square.

Try this!

Using a scientific calculator (*or your android phone*), input the following and get the equivalent value.

1. $\sqrt{36}$ = _____
2. $\sqrt{64}$ = _____
3. $\sqrt{2}$ = _____
4. $\sqrt{50}$ = _____
5. $\sqrt{81}$ = _____
6. $\sqrt{75}$ = _____



What is It

A real number has its Principal Root that can be extracted when using the symbol $\sqrt{\ }$ that is known as *radical sign.* The combination of the radical sign together with the number is called a *radical.* The number under the radical sign is known as the *radicand.*

Here it is!

Radical	Radicand	Principal Root
$\sqrt{36}$	36	6
$\sqrt{2}$	2	1.414235

Let's define more!

Definition

Principal Root is a number which produces a specific quantity when multiplied by itself. It is the positive n^{th} root of a number.

A **Perfect Square** is the square of a rational number.

Rational Number is a number that can be expressed in the form $\frac{a}{b}$ where a and b are integers, and b is not equal to 0.

Irrational Number is a number whose decimal representation is neither terminating nor repeating. This number cannot be expressed as a quotient of integers.

Let's Analyze it!

Earlier you have tried to get the equivalent value of each of the following using a scientific calculator. You have also known that the equivalent value is called Principal Root.

1. $\sqrt{36}$ = 6
2. $\sqrt{64}$ = 8
3. $\sqrt{2}$ = 1.414235…
4. $\sqrt{50}$ = 7.071067…
5. $\sqrt{81}$ = 9
6. $\sqrt{75}$ = 8.660254…

Notice that some Principal Roots are whole numbers while some are decimal numbers. That means:

- *when a Principal Root is a* ***whole number or fraction****, then the* ***Principal Root is described as Rational****.*
- *when a Principal Root is a* ***non-terminating or non-repeating decimal number****, then the* ***Principal Root is described as Irrational****.*

Let's conceptualize it!

To determine whether a Principal Root is Rational or Irrational, we need to get first the Principal Root of a number. We can use a scientific calculator to get the exact Principal Root of a certain number and tell if it's Rational or Irrational. We can also use the concept of Perfect Squares to separate Rational from Irrational Principal Root.

Consider the given below:

Given	Product
1.) 1 • 1	1
2.) 2 • 2	4
3.) 3 • 3	9
4.) 4 • 4	16
5.) 5 • 5	25

Given	Product
6.) 6 • 6	36
7.) 7 • 7	49
8.) 8 • 8	64
9.) 9 • 9	81
10.) 10 • 10	100

All the derived products are considered **Perfect Squares**. Perfect Squares are numbers that have Rational numbers as Principal Roots.

Moreover, taking the Principal Root of a number is like doing the reverse operation of squaring a number.

Thus,

1.) when $1 \cdot 1 = 1$, then, $\sqrt{1} = 1$

Now, since we have extracted a Rational number which is 1, therefore, we can say that the ***Principal Root of*** $\boldsymbol{\sqrt{1}}$ ***is Rational****.*

2.) when $2 \cdot 2 = 4$, then, $\sqrt{4} = 2$

Now, since we have extracted a Rational number which is 2, therefore, we can say that the ***Principal Root of*** $\boldsymbol{\sqrt{4}}$ ***is Rational****.*

3.) when $3 \cdot 3 = 9$, then, $\sqrt{9} = 3$

Now, since we have extracted a Rational number which is 3, therefore, we can say that the ***Principal Root of*** $\boldsymbol{\sqrt{9}}$ ***is Rational****.*

4.) also when $\frac{4}{5} \bullet \frac{4}{5} = \frac{16}{25}$, then, $\sqrt{\frac{16}{25}} = \frac{4}{5}$

Now, since we have extracted a Rational number which is $\frac{4}{5}$, *therefore, we can say that the* ***Principal Root of*** $\sqrt{\frac{16}{25}}$ ***is Rational.***

Hence, the **Principal Root of all Perfect Squares** such as but not limited to, $\sqrt{1}$, $\sqrt{4}$, $\sqrt{9}$, $\sqrt{16}$, $\sqrt{25}$, $\sqrt{36}$, $\sqrt{49}$, $\sqrt{64}$, $\sqrt{81}$, $\sqrt{100}$, …, $\sqrt{n^2}$ are **Rational**.

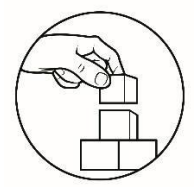
On the other hand, when a number is **not a Perfect Square**, then its **Principal Root is Irrational.**

Example:

1.) $\sqrt{2}$ *Can you think of any number that when multiplied by itself will give an answer of 2?* ***None.*** *We can say then that 2 is not a Perfect Square, therefore,* ***the Principal Root of*** $\sqrt{2}$ ***is Irrational.***

2.) $\sqrt{15}$ *Can you think of any number that when multiplied by itself will give an answer of 15?* ***None.*** *We can say then that 15 is not a Perfect Square, therefore,* ***the Principal Root of*** $\sqrt{15}$ ***is Irrational.***

3.) $\sqrt{\frac{3}{10}}$ *Can you think of any number that when multiplied by itself will give an answer of* $\frac{3}{10}$*?* ***None.*** *We can say then that* $\frac{3}{10}$ *is not a Perfect Square, therefore,* ***the Principal Root of*** $\sqrt{\frac{3}{10}}$ ***is Irrational.***



What's More

Determine whether the Principal Root of a number is Rational or Irrational.

_____ 1. $\sqrt{49}$

_____ 2. $\sqrt{3}$

_____ 3. $\sqrt{50}$

_____ 4. $\sqrt{26}$

_____ 5. $\sqrt{81}$

_____ 6. $\sqrt{121}$

_____ 7. $\sqrt{\frac{25}{64}}$

_____ 8. $\sqrt{12}$

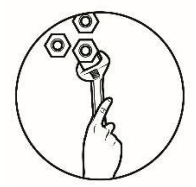
_____ 9. $\sqrt{144}$

_____ 10. $\sqrt{\frac{6}{21}}$

What I Have Learned

Based on your understanding of the lesson, complete the following sentences.

1. A real number has a_____that can be described as Rational or Irrational.
2. The square of a Rational Number is considered_____.
3. When a number is Perfect Square, then its Principal Root is_____.
4. When the Principal Root of a number is non-terminating or non-repeating decimal, then that Principal Root is described as_____.
5. When extracting the Principal Root of a real number, it can be described as either _____or_____.

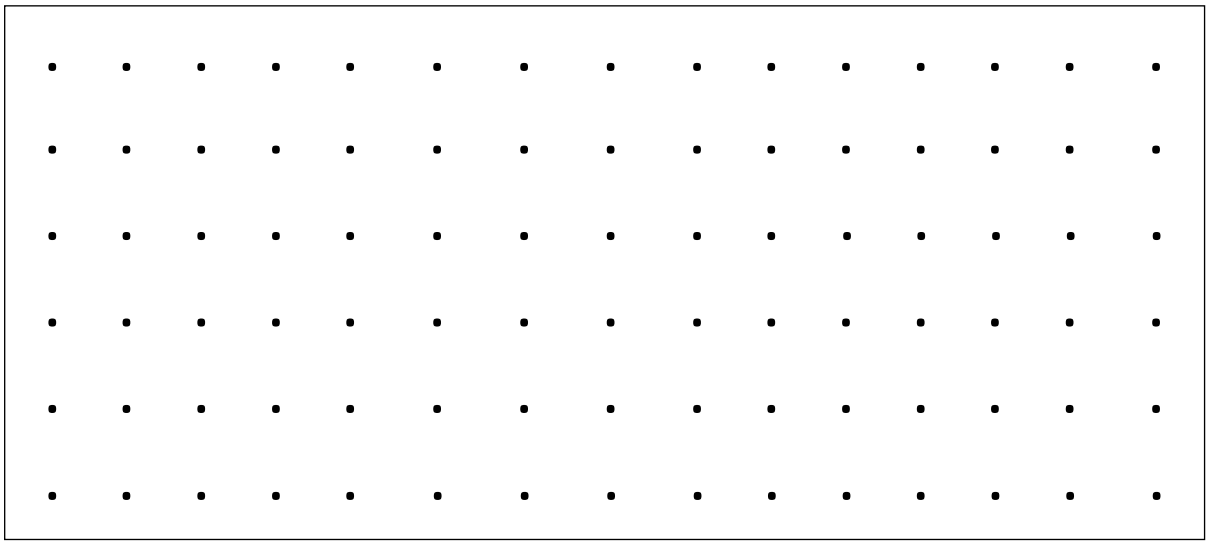


What I Can Do

Since you have already learned Principal Roots and Perfect Squares, then you are now ready to apply your learning into a real-life situation.

Consider the illustration below as a Land Area.

A. Draw Perfect Square lot as many as you can.



B. List down the Area and the length of each of the square lot you have drawn. You may use separate paper for more answers.

Area (sq. units)	Length (unit)

Lesson 2 Determine between what two consecutive integers the square root of a number lie.

What's In

In your previous lesson, you have learned how to describe the principal root if it is rational or irrational. Now, let us review perfect square integers.

NOTE: The Perfect Squares (also called "Square of a Number") are the squares of the integers.

A. Continue to answer from 2-15, number 1 was already done for you.

Exponential Form	Expanded Form	Perfect Square Integers
1^2	$1 \cdot 1$	1
2^2	$2 \cdot 2$	
3^2	$3 \cdot 3$	
4^2	$4 \cdot 4$	
5^2	$5 \cdot 5$	
6^2	$6 \cdot 6$	
7^2	$7 \cdot 7$	
8^2	$8 \cdot 8$	
9^2	$9 \cdot 9$	
10^2	$10 \cdot 10$	
11^2	$11 \cdot 11$	
12^2	$12 \cdot 12$	
13^2	$13 \cdot 13$	
14^2	$14 \cdot 14$	
15^2	$15 \cdot 15$	

Try to remember them up to 15!

B. Give what is asked.

1. Can you take the exact value of $\sqrt{12}$?_____

2. Is $\sqrt{12}$ an irrational number? _____

3. List 2 perfect square integers nearest to 12._____

4. Find the square root of the two perfect squares in item no. 3._____

5. Between what two positive integers does $\sqrt{12}$ lie? _____

Notes to the Teacher

Students should know how to get the principal root of a given number and memorize the list of perfect square integers.

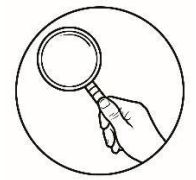
What's New

Between every two whole numbers are countless decimal numbers.

Consider the decimal number 2.123456789. This is not a kind of number we use in our daily life because it's neither 2 nor 3 but it's a number between 2 and 3.

Now try to determine between what two whole numbers each of the following decimal lie.

1. _____, 4.00677, _____
2. _____, 1.9933, _____
3. _____, 0.00144, _____
4. _____, 10.5008, _____
5. _____, 100.2001, _____



What is It

If a principal root is an irrational number, the easiest way you can do is to determine between what two integers the square root of a number lie.
Now, let us start with our discussion on how to determine the two consecutive integers where the square root of a number lie.

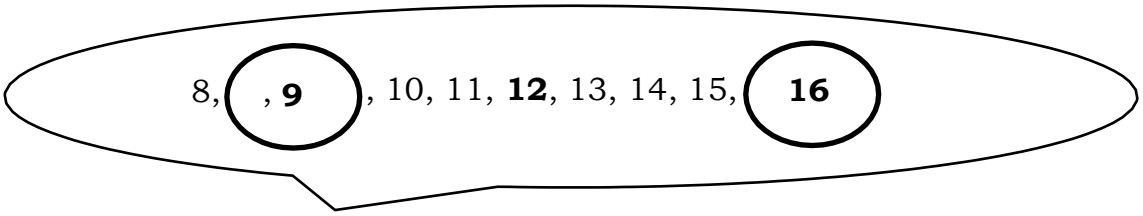
The principal roots of the radicals below are between two integers. Find the two closest integers.

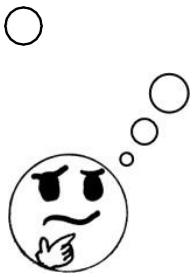
a. $\sqrt{12}$ b. $\sqrt{18}$ c. $\sqrt{40}$ d. $\sqrt{175}$

Solution:

a. $\sqrt{12}$

Think of two consecutive perfect square integers where 12 is in between them.

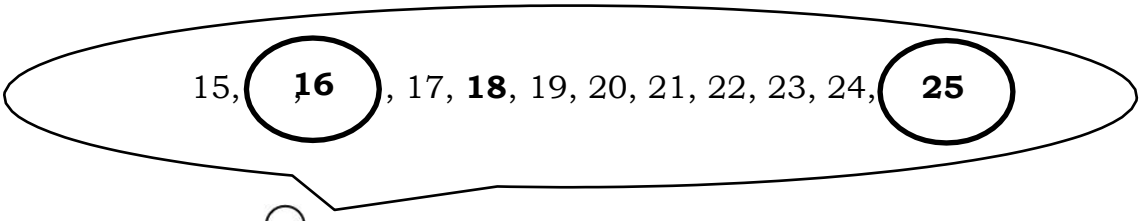




So we have **9** and **16**. Take the square roots of these numbers. Since the principal root of $\sqrt{9}$ is **3** while the principal root of $\sqrt{16}$ is **4**. Thus, $\sqrt{12}$ is between **3** and **4.**

b. $\sqrt{18}$

Think of two consecutive perfect square integers where 18 is in between them.



So we have **16** and **25**. Take the square roots of these numbers. Since the principal root of $\sqrt{16}$ is **4** while the principal root of $\sqrt{25}$ is **5**. Thus, $\sqrt{18}$ is between **4** and **5.**

c. $\sqrt{40}$

Think of two consecutive perfect square integers where 40 is in between them.

35, **,36**, 37, 38, 39, **40**, 41, 42, 43, 44, 45, 46, 47, 48, **49**

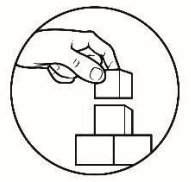
So we have **36** and **49**. Take the square roots of these numbers. Since the principal root of $\sqrt{36}$ is **6** while the principal root of $\sqrt{49}$ is **7**. Thus, $\sqrt{40}$ is between **6** and **7.**

d. $\sqrt{175}$

Think of two consecutive perfect square integers where 175 is in between them.

168, **169**, , 170, 171, 172, 173, 174, **175**, 176,... **196**

So we have **169** and **196**. Take the square roots of these numbers. Since the principal root of $\sqrt{169}$ is **13** while the principal root of $\sqrt{196}$ is **14**. Thus, $\sqrt{175}$ is between **13** and **14**.



What's More

A. Determine between what two consecutive integers each principal root lie. Write your answer in the space provided.

1. $\sqrt{77}$	_____
2. $\sqrt{87}$	_____
3. $\sqrt{50}$	_____
4. $\sqrt{136}$	_____
5. $\sqrt{243}$	_____
6. $\sqrt{6}$	_____
7. $\sqrt{160}$	_____
8. $\sqrt{94}$	_____
9. $\sqrt{118}$	_____
10. $\sqrt{159}$	_____

B. Which country consumes the most chocolate per head?

To answer that question, determine between what particular range of integers the square root of each number lie and write the letter in the box that corresponds to your answer.

A $\sqrt{24}$		**R** $\sqrt{38}$		**T** $\sqrt{90}$			**S** $\sqrt{15}$			
	W $\sqrt{136}$		**E** $\sqrt{72}$			**L** $\sqrt{7}$			**O** $\sqrt{146}$	
N $\sqrt{112}$		**D** $\sqrt{2}$		**I** $\sqrt{30}$			**Y** $\sqrt{49}$		**Z** $\sqrt{60}$	

3 & 4	11 & 12	5 & 6	9 & 10	7 & 8	8 & 9	6 & 7	2 & 3	4 & 5	10 & 11	1 & 2

What I Have Learned

Would you like to find out how much you have learned from this module?

A. Refer to the statements below and tell whether the given statement is TRUE or FALSE. Write your answer in the space provided.

_____1. Estimating is one way to determine where the irrational square root of a number lie.
_____2. The square root of 25 is a perfect square.
_____3. The square root of 30 lies between 3 and 4.
_____4. The square root of 121 lies between 10 and 11.
_____5. Only perfect square integers have a square root.

B. Write your insights about the topic:

1. How will you know if the square root of a given number is rational or irrational?

_____

_____

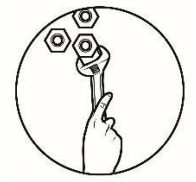
_____

2. Have you encountered any difficulty in determining between what two integers the square root of a given number lies? Why?

_____

_____

_____



What I Can Do

Here is another activity that will let you apply what you have learned about our lesson.

Complete the following statements. Use the integers that are closest to the value of the number in the middle. Write your chosen integers inside the box.

1. ☐ $< \sqrt{19} <$ ☐
2. ☐ $< \sqrt{34} <$ ☐
3. ☐ $< \sqrt{76} <$ ☐
4. ☐ $< \sqrt{115} <$ ☐
5. ☐ $< \sqrt{217} <$ ☐
6. ☐ $< \sqrt{86} <$ ☐
7. ☐ $< \sqrt{10} <$ ☐
8. ☐ $< \sqrt{43} <$ ☐
9. ☐ $< \sqrt{6} <$ ☐
10. ☐ $< \sqrt{54} <$ ☐

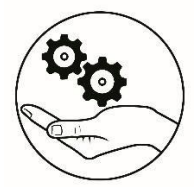
You did a great job in applying what you have learned in this topic.

Assessment

Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. What do you call a number that **can** be expressed in the form $\frac{a}{b}$, where a and b are integers, and b is not equal to 0?
   a. Integers
   b. Irrational
   c. natural
   d. rational
2. Which of the following refers to a number whose decimal representation is neither terminating nor repeating? This number cannot be expressed as a quotient of integers.
   a. Integers
   b. Irrational
   c. natural
   d. rational
3. What do you call the positive n^{th} root of a number?
   a. perfect square
   b. principal root
   c. radical
   d. radicand
4. What is the principal root of $\sqrt{81}$?
   a. -9
   b. 8
   c. 9
   d. 81
5. What is the principal root of $\sqrt{\frac{9}{4}}$?
   a. $\frac{3}{2}$
   b. $\frac{3}{4}$
   c. $\frac{9}{2}$
   d. $\frac{9}{4}$
6. Which of the following best describes the principal root of $\sqrt{50}$?
   a. integer
   b. irrational
   c. natural
   d. rational
7. Which of the following best describes the principal root of $\sqrt{121}$?
   a. integer
   b. irrational
   c. natural
   d. rational
8. Which of the statements is TRUE?
   a. $\sqrt{7}$ is an integer
   b. $\sqrt{16}$ is an irrational number
   c. $\sqrt{25}$ is a rational number
   d. $\sqrt{90}$ is neither rational nor irrational number
9. Find the number whose square root lies between 8 and 9?
   a. 8
   b. 9
   c. 75
   d. 85

10. Between what two consecutive integers does the square root of 118 lie?
    a. 8 & 9
    b. 9 & 10
    c. 10 & 11
    d. 11 & 12
11. Which of the numbers is classified as perfect square integer?
    a. 49
    b. 50
    c. 63
    d. 200
12. Between what two consecutive integers does the square root of 190 lie?
    a. 11 & 12
    b. 13 & 14
    c. 14 & 15
    d. 19 & 20
13. Which of the following numbers has an irrational square root?
    a. 1
    b. 81
    c. 100
    d. 300
14. Which of the following is NOT a perfect square integer?
    a. 121
    b. 144
    c. 149
    d. 169
15. Where does the square root of 30 lie?
    a. between 5 & 6
    b. beyond 6
    c. before 5
    d. at 6



Additional Activities

Additional activity will be given to enrich your knowledge about the lesson that you have learned in this module.

Direction:
Match the radicals in Column A to the nearest two integers where its square root lies in Column B. Write your answer on the space provided before the number.

	Column A	Column B
_____1.	$\sqrt{8}$	A. 8 & 9
_____2.	$\sqrt{14}$	B. 14 & 15
_____3.	$\sqrt{67}$	C. 12 & 13
_____4.	$\sqrt{102}$	D. 2 & 3
_____5.	$\sqrt{20}$	E. 1 & 2
_____6.	$\sqrt{3}$	F. 4 & 5
_____7.	$\sqrt{198}$	G. 11 & 12
_____8.	$\sqrt{112}$	H. 3 & 4
_____9.	$\sqrt{146}$	I. 6 & 7
_____10.	$\sqrt{122}$	J. 10 & 11
		K. 7 & 8
		L. 9 & 10

Answer Key

Lesson 2: What's New

A.
1. 4 & 5
2. 1 & 2
3. 0 & 1
4. 10 & 11
5. 100 & 101

Lesson 2: What's In

A.
4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225

B.
1. NO
2. YES
3. 9, 16
4. 3 and 4
5. 3 and 4

Lesson 1: What's I have Learned

1. Principal Root
2. Perfect Square
3. Rational
4. Irrational
5. Rational, Irrational

Lesson 1: What's More

1. Rational
2. Irrational
3. Irrational
4. Irrational
5. Rational
6. Rational
7. Rational
8. Irrational
9. Rational
10. Irrational

Lesson 1: What's In

A.
1. 1
2. 4
3. 9
4. 16
5. 25
6. 36
7. 49
8. 64
9. 81
10. 100

B.
1. Rational
2. Rational
3. Irrational
4. Irrational
5. Rational
6. Irrational

What I Know

1. D
2. B
3. B
4. B
5. A
6. B
7. B
8. B
9. C
10. A
11. D
12. C
13. C
14. B
15. B

Assessment

1. D
2. B
3. B
4. C
5. A
6. B
7. D
8. C
9. C
10. C
11. A
12. B
13. D
14. C
15. A

Lesson 2:
What's I have Learned

1. TRUE
2. FALSE
3. FALSE
4. FALSE
5. FALSE

Lesson 2:
What I can Do

1. 4 & 5
2. 5 & 6
3. 8 & 9
4. 10 & 11
5. 14 & 15
6. 9 & 10
7. 3 & 4
8. 6 & 7
9. 2 & 3
10. 7 & 8

Lesson 2:
What's More

A.
1. 8 & 9
2. 9 & 10
3. 7 & 8
4. 11 & 12
5. 15 & 16
6. 2 & 3
7. 12 & 13
8. 9 & 10
9. 10 & 11
10. 12 & 13

B.
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