THE PRESIDENT'S RECOVERY PRIORITIES
Education

Ministry of Education, Science and Technology

Lesson plans for

JSS Mathematics

JSS 2

TERM 3

Foreword

Our country's future lies in the education of our children. The Government of Sierra Leone is committed to doing whatever it takes to secure this future.

As Minister of Education, Science and Technology since 2007, I have worked every day to improve our country's education. We have faced challenges, not least the Ebola epidemic which as we all know hit our sector hard. The Government's response to this crisis – led by our President – showed first-hand how we acted decisively in the face of those challenges, to make things better than they were in the first place.

One great success in our response was the publication of the Accelerated Teaching Syllabi in August 2015. This gave teachers the tools they needed to make up for lost time whilst ensuring pupils received an adequate level of knowledge across each part of the curriculum. The Accelerated Teaching syllabi also provided the pedagogical resource and impetus for the successful national radio and TV teaching programs during the Ebola epidemic.

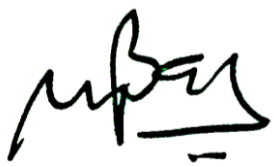
It is now time to build on this success. I am pleased to issue new lesson plans across all primary and JSS school grades in Language Arts and Mathematics. These plans give teachers the support they need to cover each element of the national curriculum. In total, we are producing 2,700 lesson plans – one for each lesson, in each term, in each year for each class. This is a remarkable achievement in a matter of months.

These plans have been written by experienced Sierra Leonean educators together with international experts. They have been reviewed by officials of my Ministry to ensure they meet the specific needs of the Sierra Leonean population. They provide step-by-step guidance for each learning outcome, using a range of recognised techniques to deliver the best teaching.

I call on all teachers and heads of schools across the country to make best use of these materials. We are supporting our teachers through a detailed training programme designed specifically for these new plans. It is really important that these Lesson Plans are used, together with any other materials you may have.

This is just the start of education transformation in Sierra Leone. I am committed to continue to strive for the changes that will make our country stronger.

I want to thank our partners for their continued support. Finally, I also want to thank you – the teachers of our country – for your hard work in securing our future.



Dr. Minkailu Bah

Minister of Education, Science and Technology

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Introduction

to the Lesson Plan Manual

These lesson plans are based on the National Curriculum
and meet the requirements established
by the Ministry of Education, Science and Technology.

1. The lesson plans will not take the whole term, so use spare time to review material or prepare for exams.
2. Teachers can use other textbooks alongside or instead of these lesson plans.
3. Read the lesson plan before you start the lesson. Look ahead to the next lesson, and see if you need to tell pupils to bring materials for next time.
4. Make sure you understand the learning outcomes, and have teaching aids and other preparation ready – each lesson plan shows these using the symbols on the right.
5. Quickly review what you taught last time before starting each lesson.
6. Follow the suggested time allocations for each part of the lesson. If time permits, extend practice with additional work.
7. Lesson plans have a mix of activities for the whole class and for individuals or in pairs.
8. Use the board and other visual aids as you teach.
9. Interact with all pupils in the class – including the quiet ones.
10. Congratulate pupils when they get questions right! Offer solutions when they don't, and thank them for trying.


Learning outcomes


Teaching aids


Preparation

Lesson Title: Practise with Expansion	**Theme:** Algebra	
Lesson Number: M-08-116	**Class/Level:** JSS 2	**Time:** 35 minutes

 **Learning Outcomes** By the end of the lesson, pupils will be able to expand an algebraic expression by multiplying.	 **Teaching Aids** None	 **Preparation** None

Opening *(2 minutes)*

1. **Say:** We have learned how to expand algebraic expressions.
2. **Ask:** Can someone tell me what it means to expand an algebraic expression? Have pupils raise their hand to answer. (Answer: To multiply a variable or number by an algebraic expression)
3. **Say:** Expansion is the opposite of factoring. To expand an algebraic expression, we multiply. To factor, we divide.
4. **Say:** Today we will practise expansion, and in the next lesson we will practise factoring. I want you to understand both of these very well.

Introduction to the New Material *(11 minutes)*

1. **Say:** Expanding means removing the brackets.
2. **Say:** Let's revise the Property of Distribution. It tells us something important about removing brackets.
3. **Ask:** Does anyone remember the Property of Distribution?
4. Discuss the Property of Distribution as a class.
5. Write on the board: $a(b + c) = a \times b + a \times c$
6. Write on the board:
7. Expand the following algebraic expressions:
   a) $-2(x + 3)$
   b) $a(2 + a + b)$
   c) $3y(y - 2)$
8. **Say:** You already know everything that you need to know in order to expand these examples. Let's look at the first one.
9. Ask pupils to expand problem (a) in their exercise books. If necessary, remind pupils of the rules for multiplying negative numbers. A negative times a negative is a positive.
10. **Ask:** Who can come on the board and expand this expression?
11. Invite one pupil to write the expansion on the board. Make corrections if necessary. (Answer: $-2(x + 3) = -2 \times x - 2 \times 3 = -2x - 6$)
12. Ask pupils to check their answer with the answer on the board.
13. Follow the same process for problem (b). (Answer: $a(2 + a + b) = 2a + a^2 + ab$)
14. Ask pupils to look at problem (c).
15. **Say:** This expansion involves both a number, 3, and a variable, y. How can we expand this?
16. Invite pupils to share their ideas and discuss as a class. Guide them to see that they need to multiply both 3 and y by each term in the expression.
17. Ask pupils to expand (c) in their exercise books.

18. Invite one pupil to write the answer on the board. Make corrections if necessary. (Answer: $3y(y-2) = 3y^2 - 6y$)
19. Ask pupils to check their answer with the answer on the board.

Guided Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $3x(2x+7)$
   b) $9(x+y+4)$
   c) $-6y(x-3y+3x)$
   d) $-2(x-y-3)$
2. Ask pupils to work in pairs. Have pupils work with their partner to simplify the algebraic expressions on the board by expansion.
3. **Say:** Now work with your partner to expand the expressions. Remember that sometimes you need to combine like terms before doing expansion.
4. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils. Remind pupils of the rules for multiplying negative numbers if needed.
5. Invite four pairs to write the answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed.
   Answers:
   a) $3x(\,2x+7) = 3x \times 2x + 3x \times 7 = (3 \times 2)x^2 + (3 \times 7)x = 6x^2 + 21\text{x}$
   b) $9(x+y+4) = 9x + 9y + 9 \times 4 = 9x + 9y + 36$
   c) $-6y(x-3y+3x) = -6y(4x-3y) = (-6 \times 4)\text{xy} + (-6 \times -3)y^2 = -24\text{xy} + 18y^2$
   d) $-2(x-y-3) = -2x + (-2 \times -1)y + (-2 \times -3) = -2x + 2y + 6$

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $-5(y+x\ +6x)$
   b) $2a(a\ +\ 10b)$
   c) $7(x-8+x^2-4x)$
   d) $-4x(x^2+x+9)$
2. Ask pupils to work individually to expand the expressions on the board.
3. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
4. After pupils have finished, ask them to work in pairs to share and compare their answers.
5. Invite four pupils to write the answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed.
   Answers:
   a) $-5(y+x\ +6x) = -5(y+7x) = -5y - 35x$
   b) $2a(a\ +\ 10b) = 2a^2 + (2 \times 10)\text{ab} = 2a^2 + 20\text{ab}$
   c) $7(x-8+x^2-4x) = 7(x^2-3x-8) = 7x^2 - 21\text{x} - 56$
   d) $-4x(x^2+x+9) = -4x^3\ - 4x^2 + (-4 \times 9)x\ =\ -4x^3\ - 4x^2 - 36x$

Closing *(2 minutes)*

1. **Ask:** What are some important things to remember when expanding algebraic expressions? (Example answers: Follow the correct rules for multiplying positive and negative numbers and for multiplying variables; multiply by each term in the expression; combine any like terms first before multiplying)
2. **Say:** In future lessons we will use what we have learned to solve linear algebra equations.

Lesson Title: Practise with Factorisation	**Theme:** Algebra	
Lesson Number: M-08-117	**Class/Level:** JSS 2	**Time:** 35 minutes

 **Learning Outcomes** By the end of the lesson, pupils will be able to identify common factors and factor an algebraic expression by dividing.	 **Teaching Aids** None	 **Preparation** None

Opening *(2 minutes)*

1. **Ask:** Who can tell me what it means to expand an algebraic expression? Have pupils raise their hand to answer. (Example answer: It means to multiply each term by a number or variable.)
2. **Ask:** Who can tell me what it means to factor an algebraic expression? (Example answer: It means to divide each term by a common factor.)
3. **Say:** These are opposites. In our last lesson we practised expansion. In today's lesson, we will practise factoring algebraic expressions by dividing.

Introduction to the New Material *(11 minutes)*

1. **Say:** Remember, a factor of a number is what you can multiply to get that number.
2. **Ask:** What are all of the factors of 12? (Answer: 1,2,3,4,6,12)
3. **Ask:** What are all of the factors of 20? (Answer: 1,2,4,5,10,20)
4. Write on the board: $12x + 20$
5. **Ask:** What are the common factors of this expression? (Answers: 1, 2, 4)
6. **Say:** We want to divide each term by the biggest common factor, 4.
7. Ask pupils to explain how to divide each term by 4. Write the correct explanation on the board. (Answer: $\frac{12x}{4} = \frac{12}{4}x = 3x$; $20 \div 4 = 5$)
8. Write the factorisation on the board: $12x + 20 = 4(3x + 5)$
9. **Say:** Remember that we can also factor out variables.
10. **Ask:** What is the common factor of $x^2 + 2x$? (Answer: x)
11. Ask pupils to explain how to divide each term by x. Write the correct explanation on the board. (Answer: $\frac{x^2}{x} = x$, $\frac{2x}{x} = 2$)
12. Write the factorisation on the board: $x(x + 2)$
13. **Say:** We can also factor out variables and their coefficient at the same time.
14. **Ask:** What are the common factors of $3x^2 + 12x$? (Answer: 3 and x, or 3x)
15. **Say:** We can divide them out at the same time.
16. Ask pupils to explain how to divide each term by 3x. Write the correct explanation on the board. (Answer: $\frac{3x^2}{3x} = x$, $\frac{12x}{3x} = 4$)
17. Write the factorisation on the board: $3x(x + 4)$

Guided Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $6x + 18$
   b) $4x - 10$

c) $12x + 18$
d) $-8x - 2y$
e) $3x^2 + 21x$

2. Ask pupils to work in pairs. Have pupils work with their partner to simplify the algebraic expressions by expansion.
3. **Say:** Now work with your partner to factor the expressions. First, write the common factor. Then factor the expressions.
4. Move around the classroom to check for understanding and make sure pupils are doing the task. Remind pupils of the rules for dividing negative numbers if needed.
5. Invite five pairs to write the answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed.
   Answers:
   a) Common factor: 6; $6x + 18 = 6(x + 3)$
   b) Common factor: 2; $4x - 10 = 2(2x - 5)$
   c) Common factor: 6; $12x + 18 = 6(2x + 3)$
   d) Common factor: -2; $-8x - 2y = -2(4x + y)$
   e) Common factor: 3x; $3x^2 + 21x = 3x(x + 7)$

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $7x + 28$
   b) $-9x - 12$
   c) $14x + 35$
   d) $9x - 3xy$
   e) $6x^2 + 24x$
2. Ask pupils to work individually to factor the expressions on the board.
3. **Say:** First, write the common factor. Then factor the expressions.
4. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
5. After pupils have finished, ask them to work in pairs to share and compare their answers.
6. Invite five pupils to write the answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed.
   Answers:
   a) Common factor: 7; $7x + 28 = 7(x + 4)$
   b) Common factor: -3; $-9x - 12 = -3(3x + 4)$
   c) Common factor: 7; $14x + 35 = 7(2x + 5)$
   d) Common factor: 3x; $9x - 3xy = 3x(3 - y)$
   e) Common factor: 6x; $6x^2 + 24x = 6x(x + 4)$

Closing *(2 minutes)*

1. **Ask:** What are the factors of a number? (Answer: Numbers you can multiply to get a given number as the result.)
2. **Ask:** Why can factoring be useful? (Answer: To simplify an expression to make it easier to work with)
3. **Say:** In future lessons, we will be using what we learned today to help us solve linear equations. This is a special kind of equation.

Lesson Title: Substitution with One Variable	**Theme:** Algebra	
Lesson Number: M-08-118	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to substitute a given value into an algebraic expression with one variable and find its value.	**Teaching Aids** None	**Preparation** None

Opening *(3 minutes)*

1. **Ask:** When you see a variable in an expression, what does it mean?
2. Invite pupils to share their ideas and discuss as a class.
3. **Say:** Variables are unknown values. They could be any unknown number, but we do not know the value unless we do some problem solving.
4. **Say:** In this lesson, we are going to learn how to substitute a given value into an algebraic expression. Substitute means to give a number value to a variable.
5. **Say:** We will use the order of operations to help us substitute a given value into an algebraic expression with one variable and find its value.
6. **Ask:** Who can remind me what the order of operations is? Have pupils raise their hand to answer. (Answer: BODMAS; Brackets, Of/Order, Divide, Multiply, Add, Subtract)

Introduction to the New Material *(12 minutes)*

1. **Say:** Let's start with a simple expression.
2. Write on the board: Find $x + 2$ when $x = 4$
3. **Say:** Here we have an algebraic expression and we are told the value of the variable. It is not unknown anymore.
4. **Ask:** What is the value of this expression, x +2, when x =4?
5. Invite pupils to share their ideas and discuss as a class to see if they can find the answer by problem solving. Guide them to the correct answer. (Answer: 6)
6. **Say:** To find the answer, we substitute 4 where x is in the expression.
7. Write on the board: $4 + 2 = 6$
8. **Say:** We can also evaluate this expression with other values of x.
9. **Ask:** What is the value of this expression when x = 5? (Answer: 7)
10. **Ask:** What is the value of this expression when x = 8? (Answer: 10)
11. **Say:** Let's try a harder expression now.
12. Write the following on the board: $x^2 + 2x + 3$
13. **Ask:** What is the value of this expression when x =1?
14. **Say:** First, we substitute 1 into this expression.
15. Write the substitution on the board: $(1)^2 + 2(1) + 3$
16. **Say:** We need to make sure we use the order of operations! Exponents first, then multiply, and finally add.
17. Write the problem on the board: $1 \times 1 + 2 \times 1 + 3 = 1 + 2 + 3 = 6$
18. **Ask:** What is the value of this expression when x = 2?
19. Invite pupils to share their ideas and discuss the answer as a class.

20. Write the answer on the board. (Answer: $2^2 + 2 \times 2 + 3 = 4 + 4 + 3 = 11$)
21. **Say:** Let's try one more expression.
22. Write on the board: Find $4x^2 - 3x + 7$ when $x = 2$
23. Ask pupils to copy the problem and write the substitution in their exercise books.
24. Invite one pupil to write the answer on the board. (Answer: $4(2)^2 - 3(2) + 7$)
25. **Ask:** What is the first step we should take to solve the problem? (Answer: Exponents – we calculate $(2)^2$)
26. **Say:** Remember to work the exponent before doing the multiplication by 4. The 4 is not in the exponent. It is only the 2.
27. Invite pupils to share their ideas and discuss the answer as a class.
28. Write the answer on the board. (Answer: $4(2)^2 - 3(2) + 7 = 4 \times 4 - 3 \times 2 + 7 = 16 - 6 + 7 = 17$)

Guided Practice *(7 minutes)*

1. Write the following problems on the board:
   a) Find $2x + 3$ when $x = 2$
   b) Find $4x^2 - 3x + 4$ when $x = 3$
2. **Say:** Now we are going to practise some problems in pairs. Work with your partners to find the solution.
3. Move around the classroom to check for understanding and make sure pupils are doing the task. Make sure pupils are substituting correctly and following the order of operations.
4. Invite two pairs to write their answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed.
   Answers:
   a) $2x + 3 = 2 \times 2 + 3 = 4 + 3 = 7$
   b) $4x^2 - 3x + 4 = 4(3)^2 - 3 \times 3 + 4 = 4 \times 9 - 9 + 4 = 36 - 9 + 4 = 31$

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $4x + 5$
   b) $2x^2 + 3x + 6$
   When $x = 2$ and $x = 3$
2. **Say:** Now we are going to substitute and simplify some expressions on our own.
3. **Say:** Find the value of each of these expressions when x is 2 and when x is 3. This is really like four different problems. You need to work on problem (a) twice and problem (b) twice.
4. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
5. After pupils have finished, ask them to work in pairs to share and compare their answers.
6. Invite different pupils to write their answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed.
   Answers:
   a) $4x + 5 = 4(2) + 5 = 8 + 5 = 13$ AND $4(3) + 5 = 12 + 5 = 17$
   b) $2x^2 + 3x + 6 = 2(2)^2 + 3(2) + 6 = 2 \times 4 + 6 + 6 = 20$
   AND $= 2(3)^2 + 3(3) + 6 = 2 \times 9 + 69 + 6 = 18 + 9 + 6 = 33$

Closing *(3 minutes)*

1. **Ask:** Who can tell me what we learned today? (Answer: Substituting a number for a variable in an algebraic expression)
2. **Ask:** Who can write an algebraic expression with the variable x on the board?
3. Invite a volunteer to come to the front and write an algebraic expression on the board.
4. **Ask:** Who can give me any number?
5. Have a volunteer tell you a number and write that number on the board.
6. Ask pupils to substitute the number into the expression.
7. Ask pupils to give their answers and explain.
8. Write the correct answer on the board.

Lesson Title: Substitution with Two Variables	**Theme:** Algebra	
Lesson Number: M-08-119	**Class/Level:** JSS 2	**Time:** 35 minutes

 **Learning Outcomes** By the end of the lesson, pupils will be able to substitute given values into an algebraic expression with two variables and find its value.	 **Teaching Aids** None	 **Preparation** None

Opening *(2 minutes)*

1. **Say:** Let's revise what we learned in the last lesson.
2. Write on the board: $2x + 3$
3. **Ask:** If we substitute $x = 6$ into this expression, what do we get?
4. Ask pupils to solve the problem in their exercise books.
5. Invite one volunteer to solve the problem on the board. Make corrections if necessary. (Answer: $2(6) + 3 = 12 + 3 = 15$)
6. **Say:** Today we are going to continue substitution, but with two variables.

Introduction to the New Material *(12 minutes)*

1. **Say:** As we have learned, you can have an algebraic expression with two different variables.
2. **Ask:** Who can give an example of an algebraic expression with the variables x and y? (Example answers: $2x^2y^2$, 3x+y, etc.)
3. Write on the board: Find $3x + 2y$ when $x = 1$ and $y = 2$
4. **Ask:** How do you think we will solve this?
5. Invite pupils to share their ideas and discuss as a class. Guide them to see that we will substitute the 2 given values for the correct variables.
6. Write the substitution on the board: $3(1) + 2(2)$
7. Invite pupils to share their ideas and discuss the answer as a class.
8. Write the answer on the board. (Answer: $3(1) + 2(2) = 3 + 4 = 7$)
9. **Say:** Great! Now let's try another algebraic expression.
10. Write this on the board: Find $2x^2 + 3xy$ when $x = 2$ and $y = 2$
11. **Say:** Please write the substitution in your exercise book.
12. Write the substitution on the board and ask pupils to check their answers. (Answer: $2(2)^2 + 3(2)(2)$)
13. **Say:** Now, let's work on the problem.
14. Discuss the problem as a class until you come to the correct answer.
15. Write the answer on the board. (Answer: $2(2)^2 + 3(2)(2) = 2 \times 4 + 12 = 8 + 12 = 20$)
16. **Say:** Let's try one more expression.
17. Write on the board: Find $x + 2xy + 5y$ when $x = 1$ and $y = -2$
18. **Say:** This problem has a negative number. Please do the substitution in your exercise books.
19. Invite a volunteer to write the substitution on the board. Make corrections if necessary. (Answer: $1 + 2(1)(-2) + 5(-2)$)
20. Ask pupils to work on the problem in their exercise books. Remind them of the rules for operating on negative numbers.

21. Write the answer on the board. Have pupils check their work. (Answer: $1 + 2(1)(-2) + 5(-2) = 1 - 4 - 10 = 1 - 14 = -13$)
22. **Say:** We do not always have to use x and y. We can solve algebraic expressions with any variables.
23. Write on the board: $2ab$
24. **Ask:** What does this expression equal when $a = 3$ and $b = 4$?
25. Discuss the answer as a class. Write the answer on the board. (Answer: $2(3)(4) = 24$)

Guided Practice *(9 minutes)*

1. Divide the class into pairs. Try to put the pupils with a partner they have not worked with before.
2. Tell pupils that they will write a problem, and their partner will solve it. Each pupil will write one problem.
3. **Say:** Write an algebraic expression with two different variables. Write this on a separate piece of paper. Assign a number to each of the variables. Write the numbers for the variables under your algebraic expression.
4. **Say:** For example, your problem will look like this:
   $2x + 3xy$
   $x = 2$ and $y = 4$
5. Write the example on the board.
6. **Say:** Find the value of the solution, and write down your answer in your notebook.
7. Give pupils time to write the algebraic expression and solve it.
8. Have pupils exchange problems with their partner.
9. **Say:** Exchange the sheet with the problem you wrote with your partner. You will solve your partner's problem and your partner will solve your problem. When you are finished, check your partner's work with your solution!
10. Move around the classroom to make sure pupils understand how to write their own problem and solve the problem written by their partner.

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   Find $4x^2y + 3xy^2 + 2xy$ when:
   a) $x = 1, y = 2$
   b) $x = 3, y = 4$
   c) $x = 2, y = 3$
2. Ask pupils to work independently to find the value of the algebraic expression.
3. **Say:** You need to find the value of the algebraic expression for each different value for x and y. It is like you have two problems using only one algebraic expression.
4. **Say:** Remember to use the correct order of operations (BODMAS).
5. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
6. After pupils have finished, ask them to work in pairs to share and compare their answers.
7. Check answers as a class. Write the answers on the board.
   Answers:
   a) $4(1)^2(2) + 3(1)(2)^2 + 2(1)(2) = 8 + 12 + 4 = 24$
   b) $4(3)^2(4) + 3(3)(4)^2 + 2(3)(4) = 144 + 144 + 24 = 312$
   c) $4(2)^2(3) + 3(2)(3)^2 + 2(2)(3) = 48 + 54 + 12 = 114$

Closing *(2 minutes)*

1. **Ask:** Who can tell me what we learned today? (Answer: We learned how to simplify algebraic expressions with two variables.)
2. **Ask:** What are some important things to remember when we simplify expressions with two variables? (Answers: Order of operations; substitute the correct value for each variable)
3. **Say:** This will be useful in our next lesson, when we learn how to solve algebraic equations.

Lesson Title: Substitution Practice	**Theme:** Algebra	
Lesson Number: M-08-120	**Class/Level:** JSS 2	**Time:** 35 minutes

 **Learning Outcomes** By the end of the lesson, pupils will be able to substitute any given value into an algebraic expression and find its value.	 **Teaching Aids** None	 **Preparation** None

Opening *(3 minutes)*

1. **Say:** In the last lesson, we learned how to substitute for variables in algebraic expressions.
2. **Ask:** What are some important things to remember when substituting for variables? Have pupils raise their hand to answer. (Example answer: The order of operations, BODMAS)
3. **Say:** In this lesson, we will be practising what we learned in order to substitute any given value into an algebraic expression and find its value.

Introduction to the New Material *(10 minutes)*

1. **Say:** An algebraic expression can have any number of variables. All of the variables can be substituted.
2. Write the following example on the board, which involves three variables:
   Find $2xyz + 3xy + 4yz$ when $x = 1, y = 2, \text{and } z = 3$
3. **Say:** Please write the substitution in your exercise book.
4. Invite one volunteer to write the substitution on the board. Correct mistakes if necessary. (Answer: $2(1)(2)(3) + 3(1)(2) + 4(2)(3)$)
5. Ask pupils to check their substitution with the one on the board.
6. Discuss the answer with the class.
7. **Say:** You can solve this problem the same way as you have been solving the problems with two variables. The only difference is that this problem has three variables. Now you can do any substitution problem!
8. Write the answer on the board. (Answer: $2(1)(2)(3) + 3(1)(2) + 4(2)(3) = 12 + 6 + 24 = 42$)
9. **Say:** Always remember to use the order of operations when substituting into expressions!

Guided Practice *(10 minutes)*

1. Write the following problems on the board:
   a) Find $x + y + z$ when $x = -7$, $y = 10$ and $z = -6$
   b) Find $8x + 3y + 4z$ when $x = 2$, $y = 4$, and $z = 5$
   c) Find $2x^2y + 3xy + y$ when $x = 2$ and $y = 4$
2. Ask pupils to work in pairs to solve the problems on the board.
3. **Say:** Remember to use the order of operations.
4. Move around the classroom and make sure pupils understand and are doing the task. For example, you may need to remind them that when a power is on a variable, it only applies to that variable and not to any other variables in the term ($2x^2y$).

5. Invite three pairs to write their answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed. Answers:
   a) $(-7) + (10) + (-6) = -7 + 10 - 6 = 3 - 6 = -3$
   b) $8(2) + 3(4) + 4(5) = 16 + 12 + 20 = 48$
   c) $2(2)^2(4) + 3(2)(4) + (4) = 2(4)(4) + 3(2)(4) + (4) = 32 + 24 + 4 = 44$

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   a) Find $3ab + bc + 2a + 3b + c$ when $a = 1,\ b = 2,\ c = 3$
   b) Find $2a + 5bc + 3a + 4b + abc$ when $a = 0,\ b = 3, c = 5$
   c) Find $-2x^2 - xy^2$ when $x = -3$ and $y = -2$
2. Ask pupils to work individually to solve the problems on the board.
3. Move around the classroom to check for understanding and make sure pupils are doing the task. For example, pupils may need to be reminded of the rules of operations on negative numbers, which are important for problem (c).
4. After pupils have finished, ask them to work in pairs to share and compare their answers.
5. Invite three pupils to write their answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed.
6. Answers:
   a) $3(1)(2) + (2)(3) + 2(1) + 3(2) + 3 = 6 + 6 + 2 + 6 + 3 = 23$
   b) $2(0) + 5(3)(5) + 3(0) + 4(3) + (0)(3)(5) = 0 + 75 + 0 + 12 + 0 = 87$
   c) $-2(-3)^2 - (-3)(-2)^2 = -2(9) + 3(4) = -18 + 12 = -6$

Closing *(2 minutes)*

1. **Ask:** Who can tell the class what we practised today? (Answer: substituting variables into algebraic expressions)
2. **Ask:** What would you do if you saw a problem with more variables? What would you do if you needed to substitute for 6 different variables, a, b, c, d, e, f?
3. Discuss the answers as a class. (Example answers: Follow the same process; be careful to substitute the correct numbers for the correct variables)
4. **Say:** In our next lesson, we will be using what we learned about simplifying algebraic expressions to solve algebraic equations.

Lesson Title: Linear Equations in One Variable	**Theme:** Algebra	
Lesson Number: M-08-121	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to identify simple linear equations in one variable and their solutions.	**Teaching Aids** None	**Preparation** None

Opening *(3 minutes)*

1. **Say:** We have been working with algebraic expressions.
2. **Ask:** Who can give me an example of an algebraic expression? Have pupils raise their hand to answer. (Answers: Any algebraic expression)
3. Write a few examples of algebraic expressions on the board. Guide pupils to see that they can be in many different combinations of numbers and variables.
4. **Say:** Today we are going to identify simple linear equations in one variable and their solutions.

Introduction to the New Material *(10 minutes)*

1. Write on the board: $x + 4$
2. **Say:** This is an example of an expression.
3. **Say:** We can set x + 4 equal to something, such as a number like 6.
4. Write on the board: $x + 4 = 6$
5. **Say:** Now we have an equation. An expression does not have an equals sign, but an equation does have an equals sign.
6. **Ask:** How many equations do we have? (Answer: 1)
7. **Ask:** How many unknowns do we have? (Answer: 1, x is the only unknown)
8. **Say:** We only have one unknown variable, x.
9. **Say:** If the number of equations equals the number of unknown variables, we can solve for the variable.
10. **Say:** The variable x represents some number.
11. **Ask:** What number plus 4 equals 6? (Answer: 2 plus four equals 6.)
12. **Say:** Therefore, x = 2 is the solution.
13. Write on the board: Solution: $x = 2$
14. **Say:** Let's try another example.
15. Write on the board: $y + 2 = 3$
16. **Ask:** What number plus 2 equals 3? (Answer: $y = 1$)
17. **Say:** Let's try one more example.
18. Write on the board: $z + 8 = 10$
19. **Ask:** What number plus 8 equals 10? (Answer: $z = 2$)
20. Give pupils another example to show that not all equations can be solved.
21. Write on the board: $x + y = 4$
22. **Ask:** Can we solve this equation? (Answer: No)
23. **Ask:** Why can't we solve this equation? (Answer: Because there are two unknown variables, with one equation; we cannot figure out which numbers x and y are equal to.)

24. **Say:** If there is only one equation but more than one unknown, we cannot solve the equation. Different values of x and y could make this true, such as 1+3 or 2+2, but we cannot identify which is the correct solution.
25. Write another example on the board: $x + y + z = 3$
26. **Say:** This is another example of an equation that cannot be solved. There are three unknowns but only one equation.

Guided Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $x + 3 = 5$
   b) $f - 1 = 2$
   c) $4 + y = 5$
   d) $15 - b = 8$
   e) Write your own equation for your partner to solve.
2. Divide the class into pairs.
3. **Say:** With your partner, solve the first four equations. You should be able to do this mentally, in your head. Write down each answer.
4. **Say:** When you have solved the first four equations, each of you must come up with your own equation. Write the solution to your equation on a separate piece of paper.
5. **Say:** When you finish writing your equation, exchange it with your partner to see if your partner is able to solve it.
6. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
7. Invite four pairs to write the answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed. (Answers: (a) $x = 2$; (b) $f = 3$; c) $y = 1$; (d) $b = 7$)
8. If time permits, invite pupils to share the equations they wrote for (e).

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $x + 4 = 8$
   b) $3 + y = 5$
   c) $p - 2 = 4$
   d) $z + 6 = 16$
   e) $x + z = 9$
   f) $a + 1 = 23$
2. **Say:** I want you to work individually and solve the equations. Write the solutions in your exercise book. When you are finished, compare your answers with your partner. If the answer cannot be solved, write 'cannot be solved'.
3. Invite different pupils to write the answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed. (Answers: (a) $x = 4$; (b) $y = 2$; (c) $p = 6$; (d) $z = 10$; (e) cannot be solved; (f) $a = 22$)

Closing *(2 minutes)*

1. **Say:** Today we learned to solve very basic equations in our heads. We also learned how to recognise equations that cannot be solved.
2. **Ask:** How can we tell if an equation can be solved or not? (Example answer: Equations can be solved if there is only one variable for one equation; if there are 2 variables we cannot solve the equation.)
3. **Say:** In our next lesson, we will learn methods to solve equations, including more complicated equations.

Lesson Title: Solving Linear Equations I	**Theme:** Algebra	
Lesson Number: M-08-122	**Class/Level:** JSS 2	**Time:** 35 minutes

 **Learning Outcomes** By the end of the lesson, pupils will be able to solve linear equations in one variable by adding or subtracting values to balance the equation.	 **Teaching Aids** None	 **Preparation** None

Opening *(2 minutes)*

1. **Say:** During our last lesson, we learned how to solve simple algebraic equations in our heads.
2. Write on the board: $x + 4 = 5$
3. **Ask:** What is the solution to this equation? Have pupils raise their hand to answer. (Answer: $x = 1$)
4. **Say:** Today we are going to learn how to solve linear equations by adding or subtracting values to balance the equation.

Introduction to the New Material *(12 minutes)*

1. **Say:** Let's start with our first example.
2. Ask pupils to look at the equation on the board: $x + 4 = 5$
3. **Say:** At the beginning of the lesson, we solved this equation in our head. We can also solve this equation by subtracting 4 from both sides of the equation.
4. Write the subtraction on the board:
   $x + 4 - 4 = 5 - 4$ ⟵ Subtract 4 from both sides
   $x = 1$
5. **Say:** When we subtract 4 from both sides, it cancels the 4 on the left. When we have x by itself, or isolated, we can have the solution.
6. **Say:** It is important to always subtract the same value from both sides of the equation.
7. **Say:** Let's try another example.
8. Write on the board: $x + 6 = 12$
9. **Ask:** What should we subtract from both sides to isolate x? (Answer: 6)
10. Write the subtraction on the board:
    $x + 6 - 6 = 12 - 6$ ⟵ Subtract 6 from both sides
    $x = 6$
11. Write another problem on the board: $y - 2 = 5$
12. **Ask:** What do we do to isolate y in this problem?
13. Invite pupils to share their ideas about how to balance the equation. Discuss as a class.
14. **Say:** In this problem, because 2 is subtracted on the left side instead of added, we can cancel it by adding 2 to both sides.
15. **Say:** Remember that subtraction cancels addition, and addition cancels subtraction.
16. **Ask:** What do we add to both sides to isolate y? (Answer: 2)
17. Write the addition on the board:
    $-2 + 2 = 5 + 2$
    $y = 7$
18. **Say:** Let's try another problem.

19. Write another problem on the board: $10 = b + 8$
20. **Say:** Sometimes the variable will be on the right side of the equation. We can still solve it in the same way. We will isolate it by adding or subtracting numbers to both sides.
21. **Ask:** What do we need to do to isolate b? (Answer: Because 8 is positive, we subtract 8 from both sides to cancel it.)
22. Write the subtraction on the board:
    $10 - 8 = b + 8 - 8$ ⟵ Subtract 8 from both sides
    $2 = b$
23. Write another problem on the board: $15 + x = 25$
24. **Ask:** What do we do to isolate x? (Answer: Because 15 is positive, we subtract 15 from both sides to cancel it.)
25. Write the addition on the board:
    $15 - 15 + x = 25 - 15$ ⟵ Subtract 15 from both sides
    $x = 10$

Guided Practice *(9 minutes)*

1. Write the following problems on the board:
   a) $x + 6 = 10$
   b) $a - 3 = 9$
   c) $7 + z = 3$
   d) $6 = p + 5$
2. Ask pupils to work in pairs to solve the equations on the board.
3. **Say:** Work with your partner to solve the equations. Make sure to write all steps. Raise your hand if you have any questions.
4. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
5. Invite four pairs to write the answers on the board showing all of the work. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed.
   Answers:
   a) $x + 6 = 10 \rightarrow x + 6 - 6 = 10 - 6 \rightarrow x = 4$
   b) $a - 3 = 9 \rightarrow a - 3 + 3 = 9 + 3 \rightarrow a = 12$
   c) $7 + z = 3 \rightarrow 7 - 7 + z = 3 - 7 \rightarrow z = -4$
   d) $6 = p + 5 \rightarrow 6 - 5 = p + 5 - 5 \rightarrow 1 = p$

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $x + 6 = 8$
   b) $b - 3 = 12$
   c) $7 + y = 12$
   d) $p + 4 = -9$
2. Ask pupils to work individually to solve the equations on the board. Remind them to show all of the work.
3. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.

4. After pupils have finished, ask them to share and compare their answers with their partner.
5. Invite four pupils to write the answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed.
   Answers:
   a) $x + 6 = 8 \rightarrow x + 6 - 6 = 8 - 6 \rightarrow x = 2$
   b) $b - 3 = 12 \rightarrow b - 3 + 3 = 12 + 3 \rightarrow b = 15$
   c) $7 + y = 12 \rightarrow 7 - 7 + y = 12 - 7 \rightarrow y = 5$
   d) $p + 4 = -9 \rightarrow p + 4 - 4 = -9 - 4 \rightarrow p = -13$

Closing *(2 minutes)*

1. **Say:** Today we learned how to solve equations by adding and subtracting to balance the equation.
2. Write on the board: $2x + 3 = 17$
3. **Ask:** Can we solve this problem with the math we learned today? (Answer: No)
4. **Say:** We can solve this equation by balancing too, but we need to take more steps. During our next lesson, we will solve equations by multiplying and dividing.

Lesson Title: Solving Linear Equations II	**Theme:** Algebra	
Lesson Number: M-08-123	**Class/Level:** JSS 2	**Time:** 35 minutes

 **Learning Outcomes** By the end of the lesson, pupils will be able to solve linear equations in one variable by multiplying or dividing values to balance the equation.	 **Teaching Aids** None	 **Preparation** None

Opening *(3 minutes)*

1. **Say:** During the last lesson we learned how to solve linear equations by adding and subtracting.
2. Write on the board: $x + 2 = 7$
3. **Ask:** How do we solve this equation? Have pupils raise their hand to answer. (Answer: Subtract 2 from both sides.)
4. Write the solution on the board:
   $x + 2 - 2 = 7 - 2$ ⟵ Subtract 2 from both sides
   $x = 5$
5. **Say:** Today we are going to learn how to solve linear equations by multiplying and dividing values to balance the equation.

Introduction to the New Material *(10 minutes)*

1. Write on the board: $6x = 12$
2. **Say:** In this equation, we are multiplying x by 6. To isolate x, we need to do the opposite of multiplying. We need to divide both sides by 6.
3. Write out the steps to solve the equation on the board:

$\frac{6x}{6} = \frac{12}{6}$ ⟵ Divide both sides by 6

$\frac{\cancel{6}x}{\cancel{6}} = \frac{12}{6}$ ⟵ Cancel 6 to isolate x

$x = \frac{12}{6}$ ⟵ Divide the right side

$x = 2$

4. **Say:** When we divide both sides by 6, we isolate x and get a solution of x = 2.
5. Write another problem on the board: $\frac{x}{5} = 3$
6. **Say:** In this equation, x is divided by 5. To isolate x, we need to do the opposite of dividing. We need to multiply both sides by 5.

7. Write out the steps to solve the equation on the board:

$\frac{x}{5} \times 5 = 3 \times 5$ ⟵ Multiply both sides by 5

$\frac{x}{5} \times 5 = 3 \times 5$ ⟵ Cancel 5 to isolate x

$x = 3 \times 5$ ⟵ Multiply the right side

$x = 15$

8. **Say:** Let's try another example.
9. Write on the board: $7x = 21$
10. **Ask:** How will we solve this problem? (Answer: Divide both sides by 7)
11. Ask pupils to try to work on the problem in their exercise books. After a minute, write the steps to solve the equation on the board and tell them to check their work.

$\frac{7x}{7} = \frac{21}{7}$ ⟵ Divide both sides by 7

$\frac{7x}{7} = \frac{21}{7}$ ⟵ Cancel 7 to isolate x

$x = \frac{21}{7}$ ⟵ Divide the right side

$x = 3$

12. Write another problem on the board: $\frac{x}{2} = -10$
13. **Ask:** How will we solve this problem? (Answer: Multiply both sides by 2)
14. Ask pupils to try to work on the problem in their exercise books. After a minute, write the steps to solve the equation on the board and tell them to check their work.

$\frac{x}{2} \times 2 = -10 \times 2$ ⟵ Multiply both sides by 2

$\frac{x}{2} \times 2 = -10 \times 2$ ⟵ Cancel 2 to isolate x

$x = -10 \times 2$

⟵ Multiply the right side

$x = -20$

Guided Practice *(10 minutes)*

1. Write the following problems on the board:
   Solve for x:
   a) $7x = 14$
   b) $\frac{x}{11} = 2$
2. Divide the class into pairs and ask them to solve the problems on the board for x.
3. **Say:** Work with your partner to solve the problems on the board. Raise your hand if you have any questions.
4. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.

5. Invite two pairs to write the answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed.
   Answers:
   a) $7x = 14 \rightarrow \frac{7x}{7} = \frac{14}{7} \rightarrow \frac{7x}{7} = \frac{14}{7} \rightarrow x = \frac{14}{7} \rightarrow$ x = 2
   b) $\frac{x}{11} = 2 \rightarrow \frac{x}{11} \times 11 = 2 \times 11 \rightarrow \frac{x}{11} \times 11 = 2 \times 11 \rightarrow x = 2 \times 11 \rightarrow$ x = 22

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   Solve for x:
   a) $3x = 18$
   b) $\frac{x}{4} = 4$
2. Ask pupils to work individually to solve the problems on the board.
3. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
4. After pupils have finished, ask them to work in pairs to share and compare their answers.
6. Invite two pupils to write the answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed.
   Answers:
   a) $3x = 18 \rightarrow \frac{3x}{3} = \frac{18}{3} \rightarrow \frac{3x}{3} = \frac{18}{3} \rightarrow x = \frac{18}{3} \rightarrow x = 6$
   b) $\frac{x}{4} = 4 \rightarrow \frac{x}{4} \times 4 = 4 \times 4 \rightarrow \frac{x}{4} \times 4 = 4 \times 4 \rightarrow x = 4 \times 4 \rightarrow$ x = 16

Closing *(2 minutes)*

1. **Say:** Today we learned how to solve linear equations by multiplying and dividing on both sides.
2. **Ask:** What are some important things to remember when balancing equations? (Example answers: We must do the same thing to both sides of the equations; we must isolate the variable on one side)
3. **Say:** In our next lesson, we will learn how to solve more complicated linear equations.

Lesson Title: Solving Linear Equations III	**Theme:** Algebra	
Lesson Number: M-08-124	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to solve linear equations with brackets and with variables on both sides of the equation.	**Teaching Aids** None	**Preparation** None

Opening *(4 minutes)*

1. **Say:** In past lessons we learned how to combine like variables in an algebraic expression.
2. Write on the board: $4x - 2x$
3. **Ask:** What do we get if we simplify the expression? Have pupils raise their hand to answer. (Answer: 2x)
4. **Say:** In past lessons, we also have learned how to distribute.
5. Write on the board: $2(x + 3)$
6. **Ask:** What does this simplify to?
7. Invite a volunteer to write the answer on the board. Make corrections if necessary. (Answer: $2(x + 3) = 2x + 6$)
8. **Say:** In today's lesson, we will use what we learned to solve linear equations with brackets and variables on both sides of the equation. You will need to use the skills you learned in previous lessons.

Introduction to the New Material *(10 minutes)*

1. Write the following equation on the board:
   $6x + 5 = 2x + 9$
2. Ask: What do we need to do first to solve for x? (Answer: Combine like terms)
3. Say: Remember that we need to isolate x. In this equation we see x twice. We need to combine the like terms so there will only be one x. Then we can isolate x.
4. Ask: Who can tell us the like terms? (Answer: 6x and 2x, 5 and 9)
5. Say: First, we will work with the term with the variable. We subtract 2x from both sides to combine x on one side.
6. Do the subtraction on the board:
   $6x - 2x + 5 = 2x - 2x + 9$ ⟵ Subtract 2x from both sides
   $4x + 5 = 9$
7. Ask: What do you think the next step is?
8. Discuss the answer as a class. Guide pupils to see that the 5 should be subtracted.
9. Say: We need to do both subtraction and division. We need to subtract the 5 and divide the 4. Any time you see a problem like this, work the subtraction before the division.
10. Write on the board: When balancing equations, add or subtract before you multiply or divide.
11. Say: Let's subtract 5 from both sides.
12. Do the subtraction on the board:
    $4x + 5 - 5 = 9 - 5$
    $4x = 4$

13. Say: Finally, we will divide both sides by 4.
14. Do the division on the board:

$$\frac{4x}{4} = \frac{4}{4} \quad \leftarrow \text{Divide both sides by 4}$$

$$x = 1$$

15. Say: When we have variables on both sides of the equation, we do the following steps:
    a) Identify the like terms.
    b) Make sure the terms with the variable are on the same side of the equation.
    c) Solve for the variable.
16. Write the steps on the board.
17. Say: We also will work with equations with brackets.
18. Write on the board: $4(\mathrm{x} + 3) = 20$
19. Say: For this problem, first we distribute 4 then we solve for x. Remember BODMAS!
20. Write the distribution on the board:
    $4(x + 3) = 20 \rightarrow 4x + 12 = 20$
21. Say: Now we solve for x.
22. Ask: What are the steps to solve for x? (Answer: First we subtract 12, then we divide by 4.)
23. Say: Remember, when balancing equations we should do addition and subtraction before multiplication and division. This is different from BODMAS, and it's just for balancing.
24. Solve the problem on the board. Involve pupils by asking them to identify each step:

$$4x + 12 - 12 = 20 - 12 \quad \leftarrow \text{Subtract 12 from both sides}$$

$$4x = 8$$

$$\frac{4x}{4} = \frac{8}{4} \quad \leftarrow \text{Divide both sides by 4}$$

$$x = 2$$

Guided Practice *(9 minutes)*

1. Write the following problems on the board:
   a) $8x + 5 = 5x + 14$
   b) $7(x + 3) = 28$
2. Divide the class into pairs.
3. **Say:** Work with your partner to solve for x in the problems. Raise your hand if you have any questions.
4. Move around the classroom to make sure pupils understand and are doing the task. Help struggling pupils.
5. Invite two pupils to write their answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed. Answers:
   a) $8x + 5 = 5x + 14 \rightarrow 8x - 5x + 5 = 5x - 5x + 14 \rightarrow 3x + 5 = 14 \rightarrow 3x + 5 - 5 = 14 - 5 \rightarrow 3x = 9 \rightarrow \frac{3x}{3} = \frac{9}{3} \rightarrow x = 3$
   b) $7(x + 3) = 28 \rightarrow 7x + 7 \times 3 = 28 \rightarrow 7x + 21 = 28 \rightarrow 7x + 21 - 21 = 28 - 21 \rightarrow 7x = 7 \rightarrow \frac{7x}{7} = \frac{7}{7} \rightarrow x = 1$

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $10x + 3 = 7x + 18$
   b) $4(x + 6) = 32$
2. Ask pupils to work individually to solve the problems for x.
3. Move around the classroom to make sure the pupils understand how to solve the equations. Remind them of the steps if needed.
4. Invite two pupils to write their answers on the board. Make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed. Answers:
   a) $10x + 3 = 7x + 18 \rightarrow 10x - 7x + 3 = 7x - 7x + 18 \rightarrow 3x + 3 = 18 \rightarrow 3x + 3 - 3 = 18 - 3 \rightarrow 3x = 15 \rightarrow \frac{3x}{3} = \frac{15}{3} \rightarrow x = 5$
   b) $4(x + 6) = 32 \rightarrow 4x + 4 \times 6 = 32 \rightarrow 4x + 24 = 32 \rightarrow 4x + 24 - 24 = 32 - 24 \rightarrow 4x = 8 \rightarrow \frac{4x}{4} = \frac{8}{4} \rightarrow x = 2$

Closing *(2 minutes)*

1. Ask the following questions to revise the material:
2. **Ask:** What did we learn today? (Answer: How to solve algebraic linear equations with variables on both sides of the equation, and equations with brackets.)
3. **Ask:** If you see a problem where you need to subtract and divide to solve for x, which should you do first? (Answer: Subtract)

Lesson Title: Solving Linear Equations IV	**Theme:** Algebra	
Lesson Number: M-08-125	**Class/Level:** JSS 2	**Time:** 35 minutes

 **Learning Outcomes** By the end the lesson, pupils will be able to solve linear equations with negative coefficients and fractions.	 **Teaching Aids** None	 **Preparation** None

Opening *(2 minutes)*

1. **Say:** What have we been working on in the past few lessons? Have pupils raise their hand to answer. (Answer: Solving linear algebra equations)
2. Write a revision problem on the board: $2x + 4 = -8$
3. **Ask:** What do we do first? (Answer: Subtract 4 from both sides)
4. **Ask:** What will the next step be? (Answer: Divide both sides by 2)
5. Write the solution on the board:

$$2x + 4 - 4 = -8 - 4$$
$$2x = -12$$
$$\frac{2x}{2} = \frac{-12}{2}$$
$$x = -6$$

6. **Say:** Today we will learn how to solve linear algebra equations involving negative coefficients and fractions.

Introduction to the New Material *(15 minutes)*

1. Write on the board: $-2x + 4 = 6$
2. Say: This equation has a negative coefficient, -2. We will follow the same process that you already know. You just need to recall and use the rules of operations on negative numbers.
3. Ask: What do we do first? (Answer: Subtract 4 from both sides)
4. Write this step on the board: $-2\mathrm{x} + 4 - 4 = 6 - 4$

$$-2x = 2$$

5. Ask: What is the next step? (Answer: Divide both sides by -2 to isolate x)
6. Write this step on the board: $\frac{-2\mathrm{x}}{-2} = \frac{2}{-2}$

$$x = -1$$

7. If needed, remind pupils of the rules for dividing by negative numbers: a negative divided by a negative is positive; a positive divided by a negative is negative.
8. **Say:** It is important that we divide by negative 2. When we isolate x, we do not want to leave the negative sign there.
9. **Say:** We will also work with coefficients involving fractions. We follow the same rules as we normally do when solving linear algebra equations, except we are working with fractions.
10. **Say:** Let's solve a problem together.
11. Write on the board: $\frac{5}{6}\mathrm{x} + \frac{1}{6} = \frac{2}{3}$

12. **Ask:** Which steps will we use to solve this equation? (Answer: First step is to subtract $\frac{1}{6}$ from both sides; second step is to divide both sides by $\frac{5}{6}$)
13. Write the subtraction on the board: $\frac{5}{6}x + \frac{1}{6} - \frac{1}{6} = \frac{2}{3} - \frac{1}{6}$
14. **Say:** The denominators of these fractions are different.
15. Work the subtraction from the right side of the equation on the board:
    $\frac{2}{3} - \frac{1}{6} = \frac{2\times2}{3\times2} - \frac{1}{6} = \frac{4}{6} - \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$
16. Remind pupils of the rules for subtracting fractions if needed. Remind them to use the LCD to make the denominators the same.
17. Finish subtracting the fractions in the equation on the board:
    $\frac{5}{6}x + \frac{1}{6} - \frac{1}{6} = \frac{2}{3} - \frac{1}{6}$
    $\frac{5}{6}x = \frac{1}{2}$
18. **Ask:** We need to isolate x. How can we do that?
19. Invite pupils to share their ideas. Guide them to see that we should multiply by the reciprocal of $\frac{5}{6}$. Remind them that multiplying two reciprocal fractions makes 1. That will make the x by itself.
20. Multiply both sides of the equation on the board by the reciprocal $\frac{6}{5}$:
    $\frac{6}{5}\times\frac{5}{6}x = \frac{6}{5}\times\frac{1}{2}$
    $1x = \frac{6\times1}{5\times2}$
    $x = \frac{6}{10} = \frac{3}{5}$
21. **Say:** We have found the answer. The value of x is $\frac{3}{5}$. That was a lot of work, but I know you can do it! You already have all of the math skills. You just need to remember to follow the right steps.

Guided Practice *(6 minutes)*

1. Write on the board: $\frac{1}{2}x + \frac{3}{10} = \frac{8}{10}$
2. Divide the class into pairs.
3. **Say:** Solve the problem on the board with your partner.
4. Move around to make sure pupils understand and are doing the task. If needed, remind them of the steps to take: subtract $\frac{3}{10}$ from both sides first, then multiply both sides by the reciprocal of $\frac{1}{2}$, which is 2.
5. Write the solution on the board. Have pupils check their answers with the answer on the board.

$\frac{1}{2}x + \frac{3}{10} - \frac{3}{10} = \frac{8}{10} - \frac{3}{10}$ ← Subtract $\frac{3}{10}$ from both sides

$\frac{1}{2}x = \frac{8-3}{10} = \frac{5}{10} = \frac{1}{2}$ ← Subtract and simplify the fractions

$\frac{1}{2}x = \frac{1}{2}$

$2(\frac{1}{2}x) = 2(\frac{1}{2})$ ← Multiply both sides by 2, the reciprocal of $\frac{1}{2}$

$x = 1$

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $-2x - 8 = 10$
   b) $-3y = 5y + 16$
2. Ask pupils to work individually to solve the problems for the variable.
3. Move around the classroom to make sure the pupils understand how to solve the equations. Remind them of the steps needed to balance equations if needed.
4. After pupils have finished, ask them to work in pairs to share and compare their answers.
5. Invite two pupils to write their answers on the board. make corrections if necessary. Ask the class to check their answers with the answers on the board. Explain the answers if needed. Answers:
   a) $-2x - 8 = 10 \rightarrow -2x - 8 + 8 = 10 + 8 \rightarrow -2x = 18 \rightarrow \frac{-2x}{-2} = \frac{18}{-2} \rightarrow x = \left(\frac{18}{-2}\right) = -9$
   b) $-3y = 5y + 16 \rightarrow -3y - 5y = 16 \rightarrow -8y = 16 \rightarrow \frac{-8y}{-8} = \frac{16}{-8} \rightarrow y = -2$

Closing *(2 minutes)*

1. **Ask:** What did we learn today? (Answer: How to solve linear algebra equations involving negative coefficients and fractions.)
2. **Ask:** Who can remind me what the rules are for working with negative numbers? Answers:
   a) Multiplying or dividing by two negatives gives a positive.
   b) Multiplying or dividing by a positive and a negative number gives a negative number.
   c) Adding or subtracting two negative numbers with the same sign means you add the numbers and keep the sign.
   d) Adding or subtracting two numbers with different signs means you subtract the numbers, and the greater number carries the sign.

Lesson Title: Verifying Solutions	**Theme:** Algebra	
Lesson Number: M-08-126	**Class/Level:** JSS 2	**Time:** 35 minutes

 **Learning Outcomes** By the end of the lesson, pupils will be able to verify solutions to linear equations using substitution.	 **Teaching Aids** None	 **Preparation** None

Opening *(2 minutes)*

1. **Say:** In the last few lessons, we have learned how to solve linear equations.
2. **Ask:** How do we know if our solution is right? Is there any way to check our answer? Have pupils raise their hand to share ideas and suggestions on how to verify answers.
3. **Say:** Today, we will learn how to verify solutions to linear equations using substitution.
4. **Say:** There are two steps. First we solve the equation. Then we check our answer.

Introduction to the New Material *(10 minutes)*

1. **Say:** Let's solve a problem first.
2. Write on the board: $2x + 3 = 7$
3. **Ask:** What do we have to do to solve this problem? (Answer: Subtract 3 from both sides and divide both sides by 2.)
4. Ask pupils to solve for x in their exercise books.
5. Write the answer on the board and tell pupils to check their work:
   $2x + 3 = 7 \rightarrow 2x + 3 - 3 = 7 - 3 \rightarrow 2x = 4 \rightarrow \frac{2x}{2} = \frac{4}{2} \rightarrow x = 2$
6. **Say:** We have found that the value of x is 2. Now we can check our answer by substituting 2 back into the original equation!
7. Ask pupils to substitute x = 2 into the original equation in their exercise books.
8. Make sure pupils recall substitution.
9. Write the substitution on the board and ask pupils to check their work:
   $2(2) + 3 = 7 \rightarrow 4 + 3 = 7 \rightarrow 7 = 7$
10. **Say:** If both sides of the equal sign are the same, it means we have found the correct solution for this equation. 7 = 7 so we have the correct solution.
11. **Say:** Let's try an incorrect answer to see what happens.
12. Ask pupils to substitute $x = 3$ into the original equation in their exercise books.
13. Do the substitution on the board and tell pupils to check their work:
    $2(3) + 3 = 7 \rightarrow 6 + 3 = 7 \rightarrow 9 = 7$
14. **Say:** We have found that 9 is equal to 7. This can't be true! Therefore, we know that x = 3 is not the answer to the equation.
15. **Say:** Substitution is a very useful way to check your answer. You can use it for any type of linear equation, including those with negative numbers and fractions.

Guided Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $5x = 3x - 12$
   b) $-3x + 7 = 19$

2. Ask pupils to work in pairs to solve for x and use substitution to check their answers.
3. **Say:** Now work with your partner to solve the two equations on the board. When you are finished solving the problems, check your answers with substitution.
4. Move around the classroom to check for understanding and make sure pupils are doing the task. Make sure pupils are not only solving the problems, but also substituting the answers to check that they are correct.
5. Invite two pairs to stand up and share their answers to the class. Ask the rest of the class if they found the same answers. Discuss the answers as a class.
6. If needed, write the substitution on the board. For the sake of time, it is not necessary to write the full solution of each problem unless pupils do not understand.
   Answers:
   a) Solve for x: $5x - 3x = 3x - 3x - 12 \rightarrow 2x = -12 \rightarrow \frac{2x}{2} = \frac{-12}{2} \rightarrow x = -6$
   Check with substitution: $5(-6) = 3(-6) - 12 \rightarrow -30 = -18 - 12 \rightarrow -30 = -30$
   b) Solve for x: $-3x + 7 - 7 = 19 - 7 \rightarrow -3x = 12 \rightarrow \frac{-3x}{-3} = \frac{12}{-3} \rightarrow x = -4$
   Check with substitution: $-3(-4) + 7 = 19 \rightarrow 12 + 7 = 19 \rightarrow 19 = 19$

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   a) $-4x + 5 = 25$
   b) $\frac{1}{2}x + 3 = 1$
2. Ask pupils to work independently to solve for x and use substitution to check their answers.
3. Walk around the classroom to make sure pupils understand and are doing the task. Remind them of the steps needed to balance equations if needed.
4. When the pupils are finished, ask them to work in pairs to share and compare their answers.
5. Check answers as a class. Write the answers on the board.
   Answers:
   a) Solve for x: $-4x + 5 - 5 = 25 - 5 \rightarrow -4x = 20 \rightarrow \frac{-4x}{-4} = \frac{20}{-4} \rightarrow x = -5$
   Check with substitution: $-4(-5) + 5 = 25 \rightarrow 20 + 5 = 25 \rightarrow 25 = 25$
   b) Solve for x: $\frac{1}{2}x + 3 = 1 \rightarrow \frac{1}{2}x + 3 - 3 = 1 - 3 \rightarrow \frac{1}{2}x = -2 \rightarrow 2(\frac{1}{2}x) = 2(-2) \rightarrow x = -4$
   Check with substitution: $\frac{1}{2}x + 3 = 1 \rightarrow \frac{1}{2}(-4) + 3 = 1 \rightarrow -2 + 3 = 1 \rightarrow 1 = 1$

Closing *(3 minutes)*

1. **Ask:** Why is it important to know how to check your solution after solving a linear algebra equation? (Possible answers: Making sure you have the right solution; making sure you did not make a mistake)
2. **Ask:** When should you check your solution to a linear algebra equation? (Answer: Always, especially if you are unsure of your answer.)
3. **Say:** In our next lessons, we will continue to check our work when we solve equations.

Lesson Title: Introduction to Linear Equation Story Problems	**Theme:** Algebra	
Lesson Number: M-08-127	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to create linear equations in one variable.	**Teaching Aids** None	**Preparation** None

Opening *(2 minutes)*

1. **Say:** We have been learning how to solve linear equations. Now we are going to write linear equations based on word problems.
2. **Say:** Before we learned how to write algebraic expressions based on a word problem. Today, we will write linear equations based on a word problem. We will not solve the problems. We will focus on being able to read the word problem, and write an equation that represents the situation in the word problem.

Introduction to the New Material *(14 minutes)*

1. Write on the board:
   You are going to the market to buy rice. Rice costs 4,000 Leones per cup.
2. **Ask:** What variable can represent rice? Have pupils raise their hand to answer. (Answer r = rice)
3. **Say:** Remember, it is useful to choose a variable that reminds us of the unknown. Using the first letter of the word is helpful.
4. **Ask:** What is an algebraic expression that can represent this situation? (Answer: $4{,}000r$)
5. Write on the board: You have 20,000 Leones in total.
6. **Say:** You have 20,000 Leones and want to buy as many cups of rice as possible.
7. **Ask:** How can we write an algebraic equation representing how many cups of rice you can buy with 20,000 Leones if each cup of rice costs 4,000 Leones?
8. Invite pupils to share their ideas and discuss as a class. Guide them to the correct answer.
9. Write the correct equation on the board: $4{,}000r = 20{,}000$
10. **Say:** This equation says that r cups of rice at 4,000 Leones per cup equals 20,000 Leones.
11. **Say:** This is a linear equation in one variable. We can solve this equation for r.
12. Ask pupils to try to solve for r in their exercise books.
13. **Ask:** What steps did you take? (Answer: divide both sides by 4,000 to isolate r)
14. Write the solution on the board: $\frac{4{,}000r}{4{,}000} = \frac{20{,}000}{4{,}000}$
    $r = 5$
15. **Say:** You can buy 5 cups of rice with your 20,000 Leones.
16. **Say:** You are travelling to another town by taxi. It costs 50,000 Leones per person for the taxi. It costs an additional 5,000 Leones for each bag you carry.
17. **Ask:** If you spend 65,000 Leones on this trip, how many bags did you carry with you?
18. **Ask:** What is the unknown in this problem? (Answer: Number of bags you carry)
19. **Ask:** What variable can represent this unknown? (Answer: b = bags)

20. **Ask:** Which number can be a coefficient on the variable b? (Answer: 5,000, because each bag costs 5,000 Leones.)
21. **Ask:** Are there any constant numbers that do not change depend on how many bags you carry? (Answer: 50,000 Leones for the taxi fare.)
22. **Ask:** What is the equation that represents this situation?
23. Invite pupils to share their ideas. Guide them to the correct answer.
24. Write the answer on the board:
    $5{,}000b + 50{,}000 = 65{,}000$
25. **Say:** This equation says that you spent 50,000 on the seat, and 5,000 on each bag. You spent 65,000 in total.

Guided Practice *(7 minutes)*

1. Write the following steps on the board:
   a) Identify the unknown variable.
   b) Assign a letter to represent that variable.
   c) Identify any value that is multiplied by the variable (the coefficient).
   d) Identity any value that is constant.
   e) Write the algebraic expression representing the situation.
   f) Write the algebraic equation representing the situation.
2. Revise the steps for writing an algebraic equation with pupils.
3. Write the following problem on the board:
   You want to wash clothes. It takes you one hour to get all of the water you need to wash the clothes. You spend $\frac{1}{2}$ hour for each piece of clothing you wash. If you spend five hours washing clothes, how many pieces of clothing did you wash?
4. Read the problem aloud to pupils.
5. Ask pupils to work in pairs to write the equation.
6. **Say:** Now you are going to work with a partner to write algebraic equations for the problem on the board. Do not solve the problem; just write an algebraic equation representing the problem. Make sure you show the steps. (Point to the steps on the board.)
7. Move around the classroom to check for understanding and make sure pupils are doing the task. Make sure they understand how to write an equation representing the situation. Help struggling pupils.
8. When pupils are finished, invite one pair to write the equation on the board and explain it to the class.
   Answer: $\frac{1}{2}c + 1 = 5$ where c is pieces of clothing
   Explanation: 1 hour to collect water is constant and $\frac{1}{2}$ hour must be multiplied by the number of pieces of clothing. It is set equal to 5, because this is the total amount of time spent.

Independent Practice *(10 minutes)*

1. Write the following problems on the board:
   a) You want to clean your house, both inside and outside. It takes you two hours to sweep in front of your house. It takes you one hour to clean each room inside your house. If you spend six hours cleaning, how many rooms do you have in your house?

b) You want to cook a meal for your family. It takes two hours to setup to cook (including buying the food, starting the fire, washing the pot) regardless of how many people you are cooking for. It takes an additional $\frac{1}{4}$ hour per person you are cooking for. If you spend six hours cooking, how many people did you cook for?

2. Read the problems aloud to pupils.
3. Ask pupils to work independently to write the correct equation for each problem.
4. Move around the classroom to check for understanding and make sure pupils are doing the task. Make sure they understand how to write an equation representing the situation. Help struggling pupils.
5. After pupils finish, ask them to share and compare their equations with a partner.
6. Invite two pupils to write the answers on the board and explain their answers to the class. Make corrections if necessary.
   Answers:
   a) $2 + 1r = 6 \rightarrow 2 + r = 6$ (where r is the number of rooms)
   b) $\frac{1}{4}p + 2 = 6$ (where p is the number of people)

Closing *(2 minutes)*

1. **Say:** Today we learned how to write algebraic equations given word problems.
2. **Ask:** What are some important things to remember when writing algebraic equations? (Example answers: Write a coefficient on the variable if the total changes depending on changes in the value associated with the variable; write any constant values without the variable; set the equation to equal the total amount)
3. **Say:** In our next lesson, we will learn how to solve these algebraic equations.

Lesson Title: Solving Linear Equations Story Problems I	**Theme:** Algebra	
Lesson Number: M-08-128	**Class/Level:** JSS 2	**Time:** 35 minutes

 **Learning Outcomes** By the end of the lesson, pupils will be able to solve simple story problems by creating and solving linear equations.	 **Teaching Aids** None	 **Preparation** None

Opening *(3 minutes)*

1. **Ask:** Who can give me an example of a word problem we discussed in our last lesson, and the equation we wrote for that problem? Have pupils raise their hand to answer.
2. **Say:** In our last lesson, we learned how to read a word problem and write a linear equation based on that word problem. In today's lesson, we will write linear equations based on a word problem and solve the linear equations.

Introduction to the New Material *(12 minutes)*

1. **Say:** Now we are going to write an equation and solve the equation to find the answer.
2. **Say:** We will use the same steps as in our last lesson, but today we will also solve the problem.
3. Write the steps on the board, read them and make sure pupils understand them.
   Steps:
   a) Identify the unknown variable.
   b) Assign a letter to represent that variable.
   c) Identify any value that is multiplied by the variable (the coefficient).
   d) Identity any value that is constant.
   e) Write the algebraic expression representing the situation.
   f) Write the algebraic equation representing the situation.
   g) Solve the algebraic equation you wrote.
4. Write the following problem on the board:
   You make 20 dollars for every hour that you work. If you make 400 dollars, how many hours did you work?
5. Ask: What is the unknown in this problem? (Answer: hours you work)
6. Ask: What variable can represent this unknown? (Answer: h = hours)
7. Ask: Which number can be a coefficient on the variable h? Why? (Answer: 20 because if you make 20 dollars for each hour you work, you should multiply 20 by the number of hours worked.)
8. Ask: What is constant and does not change? (Answer: Nothing in this problem.)
9. Ask: What is the algebraic expression representing this situation?
10. Invite pupils to share their ideas and discuss the answer as a class. (Answer: $20\mathrm{h}$)
11. Ask: What is the algebraic equation representing this situation? (Answer: $20\mathrm{h} = 400$)
12. Ask pupils to solve for h in their exercise books.
13. Invite one pupil to write the answer on the board. Make corrections if necessary.

a) Answer → $20h = 400$

$\frac{20h}{20} = \frac{400}{20}$

$h = 20$ hours

b) **Say:** Make sure to show all steps when solving the problem.

Guided Practice *(10 minutes)*

1. Write the following problems on the board:
   a) You are building your new house. It costs you 2,000 Leones for each room you build. If you spend 12,000 Leones to build the new house, how many rooms does the house have?
   b) You have some reading books. Your teacher gives you two more reading books. If you have 10 reading books all together, how many books did you start with?
2. Ask pupils to work in pairs to write the equations and solve them.
3. **Say:** Now you will work with your partner to solve the problems on the board.
4. **Say:** Make sure you follow the steps on the board! (Point to steps a-g from the introduction on the board.) It is important to write the equation correctly before solving it.
5. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
6. Invite two pairs to each share an answer with the class. Pupils should explain why they wrote the equation the way they did, and how they solved the equation. Make corrections if necessary. Answers:
   a) Equation: $2000r = 12000$; Solution: $\frac{2000r}{2000} = \frac{12000}{2000} \rightarrow r = 6$; The house has 6 rooms.
   b) Equation: $b + 2 = 10$; Solution: $b + 2 - 2 = 10 - 2 \rightarrow b = 8$; You started with 8 books.

Independent Practice *(8 minutes)*

1. Write the following problem on the board:
   You go shopping for shoes. You buy three pairs of shoes. Now you own seven pairs of shoes total. How many shoes did you start with?
2. Ask pupils to work independently to solve the problem. Remind them to write the equation first.
3. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
4. After pupils have finished, ask them to share and compare their answer with a partner.
5. Invite one pupil to write the equation on the board. Invite another pupil to write the solution and answer. Both pupils should explain their work to the class. Make corrections if necessary. Answer:
   Equation: $S + 3 = 7$
   Solution: $S + 3 - 3 = 7 - 3 \rightarrow S = 4$; You started with four pairs of shoes.

Closing *(2 minutes)*

1. **Say:** Today we practised writing basic linear equations for word problems and then solving the equations.

2. **Ask:** What are some things that are important to remember when solving linear equation word problems? (Example answers: Choose the correct numbers for the coefficient and constant; balance the equation correctly to solve for the variable)
3. **Say:** In our next lesson, we will practise writing more difficult algebraic equations based on story problems and solving them.

Lesson Title: Solving Linear Equation Story Problems II	**Theme:** Algebra	
Lesson Number: M-08-129	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to solve more difficult story problems by creating and solving linear equations.	**Teaching Aids** None	**Preparation** None

Opening *(2 minutes)*

1. **Ask:** Who can give me an example of a word problem we discussed in our last lesson, and the equation we wrote for that problem? Have pupils raise their hand to answer.
2. **Say:** In our last lesson, we learned how to read a word problem and write a linear equation based on that word problem. In today's lesson, we will write more difficult linear equations based on a word problem and solve those linear equations.

Introduction to the New Material *(12 minutes)*

1. Revise the steps pupils should follow when writing and solving equations. They should have them in their notes from the previous lesson.
   a) Identify the unknown variable.
   b) Assign a letter to represent that variable.
   c) Identify any value that is multiplied by the variable (the coefficient).
   d) Identity any value that is constant.
   e) Write the algebraic expression representing the situation.
   f) Write the algebraic equation representing the situation.
   g) Solve the algebraic equation you wrote.
   c) Write the following problem on the board:

   You are building your new house. It costs you 5,000 dollars to purchase the land. It costs you 1,000 dollars for each room in the house. If building the house costs you 10,000 dollars, how many rooms does the house have?
2. **Say:** Now we are going to write an equation and solve the equation for the problem on the board.
3. **Say:** First we will assign variables.
4. **Ask:** What is our unknown in this problem? (Answer: Number of rooms in the house)
5. **Ask:** What variable could represent rooms? (Answer: r, or any other acceptable variable)
6. **Ask:** Which number can be a coefficient on the variable r? (Answer: 1,000 dollars per room)
7. **Ask:** What is constant in the situation? (Answer: 5,000 dollars to purchase the land)
8. **Ask:** What is the algebraic expression which represents the situation?
9. Invite pupils to share their ideas and discuss the answer as a class. (Answer: $1{,}000\mathrm{r} + 5{,}000$)
10. **Ask:** What is the linear equation? (Answer: $1{,}000\mathrm{r} + 5{,}000 = 10{,}000$)
11. **Say:** Now that we have the equation, we can solve for the unknown variable, r.
12. **Ask:** What do we do first? (Answer: Subtract 5,000)
13. **Ask:** What do we do second? (Answer: Divide by 1,000)

14. Ask pupils to solve for r in their exercise books.
15. Invite one pupil to write the answer on the board. Make corrections if necessary. Ask the class to check their answers with the answer on the board. Explain the answer if needed.

$$1{,}000r + 5{,}000 = 10{,}000$$

$$1{,}000r + 5{,}000 - 5{,}000 = 10{,}000 - 5{,}000$$

$$1{,}000r = 5{,}000$$

$$\frac{1{,}000r}{1{,}000} = \frac{5{,}000}{1{,}000}$$

$$r = 5$$

There are 5 rooms!

Guided Practice *(9 minutes)*

1. Write the following problem on the board:
   You spend two hours each day in mathematics class, and then are assigned mathematics homework problems to work on at night. Each homework problem assigned to you takes you $\frac{1}{2}$ an hour. If you spend six hours on math in one day, how many mathematics homework problems were assigned to you?
2. Ask pupils to work in pairs to write the equation and solve the problem.
3. **Say:** Now you will work with your partner to solve the problem. Make sure you follow the steps; it is important to write the equation correctly before solving it.
4. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
5. Invite one pair to write the equation on the board. Invite another pair to write the solution to the equation. Both pairs should explain their answers. Make corrections if necessary.
   Answer:
   Equation: $\frac{1}{2}m + 2 = 6$, where m is number of mathematics problems
   Solution: $\frac{1}{2}m + 2 - 2 = 6 - 2 \rightarrow \frac{1}{2}m = 4 \rightarrow 2 \times \frac{1}{2}m = 2 \times 4 \rightarrow m = 8$; You solved 8 mathematics problems for homework.

Independent Practice *(10 minutes)*

1. Write the following problem on the board:
   You are selling cookies. You start with 8,000 Leones in your pocket. For each cookie you sell, you make 1,000 Leones. If you have 25,000 Leones at the end of the day, how many cookies did you sell?
2. Ask pupils to work independently to write the correct equation and solve the problem.
3. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
4. After pupils have finished, ask them to share and compare their work with a partner.
5. Invite one pupil to write the equation on the board. Invite another pupil to write the solution to the equation. Both pupils should explain their answers. Make corrections if necessary.

Answer:

Equation: $1{,}000c + 8{,}000 = 25{,}000$, where *c* is cookies

Solution: $1{,}000c + 8{,}000 - 8{,}000 = 25{,}000 - 8{,}000 \rightarrow 1{,}000c = 17{,}000 \rightarrow \frac{1{,}000c}{1{,}000} = \frac{17{,}000}{1{,}000} \rightarrow c = 17$; You sold 17 cookies.

Closing *(2 minutes)*

1. **Say:** Today we learned how to solve more difficult linear equations.
2. **Ask:** What are some important things to remember when solving this type of problem? (Example answers: Write the correct numbers as constant and coefficient when balancing equations; add or subtract before multiplying or dividing)
3. **Say:** Tomorrow, we will use what we learned to solve more linear algebra equations.

Lesson Title: Linear Equation Practice	**Theme:** Algebra	
Lesson Number: M-08-130	**Class/Level:** JSS 2	**Time:** 35 minutes

 **Learning Outcomes** By the end of the lesson, pupils will be able to create and solve linear equations in one variable.	 **Teaching Aids** None	 **Preparation** None

Opening *(2 minutes)*

1. **Say:** In the past few lessons, we learned how to write linear equations based on word problems and then solve them.
2. **Ask:** What are some of the challenging things about solving linear equation story problems? Have pupils raise their hand to answer.
3. **Say:** Today we will practise creating and solving linear equations so you can become very skilled at solving these types of problems!

Introduction to the New Material *(10 minutes)*

1. **Ask:** Who can remind us what steps we used when given a word problem from which we need to write and solve a linear algebra equation?
2. Write the steps on the board as pupils identify them. Remind pupils to use their notes from previous lessons.
   Steps:
   a) Identify the unknown variable.
   b) Assign a letter to represent that variable.
   c) Identify any value that is multiplied by the variable (the coefficient).
   d) Identity any value that is constant.
   e) Write the algebraic expression representing the situation.
   f) Write the algebraic equation representing the situation.
   g) Solve the algebraic equation you wrote.
3. **Say:** Let's do one revision problem for practise.
4. Write the following problem on the board:
   You are travelling in a taxi. The fare per person is 60,000 Leones. The driver charges 7,000 Leones for each bag you have. If you pay 88,000 Leones for your trip, how many bags did you carry with you?
5. **Say:** First we will assign variables.
6. **Ask:** What is our unknown in this problem? (Answer: Number of bags you carry on your trip)
7. **Ask:** What variable could represent bags? (Answer: b = bags, or any other acceptable variable)
8. **Ask:** Which number can be a coefficient on the variable b? (Answer: 7,000 Leones per bag)
9. **Ask:** What is constant in the situation? (Answer: 60,000 Leones per person to travel)
10. **Ask:** What is the algebraic expression which represents the situation?
11. Ask pupils to write the algebraic expression in their exercise books.
12. Discuss the answer as a class. (Answer: $7{,}000b + 60{,}000$)
13. **Ask:** What is the linear equation? (Answer: $7{,}000b + 60{,}000 = 88{,}000$)
14. **Say:** Now we solve for the unknown variable, b.

15. **Ask:** What do we do first? (Answer: Subtract 60,000)
16. **Ask:** What do we do second? (Answer: Divide by 7,000)
17. Ask pupils to solve for b in their exercise books.
18. Invite one pupil to write the solution on the board. Make corrections if necessary. Ask pupils to check their answer with the answer on the board.
    Answer:

$$7{,}000b + 60{,}000 = 88{,}000$$

$$7{,}000b + 60{,}000 - 60{,}000 = 88{,}000 - 60{,}000$$

$$7{,}000b = 28{,}000$$

$$\frac{7{,}000b}{7{,}000} = \frac{28{,}000}{7{,}000}$$

$b = 4$; You carry 4 bags with you on your trip.

Guided Practice *(10 minutes)*

1. Write the following problem on the board:
   You go to the market. You spend 7,000 Leones on cooking oil. You spend the rest of your money on rice, which costs 5,000 Leones per cup. If you spend 52,000 Leones at the market, how many cups of rice did you buy?
2. Ask pupils to work in pairs to write the equation and solve the problem.
3. **Say:** Now you will work with your partner to solve the problem on the board.
4. **Say:** Make sure you follow the steps on the board! It is important to write the equation correctly before solving it. (Point to steps a-g from the introduction on the board.)
5. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
6. Invite one pair to write the equation on the board. Invite another pair to write the solution to the equation. Both pairs should explain their answers. Make corrections if necessary.
   Answer:
   Equation: $5{,}000c + 7{,}000 = 52{,}000$, where c is number of cups of rice
   Solution: $5{,}000c + 7{,}000 - 7{,}000 = 52{,}000 - 7{,}000$ → $5{,}000c = 45{,}000$ → $\frac{5{,}000c}{5{,}000} = \frac{45{,}000}{5{,}000}$
   → $c = 9$; You bought 9 cups of rice.

Independent Practice *(11 minutes)*

1. Write the following problems on the board:
   a) You are going to work on your farm. It takes you two hours to get the water. It takes you $\frac{1}{4}$ hour to pull the weeds from each bed of vegetable plants. If you spend four hours working at the farm, how many beds did you pull the weeds from?
   b) You start with 15,000 Leones in your pocket. You are selling DVDs. For every DVD you sell, you make 10,000 Leones. If you have 105,000 Leones in your pocket at the end of the day, how many DVDs did you sell?
2. Ask pupils to work independently to write the equations and solve the problems.

3. Move around the classroom to check for understanding and make sure pupils are doing the task. Help struggling pupils.
4. Invite two pupils to each write one of the answers on the board. Both pupils should explain their answers. Make corrections if necessary.
   Answers:
   a) Equation: $\frac{1}{4}b + 2 = 4$, where b is beds
      Solution: $\frac{1}{4}b + 2 - 2 = 4 - 2 \rightarrow \frac{1}{4}b = 2 \rightarrow 4 \times \frac{1}{4}b = 4 \times 2 \rightarrow b = 8$
      You pulled the weeds from 8 beds.
   b) Equation: $10{,}000d + 15{,}000 = 105{,}000$, where d is number of DVDs.
      Solution: $10{,}000d + 15{,}000 - 15{,}000 = 105{,}000 - 15{,}000 \rightarrow 10{,}000d = 90{,}000 \rightarrow \frac{10{,}000d}{10{,}000} = \frac{90{,}000}{10{,}000} \rightarrow d = 9$
      You sold 9 DVDs.

Closing *(2 minutes)*

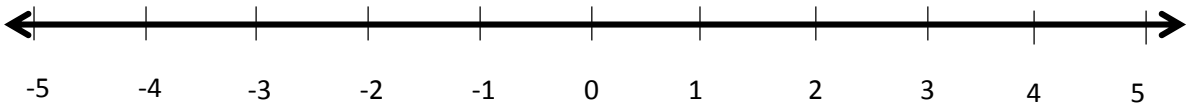
1. **Say:** Today we practised solving linear equations from word problems.
2. **Ask:** Can anyone remember why we call them, 'linear' equations? (Answer: We call them linear because they can all be graphed on the Cartesian plane, and when we graph them it makes a line.)
3. **Say:** All of these practical problems that we have been solving can also be graphed!
4. **Say:** In the next lessons, we will continue working with linear equations, but we will start learning how to graph these equations on the Cartesian plane.

Lesson Title: Introduction to the Cartesian Plane	**Theme:** Algebra	
Lesson Number: M-08-131	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to: 1. Draw a Cartesian plane, identify the x and y axes and label them with positive and negative values. 2. Identify that the same x and y are often variables in linear equations, and the Cartesian plane is used to graph equations.	**Teaching Aids** None	**Preparation** None

Opening *(4 minutes)*

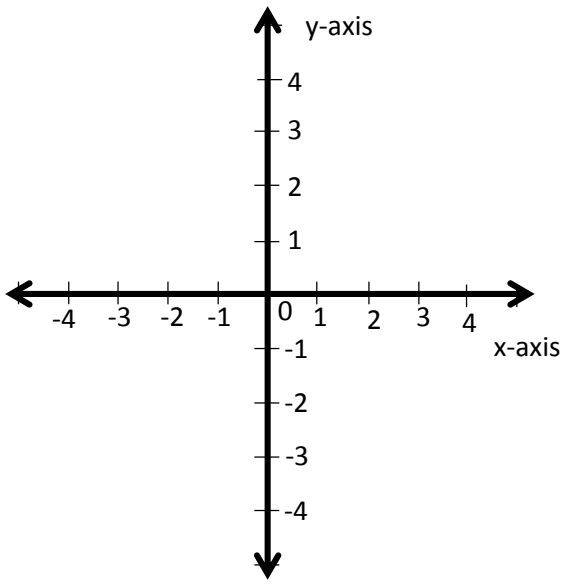
1. Revise number lines with pupils.
2. **Ask:** What is a number line? Have pupils raise their hand to answer. (Answer: A line with numbers labeled, where you can plot points.)
3. Ask pupils to draw a number line from -5 to 5 in their exercise books.
4. Invite a volunteer to draw the number line on the board. (Answer: see number line below)



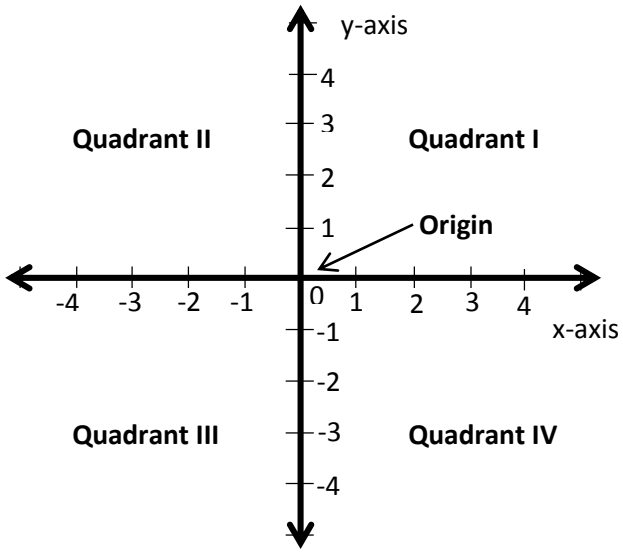
5. **Say:** Remember that on the number line, the negative numbers are to the left and positive numbers are to the right of zero.
6. **Say:** Today we will discuss the Cartesian plane. You will see that it looks like two number lines crossing.

Introduction to the New Material *(14 minutes)*

1. Draw the Cartesian plane on the board (see diagram to the right).
2. **Say:** This is called the Cartesian coordinate plane. It is a system that consists of two number lines drawn at a right angle to one another. The two lines intersect at zero.
3. **Say:** A plane is any flat surface. The Cartesian plane helps us to describe where things are on a flat surface, like our paper or the board.
4. **Say:** We will use the Cartesian plane later to draw (or graph) points, lines and other shapes. It helps us to show where things are and how they look.

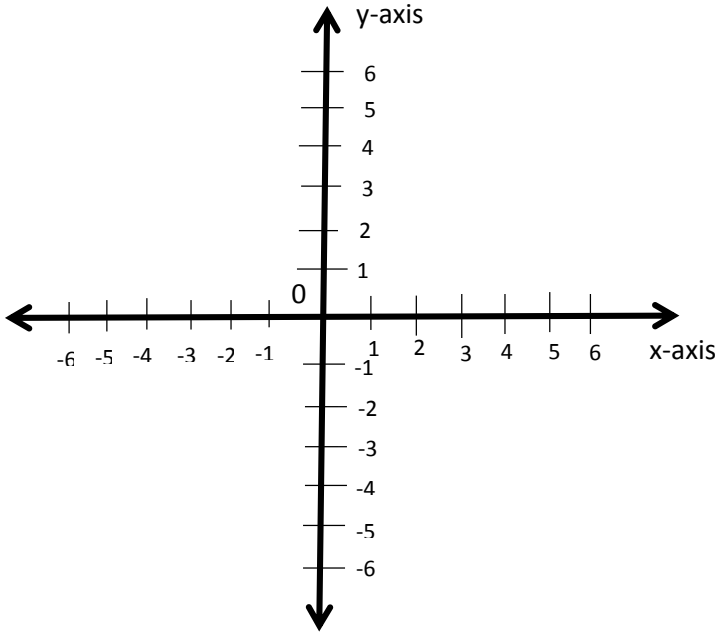


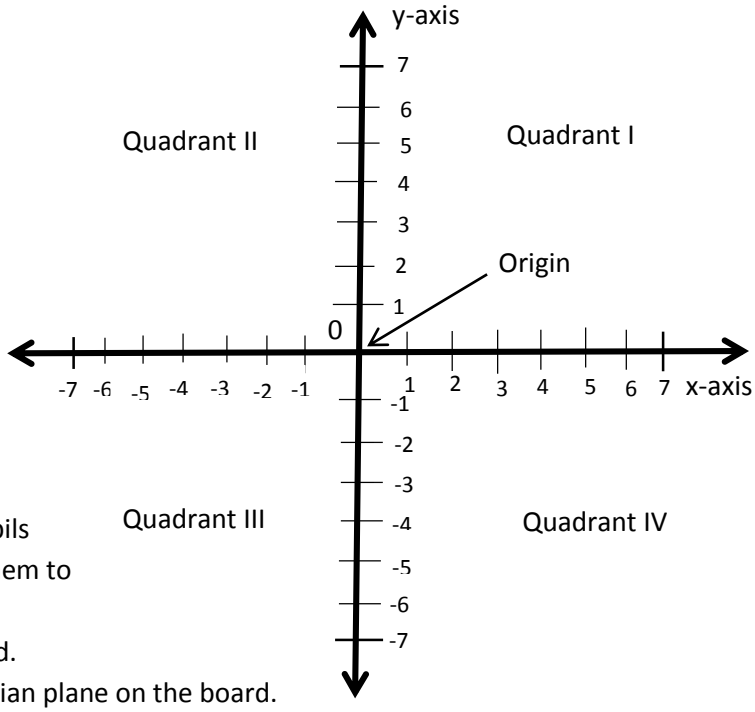
5. **Say:** Look at the small marks on the axes for each number. It is important that all of the marks on the axes are the same distance apart. This is the only way our graphs will be accurate.
6. **Say:** The horizontal number line is called the 'x- axis'. The vertical number line is called the 'y-axis'.
7. **Say:** This x and y are the same x and y that we see as variables in equations. We can use the Cartesian plane to draw graphs of equations with x and y in them.
8. **Say:** On the x-axis, the positive numbers are to the right of zero, and the negative numbers are to the left of zero. On the y-axis, the positive numbers are above zero, and the negative numbers are below zero. The numbers go on forever on both the x- and y-axis, as with all number lines.
9. Label the origin on the Cartesian plane (see diagram below).
10. **Say:** The point at which the two axes intersect is called the 'origin'. The origin is at zero on the x-axis and zero on the y-axis.
11. Label the quadrants of the Cartesian plane (see diagram below).
12. **Say:** The two number lines divide the plane into four sections called 'quadrants'. A quadrant is one of the four sections on a Cartesian plane.
13. **Say:** The top right of the coordinate is called the first quadrant. We find the second, third and fourth quadrants by moving in a counter-clockwise direction, or left, from the first quadrant.



Guided Practice *(6 minutes)*

1. Write on the board:
   a) The Cartesian coordinate plane from -6 to +6 on both axes.
   b) Label the x-axis and y-axis, and all of the numbers -6 to +6.
2. Ask pupils to work in pairs and do the work in their exercise books.
3. Move around the classroom to make sure pupils understand and are doing the task. Make sure pupils put even spacing between the marks on the axes and label the axes correctly.
4. Invite a pair to come to the board and draw the x- and y-axes. Invite another pair to label the axes. Make corrections if necessary. (Answer: see the graph below)





Independent Practice *(9 minutes)*

1. Write these instructions on the board:
   a) Draw a Cartesian plane.
   b) Label the axes from -7 to +7.
   c) Label the origin.
   d) Label each quadrant.
2. Ask pupils to work individually to draw and label the Cartesian plane.
3. Move around the classroom to make sure pupils understand and are doing the task. Remind them to use the examples on the board to help them.
4. Invite a pupil to draw the answer on the board.
5. Ask pupils to check their work with the Cartesian plane on the board.

Closing *(2 minutes)*

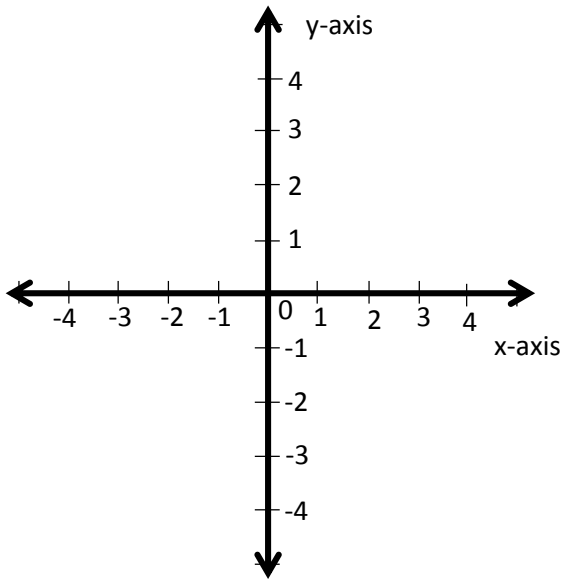
1. Ask the following questions to revise the material:
   a) Describe the term 'quadrant' in your own words.
   b) What do we call the vertical axis?
   c) What do we call the horizontal axis?
   d) What is a coordinate plane used for?
2. Discuss the answers as a class. (Answers: a) A quadrant is one the four sections divided by the two axes in a Cartesian plane; b) y-axis; c) x-axis; d) To graph or draw shapes; to graph equations)

Lesson Title: Plotting Points in the Cartesian Plane	**Theme:** Algebra	
Lesson Number: M-08-132	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to identify points in each quadrant of a Cartesian plane and write them in the form.	**Teaching Aids** None	**Preparation** None

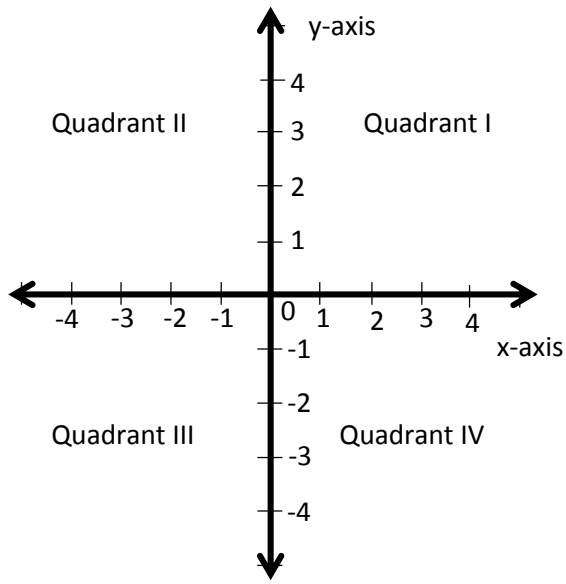
Opening *(2 minutes)*

1. **Ask:** What did we learn in the last lesson? Have pupils raise their hand to answer. (Answer: How to draw a Cartesian coordinate plane.)
2. **Ask:** Who can come on the board and draw a coordinate plane? (Any coordinate plane is fine; the one to the right is an example answer.)
3. **Say:** Today, we will learn how to identify points in a Cartesian plane.



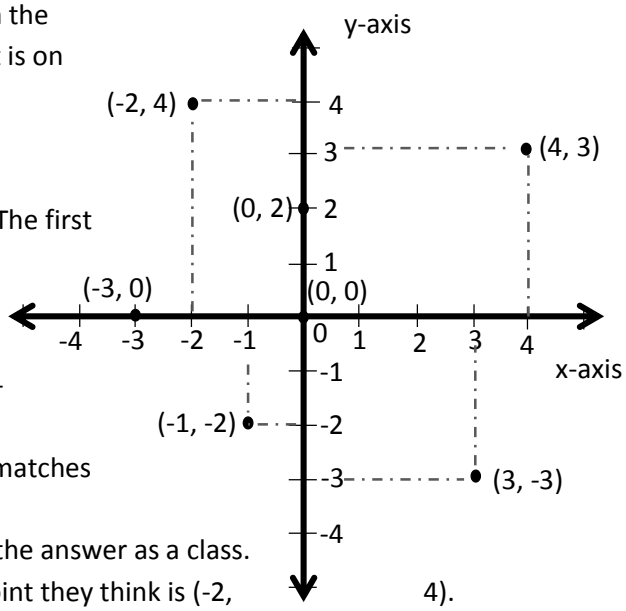
Introduction to the New Material *(11 minutes)*

1. Draw a Cartesian plane on the board.
2. **Say:** Recall that there are four quadrants and they go around the coordinate plane counterclockwise, to the left from the first quadrant.
3. Invite a volunteer to come to the board and label the 4 quadrants on the plane (see diagram to the right).
4. **Say:** Today I will show you different points on the Cartesian plane and how to identify them.
5. Plot the four points in the diagram below on the Cartesian plane on the board. Note: There is no need to teach pupils how to graph them at this point; simply plot them and move to the next step.



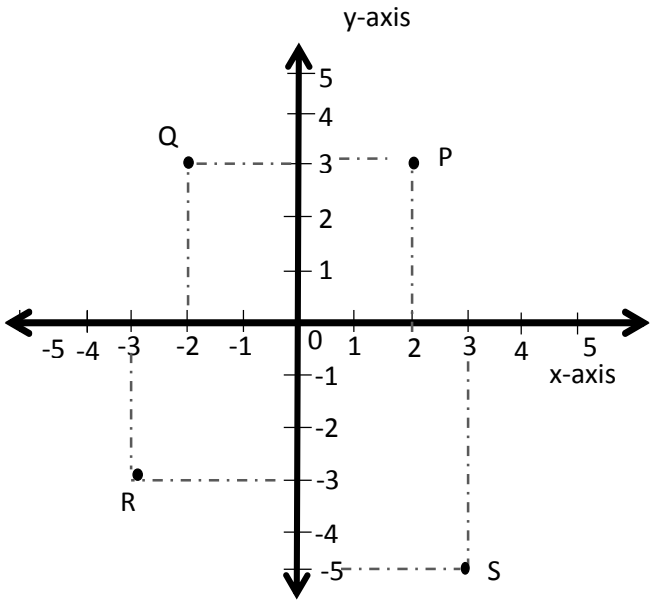
6. **Say:** Any point on the Cartesian plane can be located by an 'ordered pair' of integers. These integers are called the 'coordinates' of the points. Each of the points shown here has coordinates that can be used to locate it.
7. Label the point (4, 3).
8. **Say:** These two numbers, 4 and 3, tell us where to locate this point.
9. Count 4 spaces on the x-axis and 3 spaces in the y-axis, ending at point (4, 3).

10. **Say:** The first number, 4, tells us where the point is on the x-axis. The second number, 3, tells us where the point is on the y-axis.
11. Write on the board: ordered pair: (x, y)
12. **Say:** This is what an ordered pair looks like. It has two numbers inside brackets and separated by a comma. The first number tells us how far to count on the x-axis. The second number tells us how far to count on the y-axis.
13. Write another ordered pair anywhere on the board: (-2, 4)
14. **Ask:** Which one of the points on this Cartesian plane matches this ordered pair?
15. Allow pupils to think for a moment before discussing the answer as a class.
16. Invite pupils to come to the board and point to the point they think is (-2, 4).
17. Label the point (-2, 4) on the Cartesian plane on the board.
18. **Say:** The first number is -2, so it tells us to count 2 spaces to the left, or in the negative direction, on the x-axis. The second number is positive 4, which tells us to count 4 spaces up, or in the positive direction, on the y-axis.
19. Follow the same process with the other two points. Allow pupils to think about them for a moment before discussing the answers as a class.
20. Plot the following points on the same coordinate plane: (0, 0), (0, 2) and (-3, 0). (See diagram to the right)
21. **Say:** The origin is at zero on the x- and y-axes, so we write its coordinates as two zeros.
22. **Say:** Any point with zero for the x-value is on the y-axis. We cannot move left or right along the x-axis. Any point with zero for the y-value is on the x-axis. We cannot move up or down along the y-axis.
23. Allow pupils a moment to copy the Cartesian plane and label the four points on the Cartesian plane in their exercise books.



Guided Practice *(10 minutes)*

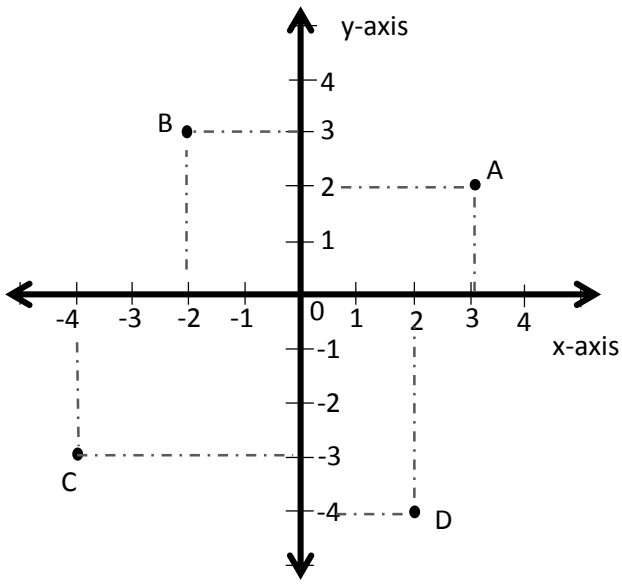
1. Draw the Cartesian plane on the board showing four points P, Q, R, and S (see diagram to the right).
2. Write the following problem on the board:
   For each of the points on the coordinate plane:
   a) Identify which quadrant it is in.
   b) Write the ordered pair (x, y) for each point.
3. Ask pupils to copy the Cartesian plane into their exercise book and work in pairs to answer the questions.
4. Move around the classroom to make sure pupils understand and are doing the task. Help struggling pupils.



5. Invite four different pairs to give the quadrant and ordered pair for each point. Make corrections if necessary. (Answers: P: Quadrant I (2,3); Q: Quadrant II (-2,3); R: Quadrant III (-3, -3); S: Quadrant IV (3,-5))

Independent Practice *(10 minutes)*

1. Draw a Cartesian plane on the board showing the points A, B, C and D (see diagram below).
2. Write the following problem on the board:
   For each of the points on the coordinate plane:
   a) Identify which quadrant it is in.
   b) Write the ordered pair (x, y) for each point.
3. Ask pupils to copy the Cartesian plane into their exercise book and work individually to answer the questions.
4. Move around the classroom to make sure pupils understand and are doing the task. Help struggling pupils.
5. Invite four different pupils to give the quadrant for each point. Invite four other pupils to give the ordered pair for each point. Make corrections if necessary. (Answers: A: Quadrant I (3, 2); B: Quadrant II (-2, 3); C: Quadrant III (-4,-3); D: Quadrant IV (2,-4))



Closing *(2 minutes)*

1. **Ask:** What did we learn today? (Example answers: The different quadrants of the coordinate plane; how to identify points on the plane and write their ordered pair)
2. **Ask:** In what order do we write the ordered pair for points on the coordinate plane? (Answer: (x-coordinate, y-coordinate)
3. In which quadrant are the x- and y-coordinate both negative? (Answer: Quadrant III)

Lesson Title: Plotting Points in the Cartesian Plane	**Theme:** Algebra	
Lesson Number: M-08-133	**Class/Level:** JSS 2	**Time:** 35 minutes

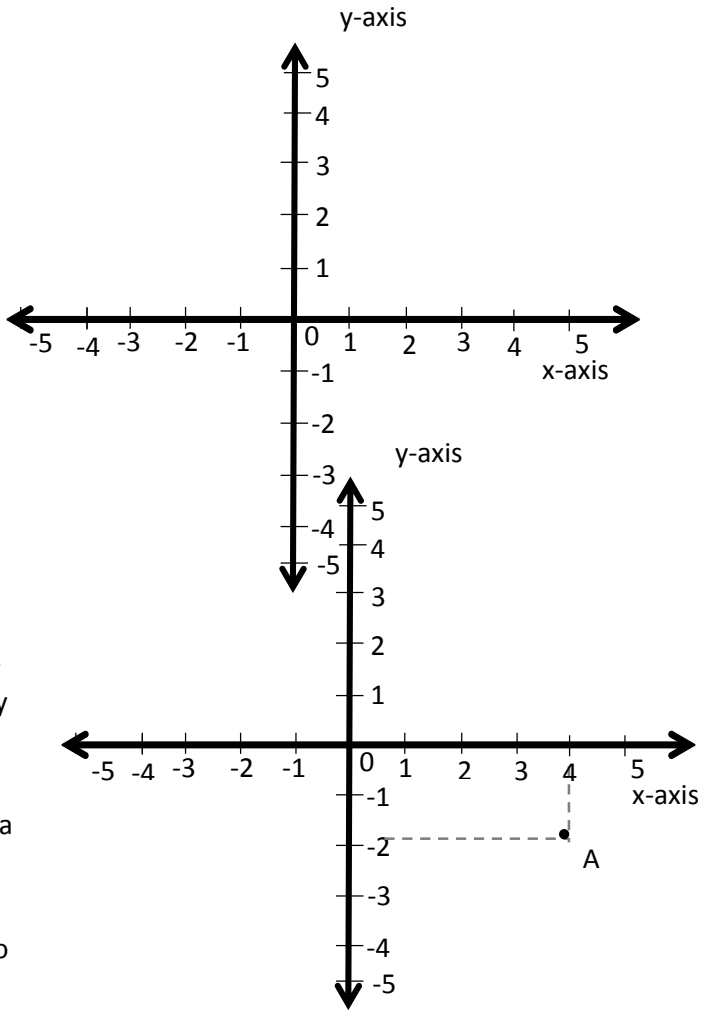
Learning Outcomes	**Teaching Aids**	**Preparation**
By the end of the lesson, pupils will be able to plot given points in any quadrant of the Cartesian plane.	None	None

Opening *(5 minutes)*

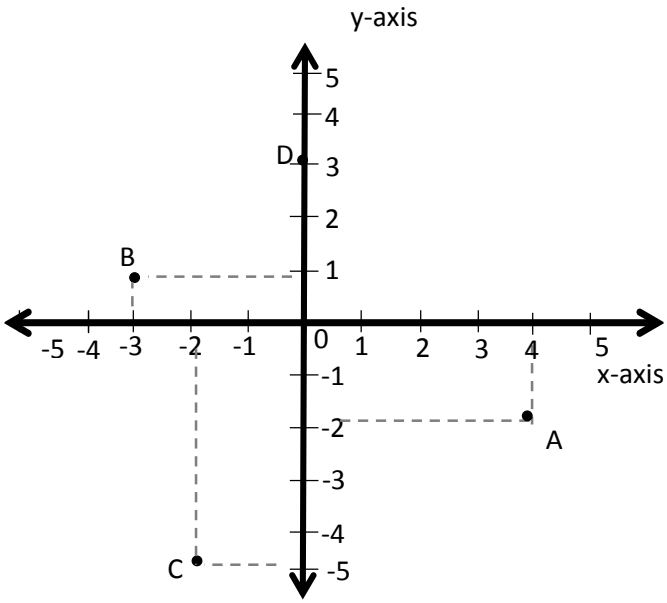
4. **Ask:** What did we learn in the last lesson? Have pupils raise their hand to answer. (Answer: How to identify points in the quadrant plane)
5. **Ask:** What is an ordered pair? (Answer: It has the form (x, y) and tells us where the point is on the plane.)
6. **Ask:** How do we identify the ordered pair for a point? (Answer: Count how far the point is from the x- and y-axes.)
7. **Say:** Today we will learn how to plot our own points on the Cartesian plane.

Introduction to the New Material *(11 minutes)*

1. Draw a Cartesian plane on the board, from -5 to 5 (see diagram to the right).
2. Write on the board: A (4, -2)
3. **Say:** Let's plot point A on this coordinate plane.
4. **Say:** Remember, when reading the coordinates of a point, the x-coordinate comes first, and the y- coordinate comes second (x-coordinate, y-coordinate).
5. **Ask:** For (4,-2), what is the x-coordinate, and what is the y-coordinate? (Answer: 4 is the x-coordinate and y is the y coordinate.)
6. **Say:** We locate the x-coordinate, 4, by finding 4 on the x-axis. We locate the y-coordinate, -2, by finding -2 on the y-axis.
7. **Say:** After locating 4 and -2, we see that -2 is below 4 and 4 is to the right of -2. So, we draw a straight line down from 4, and a straight line right from -2 and draw the point.
8. Draw the example on the board (see diagram to the right).
9. Follow the same process to plot the following points: B (-3, 1), C (-2, -5), D (0, 3)
10. Make sure you involve pupils in plotting each point (see answers below).

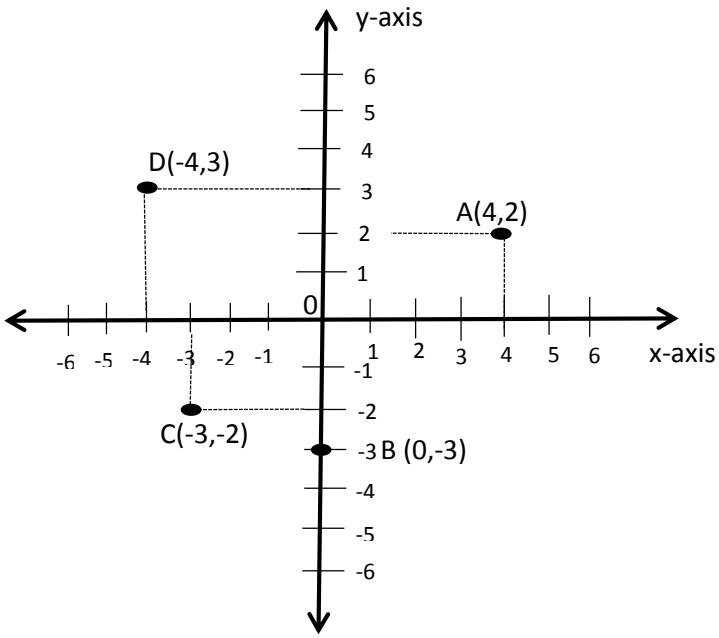


11. Draw pupils' attention to point D; note that it is on the y-axis because the x-value is zero.
12. **Say:** Remember, if the x-value is zero, the point is on the y-axis. If the y-value is zero, the point is on the x-axis.



Guided Practice *(7 minutes)*

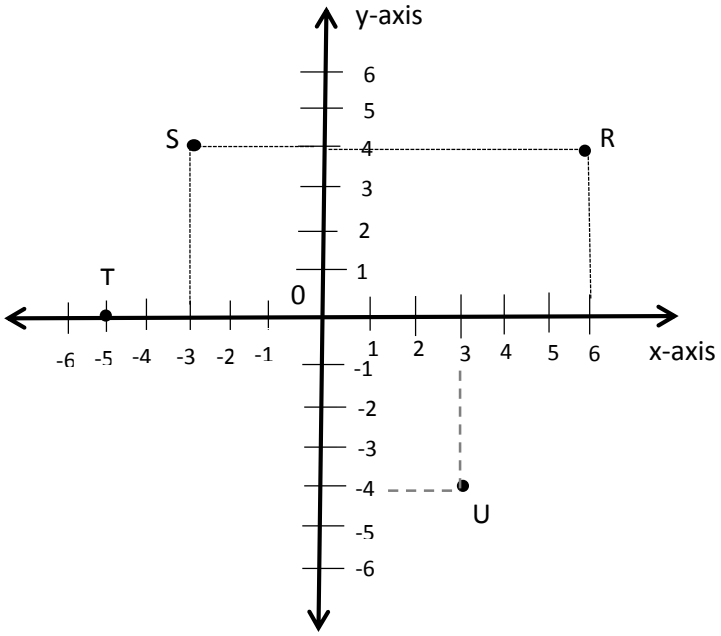
1. Draw a new Cartesian plane on the board.
2. Write the following points on the board:
   A (4, 2)
   B (0, -3)
   C (-3, -2)
   D (-4, 3)
3. Ask pupils to copy the Cartesian plane in their exercise books.
4. Ask pupils to work in pairs to plot the points on the board in the Cartesian plane in their exercise books.
5. Move around the classroom to make sure pupils understand and are doing the task. Help struggling pupils.
6. Invite four pairs to each come plot one of the points on the coordinate plane on the board. Make corrections if necessary.
7. Ask pupils to compare their answers with the answers on the board (see diagram to the right).



Independent Practice *(10 minutes)*

1. Write the following instructions on the board:
   a) Draw the coordinate plane below with axes from -6 to 6.
   b) Draw the following points on the coordinate plane: R (6, 4), S (-3, 4), T (-5, 0), U (3, -4)

2. Ask pupils to work individually. Tell them to draw the Cartesian plane in their exercise books and plot the points on the plane.
3. Move around the classroom to make sure pupils understand and are doing the task. Make sure they know how to plot the points.
4. Draw the Cartesian plane on the board and invite four pupils to come to the front and plot the points on the board. Make corrections if necessary.
5. Have pupils check their answers with the answers on the board. (Answers: see below)



Closing *(2 minutes)*

1. Ask pupils the following questions to revise the material:
   a) What are coordinates?
   b) What is a Cartesian plane?
   c) What is the point called where the x and y axes intersect?
2. Discuss the answers as a class. (Answers: a) An ordered pair, points along the x and y-axes or sometimes called x values and y values; b) A flat surface or area or space where we can use coordinates to draw shapes, lines, etc.; c) The point of origin, 0)
3. **Say:** In our next lesson, we will use what we learned about plotting points to graph lines on the plane.

Lesson Title: Table of Values	**Theme:** Algebra	
Lesson Number: M-08-134	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to create a table of values and plot each point on the coordinate plane.	**Teaching Aids** None	**Preparation** None

Opening *(2 minutes)*

1. **Ask:** What did we learn in the last lesson? Have pupils raise their hand to answer. (Answer: How to plot points on the coordinate plane.)
2. **Say:** Remember that the x and y on the coordinate plane are the same x and y that we see in linear equations. I told you that we could graph linear equations on the Cartesian plane. Today we will create a table of values and plot each point on the coordinate plane and in the next lesson we will graph a line.

Introduction to the New Material *(11 minutes)*

1. **Say:** Today, we will learn how to make a table of values.
2. **Say:** We can write a table of values from a linear equation.
3. Write on the board: $y = x + 1$
4. **Say:** Let's start with this linear equation. The solutions to this equation are also points on the line. The solutions can be written as ordered pairs.
5. **Say:** We can make a table of values to show the solutions to this equation.
6. Write on the board:

x	y
0	
1	
2	
3	

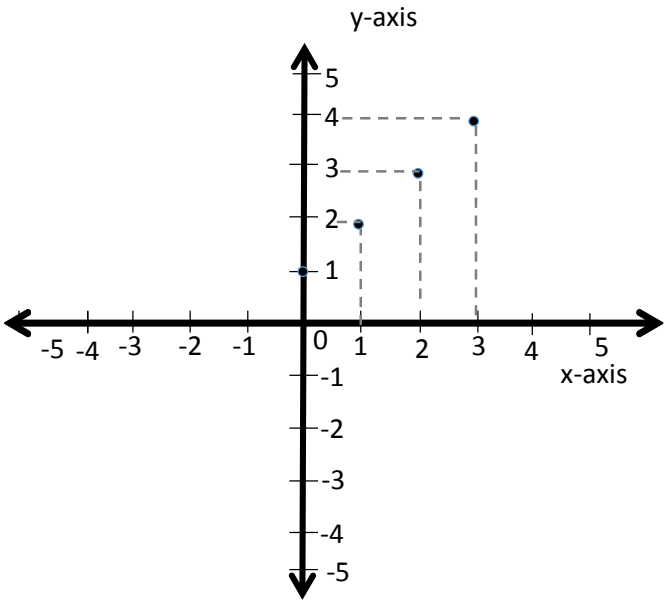
7. **Say:** These are some values of x. Now to find the value of y for each of these values of x, we use our equation, $y = x + 1$.
8. **Say:** We can substitute each of these values for x into the equation y = x+1 to find the value of y.
9. Substitute each value of x on the board, and find each value of y. (Answers: see below)

$x = 0: y = (0) + 1 = 1$
$x = 1: y = (1) + 1 = 2$
$x = 2: y = (2) + 1 = 3$
$x = 3: y = (3) + 1 = 4$

10. Write each y-value in the table (see table at right).
11. **Say:** We can write each row in this table of values as an ordered pair. The rows tell us the points we will plot.
12. Write the ordered pair for each row (see table at right).

x	y	(x, y)
0	1	(0, 1)
1	2	(1, 2)
2	3	(2, 3)
3	4	(3, 4)

13. Now plot these points on the coordinate plane (see answer below).



Guided Practice *(10 minutes)*

1. Divide the class into pairs.
2. Write the following instructions on the board:
   a) Draw the coordinate plane.
   b) Complete the table of values for the equation: $y = x - 1$ →
   c) Determine the coordinates of your points.
   d) Plot the points on the coordinate plane.
3. **Say:** Now work with your partner to do the task.
4. Move around the classroom to make sure the pupils understand how to fill the table and plot the points. Help struggling pupils.
5. Invite different pairs to come to the board to fill the table and plot the points. If they are having a difficult time with the substitution, write the substitution of each x-value into the linear equation too. Make corrections if necessary. (Answers: see image to the right and table of values below)

x	y
0	
1	
2	
3	

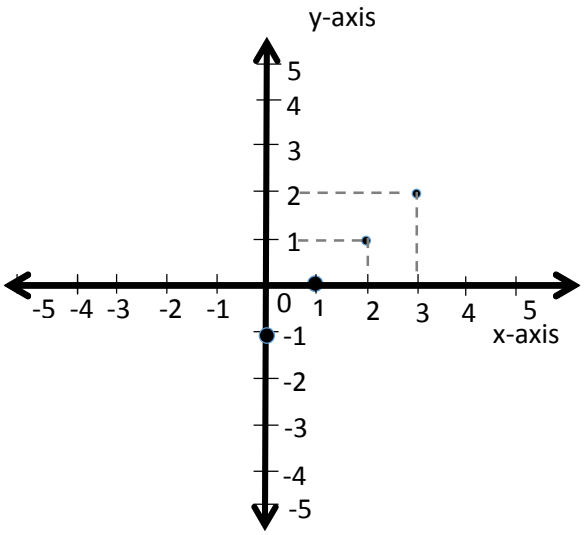


Table of values:

x	y	(x, y)
0	-1	(0, -1)
1	0	(1,0)
2	1	(2,1)
3	2	(3,2)

Independent Practice *(10 minutes)*

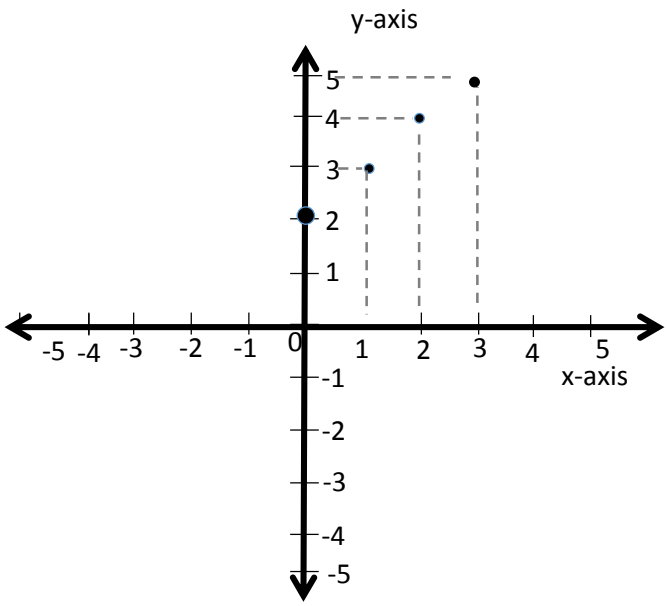
1. Write the following instructions on the board:
   a) Draw the coordinate plane.
   b) Complete the table of values for the equation: $y = x + 2$ →
   c) Determine the coordinates of your points.
   d) Plot these points on the coordinate plane.

x	y
0	
1	
2	
3	

2. Ask pupils to work individually to do the task.
3. Move around the classroom to make sure the pupils understand how to fill the table and plot the points. Help struggling pupils.
4. Invite pupils to fill the table and plot the points on the board. If they are having a difficult time with the substitution, write the substitution of each x-value into the linear equation too. Make corrections if necessary. (Answers: see below)

   Table of values:

X	y	(x, y)
0	2	(0,2)
1	3	(1,3)
2	4	(2,4)
3	5	(3,5)



Closing *(2 minutes)*

1. **Ask:** What did we learn today? (Answer: How to plot points on a coordinate plane using a table of values)
2. **Ask:** What is important to remember when filling a table of values? (Example answers: Substitute x correctly and solve for each y; each row corresponds to an ordered pair that we can plot)
3. **Ask:** What is important to remember when plotting points? (Example answers: Do not mix up the x- and y-value; remember to move horizontally for x and vertically for y)

Lesson Title: Graphing a Line	**Theme:** Algebra	
Lesson Number: M-08-135	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to plot points and connect them to graph a straight line.	**Teaching Aids** None	**Preparation** None

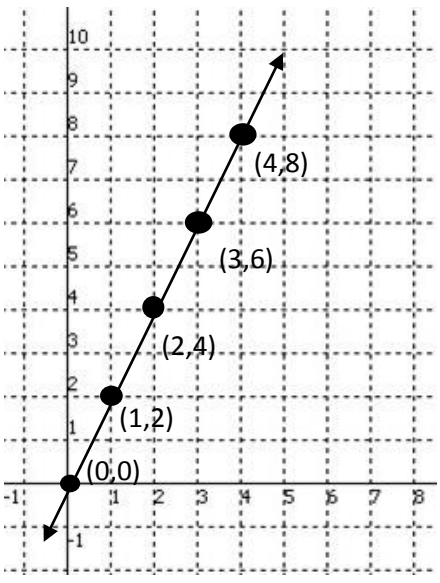
Opening *(2 minutes)*

1. **Ask:** What is a table of values used for? Have pupils raise their hand to answer. (Answer: It is used to find ordered pairs that we can plot on the Cartesian plane.)
2. **Ask:** What does an ordered pair look like? (Answer: It has two values in brackets; the first one is the x-value and the second one is the y-value.)
3. **Say:** Today, we will learn to graph lines using a table of values.
4. **Say:** You already know everything you need to know to graph a line. Today we will simply connect the points and practise.

Introduction to the New Material *(11 minutes)*

1. **Say:** When graphed on the coordinate plane, the linear algebra equations we have been working with graph a straight line.
2. Write on the board: Graph $y = 2x$
3. **Say:** Let's start by making a table of values, like we did in previous lessons.
4. Write the table with only the x-values (see table to the right).
5. Find and write each corresponding y-value in the table. Involve pupils as much as possible.
   Example: $y = 2(0) = 0; y = 2(1) = 2; y = 2(2) = 4$
6. Ask pupils to come write the ordered pair next to each row in the table of values. (Answers: see table to the right)
7. **Say:** Now we plot our points on the Cartesian plane.
8. Draw a Cartesian plane on the board. (It is not necessary to draw each grid line, but make sure the lines on the x- and y-axis are all the same distance apart so your graph will be clear.)
9. Invite five different pupils to each plot one of the points on the Cartesian plane. Make corrections if necessary.
10. **Say:** We add a line connecting the points to graph our line.
11. Use the straight edge of anything (for example, an exercise book or ruler) to draw the straight line connecting the points. (Answer: see graph to the right)
12. **Say:** We have graphed a line!

x	y	(x,y)
0	0	(0,0)
1	2	(1,2)
2	4	(2,4)
3	6	(3,6)
4	8	(4,8)



Guided Practice *(10 minutes)*

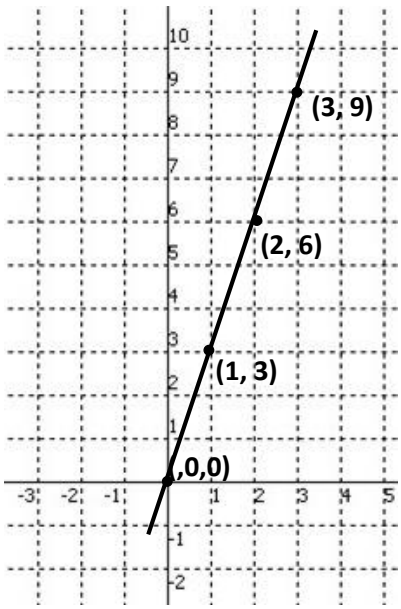
1. Write the following instructions on the board:
   a) Draw the coordinate plane.
   b) Fill the table of values for the equation: $y = 3x$ →
   c) Determine the coordinates of your points.
   d) Plot these points on the coordinate plane.
   e) Draw a line through these points.

x	y
0	
1	
2	
3	

2. Divide the class into pairs to do the task.
3. Move around the classroom to make sure pupils understand how to calculate and plot the points. Help struggling pupils.
4. Draw the empty coordinate plane on the board. Invite four different pairs to come to the board. Each pair is responsible for a point. Ask the pairs to show their calculation, write the y-value in the table, and then draw the point on the coordinate plane. Make corrections if necessary. (Answers: see below)
   Table of values:

x	y
0	0
1	3
2	6
3	9

Calculation:	(x, y)
$y = 3(0) = 0$	(0. 3)
$y = 3(1) = 3$	(1,3)
$y = 3(2) = 6$	(2,6)
$y = 3(3) = 9$	(3,9)



Independent Practice *(10 minutes)*

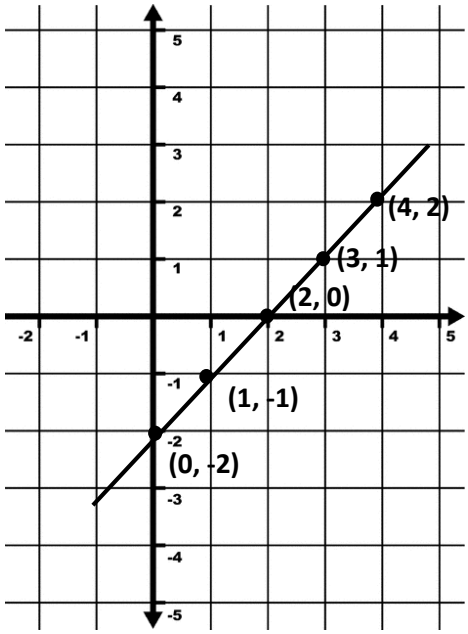
1. Write the following instructions on the board:
   a) Draw the coordinate plane.
   b) Fill the table of values for the equation: $y = x - 2$ →
   c) Determine the coordinates of your points.
   d) Plot these points on the coordinate plane.
   e) Draw a line through these points.

x	y
0	
1	
2	
3	
4	

2. Ask pupils to work individually to do the task.
3. Move around the classroom to make sure pupils understand how to calculate and plot the points. Help struggling pupils.
4. Invite five different pupils to come to the board. Each pupil is responsible for a point. Ask the pupils to show their calculation, write the y-value in the table, and draw the point on the coordinate plane. Make corrections if necessary. (Answers: see below)

x	Y
0	-2
1	-1
2	0
3	1
4	2

Calculation	(x, y)
$y = (0) - 2 = -2$	(0,-2)
$y = (1) - 2 = -1$	(1,-1)
$y = (2) - 2 = 0$	(2,0)
$y = (3) - 2 = 1$	(3,1)
$y = (4) - 2 = 2$	(4,2)



Closing *(2 minutes)*

1. **Ask:** What did we learn today? (Answer: How to plot points on a coordinate plane using a table of values, and draw a line through the points)
2. **Ask:** What is important to remember when graphing a line? (Example answers: draw the Cartesian plane accurately; make all the values/marks the same distance apart; fill the table of values)

Lesson Title: Data Collection	**Theme:** Statistics and Probability	
Lesson Number: M-08-136	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to collect data from class members and display it in lists and pictograms.	**Teaching Aids** None	**Preparation** None

Opening *(3 minutes)*

1. Write the following question on the board:
   What is your favorite fruit, out of bananas, oranges, or pineapples?
2. Ask pupils to vote by raising their hand, if possible select one or two pupils to take charge of the counting.
3. Write the totals on the board. (Example answers: Banana: 8; Oranges: 10; Pineapple: 6)
4. **Say:** Today we will learn how to collect and display data such as this in lists and pictograms.

Introduction to the New Material *(12 minutes)*

1. **Say:** Data is any numerical fact, information, or measurement of something.
2. Draw tally marks next to the totals on the board. Use the totals from your class. (Example: see below)

   Banana - 𝍸 𝍸 /// (8)

   Pineapple - 𝍸 𝍸 𝍸 𝍸 / (6)

   Orange - 𝍸 𝍸 (10)
3. **Ask:** What do the tally marks represent? Have pupils raise their hand to answer. (Answer: The strokes represent the number of people who like each fruit best; they are grouped in fives.)
4. **Say:** Symbols or pictures can also be used to represent a certain number of items, when we show data with pictures or symbols it is called a pictogram.
5. Draw the following pictures on the board:

 For 2 pupils

 For 2 pupils

 For 2 pupils

6. **Say:** We will use these pictures to make a pictogram. Each piece of fruit represents two pupils.
7. Draw the row of bananas. Use the totals from your class. (Example: see below)
8. Ask pupils to draw the other rows for pineapples and oranges in their exercise books.
9. Invite two pupils to come to the board and complete the rows. (Example: see below)
10. Make any corrections necessary and give assistance as needed.

Guided Practice *(8 minutes)*

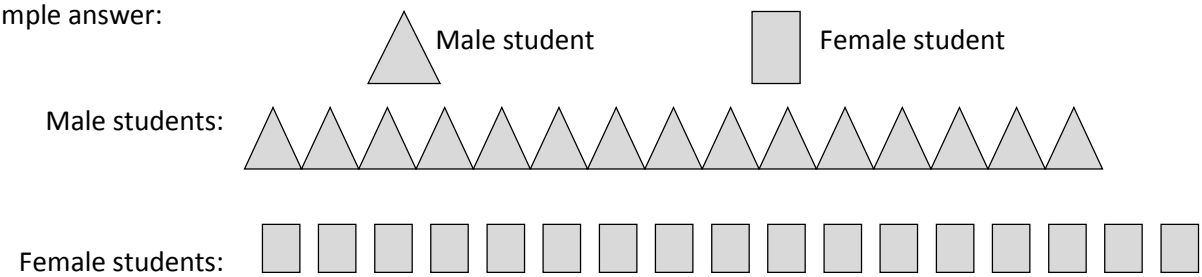
1. Write the following problem on the board:

Momo wanted to survey people on what football team they support. He found that 14 people supported Barcelona, 10 people said Chelsea was their favorite, and 2 people were Manchester United supporters.

2. Ask pupils to work with in pairs.
3. **Say:** Display the information in a pictogram. Use one picture to represent one person.
4. Draw a picture to represent one person on the board: 
5. Move around the classroom to make sure pupils understand and are doing the task. Help pupils to use pictures to represent the people surveyed.
6. Invite three pupils to come to the board and display the information in a pictogram. Make corrections if necessary. (Answer: see below)

Independent Practice *(10 minutes)*

1. Write the following problem on the board:
   There are 150 male students and 170 female students enrolled in a school. Display the information in a pictogram. Select any symbol you choose.
2. Ask pupils to work individually and show their work in their exercise books.
3. **Say:** Remember symbols can equal more than one piece of data. Since the numbers are so large, you should make each symbol represent 10 students.
4. Move around the classroom to make sure pupils understand and are doing the task. Help pupils to use one symbol to represent 10 students.
5. Invite two pupils to come to the board and display the information in a pictogram. Make corrections and explain answers if necessary. Ask pupils to check their answers.
   Example answer:



Closing *(2 minutes)*

1. Ask pupils the following questions to revise the material:
   a) What is data?
   b) What is a pictogram?
2. Discuss the answers as a class. (Answers: a) Data is any numerical fact or information that can be measured or given a numerical qualification; b) Symbols or pictures used to represent a certain number of items)

Lesson Title: Tables of Data	**Theme:** Statistics and Probability	
Lesson Number: M-08-137	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to organise and display collected data in a table.	**Teaching Aids** None	**Preparation** None

Opening *(3 minutes)*

1. Ask pupils the following questions:
   a) How many Science teachers are in your school? (Example answer: 4)
   b) How many Maths teachers are in your school? (Example answer: 6)
   c) How many English teachers are in your school? (Example answer: 4)
   d) How many Social Studies teachers are in your school? (Example answer: 5)
2. Have pupils raise their hands to answer the questions. Then write the totals on the board.
3. **Say:** Now we have all this information about our school, which we will use later in the lesson.
4. **Say:** Today, we will learn how to organise and display collected data such as this in a table.

Introduction to the New Material *(15 minutes)*

1. Draw an empty table on the board (see below).
2. **Say:** A table is a way to organise data in rows and columns. We will make a table showing our birth months.

Number of Pupils Born Per Month

Months	Tally Marks	Number of Pupils
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		
Total		

3. **Say:** First we will make a tally mark for each pupil to show his or her month.
4. **Say:** All those who were born in January, raise your hands.

5. Count the number of pupils who raise their hands and put tally marks in the middle column. (Example: see below)

Months	Tally Marks	Number of Pupils
January	𝍸 /	

6. Do the same for the other 11 months.
7. Ask pupils to count the number of tally marks for each month. If time permits, have pupils come to the board to count the tally marks and fill in the numbers. If not, write the totals yourself. (Example: see below)

Months	Tally Marks	Number of Pupils
January	𝍸 /	6

8. After the table has been filled, show pupils how the numbers in each column together equal the total number of pupils in the class.

Guided Practice *(7 minutes)*

1. Draw the empty table on the board (see table below).

The Number of Teachers Per Subject

Subject	Number of Teachers
Maths	
Science	
English	
Social Studies	
Total	

2. **Say:** We can put the information we know about our school that we discussed earlier into a table.
3. Ask pupils to work in pairs to complete the table using the information about your school.
4. Move around the classroom to make sure pupils understand and are doing the task. Help struggling pupils.
5. Invite different pairs to tell you the number of teachers per subject. Write the correct answers in the table.
6. Ask pupils to check their answers with the completed table on the board.

Independent Practice *(8 minutes)*

1. Write the following problem on the board:
   20 pupils took a 100-point science test. The scores were: 90, 90, 100, 70, 60, 80, 70, 70, 60, 80, 90, 80, 60, 80, 90, 70, 100, 90, 90, and 80. Organise the data into a table.
2. Ask pupils to create the table individually.
3. Move around the classroom to make sure pupils understand and are doing the task. For example, they may need help deciding what columns to use: ‘scores’ and ‘number of pupils’.
4. **Ask:** Who can come to the board and present the information in a table?
5. Invite one volunteer to draw the table on the board. Make corrections if necessary.
6. Ask pupils to compare their table with the table on the board. (Answer: see table below)

Pupils' Scores on Science Test

Scores	Number of Pupils
60	3
70	4
80	5
90	6
100	2
Total	**15**

Closing *(2 minutes)*

1. Ask the following questions to revise the material:
   a) What is the statistical term for a chart using symbols or pictures used to represent a certain number of items?
   b) What is the definition of data?
2. Discuss the answers as a class. (Answers: a) pictogram; b) Any list of information or facts gathered for statistical purposes)

Lesson Title: Bar Charts	**Theme:** Statistics and Probability	
Lesson Number: M-08-138	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to display collected data in a bar chart.	**Teaching Aids** None	**Preparation** None

Opening *(2 minutes)*

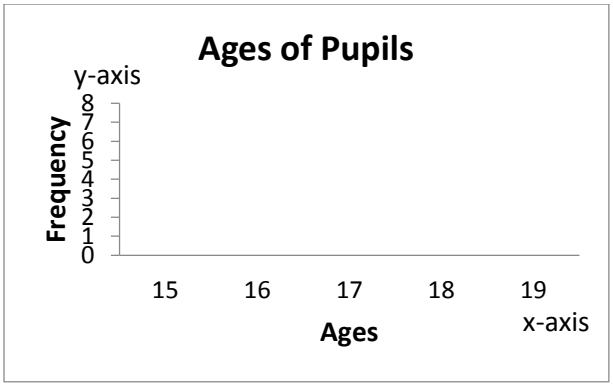
1. Ask pupils to define the following words: data, table
2. Discuss the definitions as a class. (Answers: Data is any numerical fact, information, or measurement of something; A table is a way to organise data in rows and columns.)
3. **Say:** Today, we will learn how to display collected data in a bar chart.

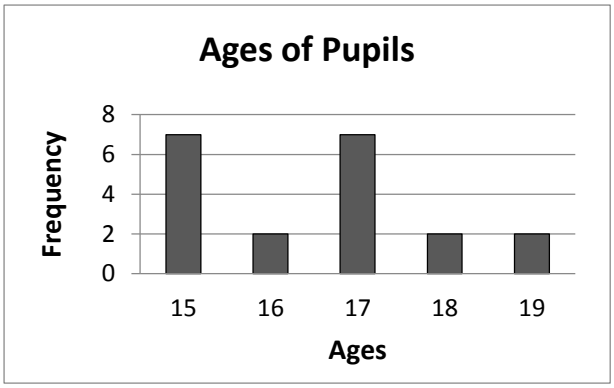
Introduction to the New Material *(11 minutes)*

1. Write the following information on the board:
   20 people have the following ages: 15, 15, 15, 17, 19, 15, 17, 18, 18, 16, 17, 15, 15, 17, 17, 17, 15, 16, 19, and 17.
2. Invite a volunteer to come to the board and write all of the ages in numerical order. Tell the pupil to be sure to repeat them the correct number of times. (Answer: 15, 15, 15, 15, 15, 15, 15, 16, 16, 17, 17, 17, 17, 17, 17, 17, 18, 18, 19, 19)
3. **Say:** The ages are in a list even though most of them appear more than once.
4. **Say:** We can put the result in a table. Another term for this type of table is 'frequency table.' Frequency means the number of times something happens. In this case, it means the number of times a grade appears.
5. Draw the empty table on the board (see table on the right).
6. Invite different pupils to count the number of repetitions of each age and write the total number for each in the frequency table. (Answer: see second table to the right)
7. **Say:** The number in the table is what we call frequency. We are now going to put the frequency table into a bar chart.
8. **Say:** A bar chart has rectangular bars of equal width. The height of the bars is equal to the number of items beings represented.
9. Draw the empty bar chart on the board. Label and show pupils the x-axis, y-axis, title, and labels. (See bar chart below on the left)

Age	Total
15	
16	
17	
18	
19	
Total	

Age	Total
15	7
16	2
17	7
18	2
19	2
Total	20



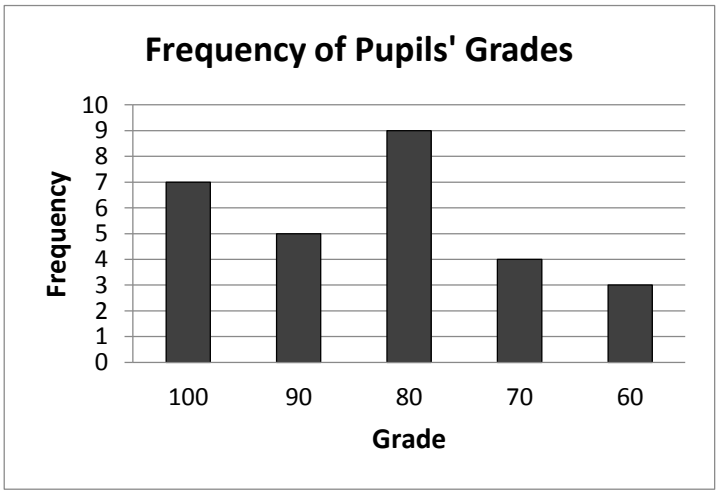


10. **Say:** Now we will draw a bar to show the number of pupils who are each age. Notice that the bars are separated by equal gaps.
11. Draw the bar chart for pupils. (See bar chart above on the right.)

Guided Practice *(10 minutes)*

1. Write the following information on the board:
   At a recent exam, pupils' scores were as follows: 100, 100, 100, 90, 80, 80, 90, 70, 60, 100, 90, 90, 100, 100, 70, 70, 100, 90, 80, 80, 80, 80, 80, 80, 80, 60, 70 and 60.
2. Ask pupils to work in pairs.
3. **Say:** With your partner, organise the results and then display the scores in a frequency table. Once you have completed the frequency table, draw a bar chart showing the scores.
4. Move around the classroom to make sure pupils understand and are doing the task. Help struggling pupils. For example, help to draw the empty frequency table and bar chart if needed.
5. Invite different pairs to help you complete the frequency table. Write the correct answers in the table on the board.
6. Ask pupils to check their answers with the completed table on the board.
7. Invite different pairs to come to the front to fill in the frequency of grades in the bar chart. Make corrections if necessary.
8. Ask pupils to check their answers with the completed bar chart on the board.
   (Answers: see below)

Grade	Frequency
100	7
90	5
80	9
70	4
60	3



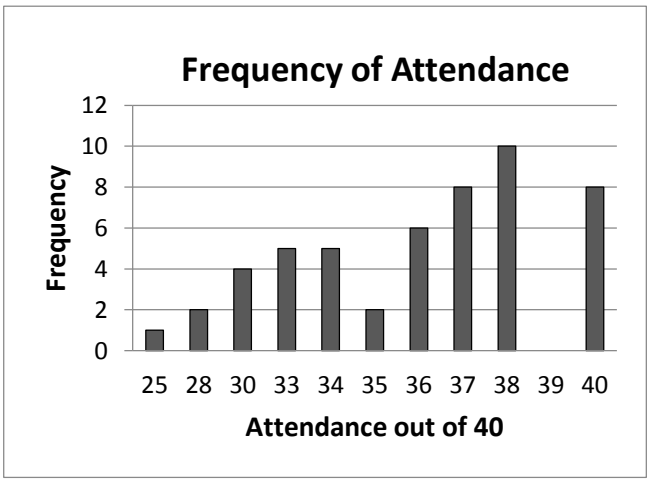
Independent Practice *(10 minutes)*

1. Write the following information on the board:
   The following are the attendance rates of a class of 40 people over 50 days: 40, 40, 40, 40, 40, 40, 40, 40, 38, 38, 38, 38, 38, 38, 38, 38, 38, 38, 37, 37, 37, 37, 37, 37, 37, 37, 36, 36, 36, 36, 36, 36, 35, 35, 34, 34, 34, 34, 34, 33, 33, 33, 33, 30, 30, 30, 30, 28, 25.

Attendance Rate	Frequency
25	
28	
30	
33	
34	
35	
36	
37	
38	
39	
40	
Total	**50**

Attendance Rate	Frequency
25	1
28	2
30	4
33	4
34	5
35	2
36	6
37	8
38	10
39	0
40	8
Total	**50**

2. Draw the empty table (see above left) on the board.
3. Ask pupils to copy the empty table into their exercise books.
4. Ask pupils to work individually to complete the table and draw a bar chart showing the frequency of class attendance out of 40.
5. Move around the classroom to make sure pupils understand and are doing the task. Help struggling pupils.
6. Invite different pupils to stand and read out the values for the frequency table. (Answers: see frequency table above right)
7. Invite other pupils to come to the front and fill the bar chart with the frequency of attendance. Make corrections if necessary. (Answers: see below)



Closing *(2 minutes)*

1. Ask the following questions to revise the material:
   a) What is the meaning of frequency?
   b) What is a bar chart?
   c) What are the parts of a bar chart?
2. Discuss the answers as a class. (Answers: a) The number of times an item or something appears or happens); b) A chart with rectangular bars of equal width that holds statistical information; c) x-axis, y-axis, title, labels and bars)

Lesson Title: Line Graphs	**Theme:** Statistics and Probability	
Lesson Number: M-08-139	**Class/Level:** JSS 2	**Time:** 35 minutes

 **Learning Outcomes** By the end of the lesson, pupils will be able to display collected data in a line graph.	 **Teaching Aids** None	 **Preparation** None

Opening *(3 minutes)*

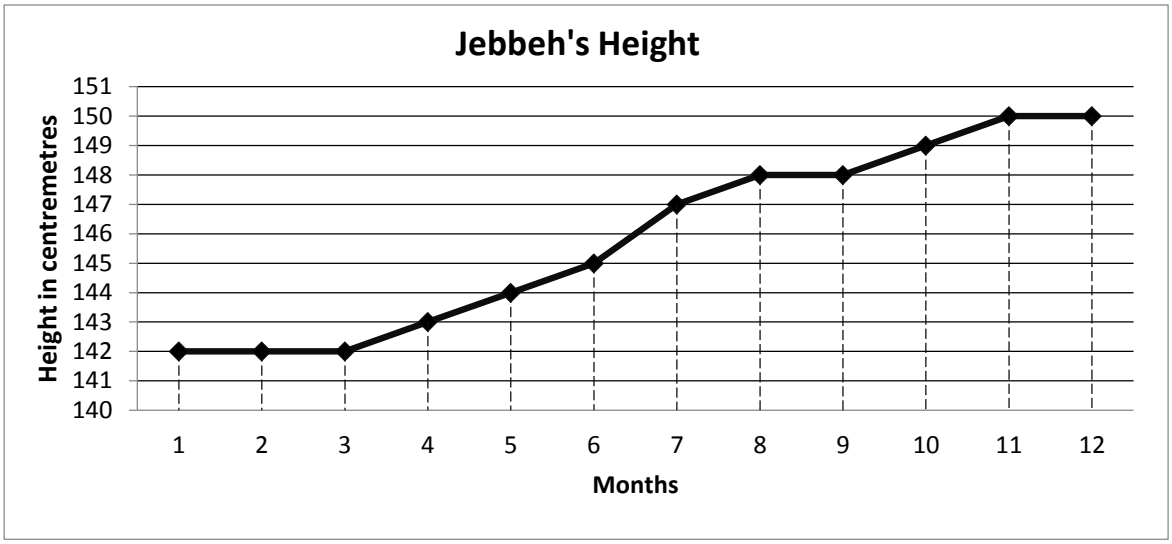
1. **Ask:** What is a graph? Have pupils raise their hand to answer. (Example answer: A graph is a picture that shows information.)
2. Discuss the different types of graphs as a class. (Example answers: Bar graph, line graph, circle graph)
3. **Say:** A graph can make information easy to understand without using words.
4. **Say:** Today, we are going to learn how to display collected data in a line graph.

Introduction to the New Material *(12 minutes)*

1. **Say:** To draw a line graph, you need a collection of data that has changed over time.
2. **Say:** A line graph is a graph that uses points connected by a line to show how something changes in value as time goes.
3. Write the following information on the board:
   Jebbeh began measuring her height in centimetres every month at age 11 to know how much she is growing. Here is the data she collected for the year:

Months	1	2	3	4	5	6	7	8	9	10	11	12
Height in cm.	142	142	142	143	144	145	147	148	148	149	150	150

4. **Say:** Together, we are going to display this data in a line graph.
5. **Say:** Like other graphs, line graphs need two axes, one vertical (y-axis) and one horizontal (x-axis).
6. Invite a volunteer to come to the board and draw the lines for the x- and y-axes.
7. **Ask:** Which values should we put on the x-axis? (Answer: Months)
8. **Ask:** Which values should be on the y-axis? (Answer: Height in centimetres)
9. **Say:** The vertical axis represents the range of height in cm. Jebbeh's lowest height was 142 cm, and her highest height was 150 cm. We will make our y-axis range from 140 to 151 cm to cover all of her data.
10. Remind pupils that they do not need to start the y-axis at 0. They can start it at any convenient number, as long as the number they start from is less than the lowest y-axis value to be plotted.
11. **Say:** The horizontal axis represents the months when height in cm was calculated.
12. Have pupils help you plot the graph on the board (see graph below).

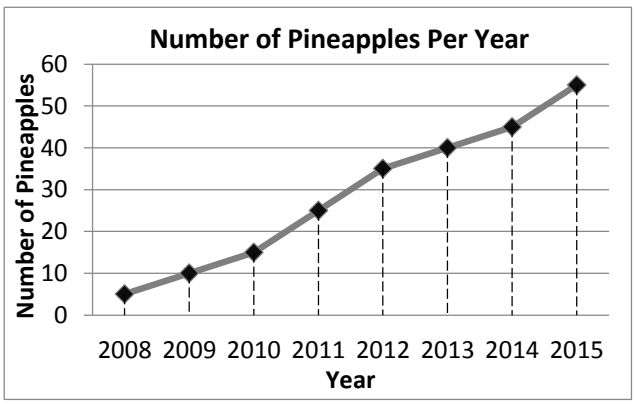


Guided Practice *(8 minutes)*

1. Write the following problem on the board:
   Momo grows pineapples. Every year he plants more pineapples. The table shows how many pineapples Momo grew each year for eight years. Display the data in a line graph.

Year	2008	2009	2010	2011	2012	2013	2014	2015
Number of pineapples	5	10	15	25	35	40	45	55

2. Ask pupils to work in pairs to display the data on a line graph.
3. Move around the classroom to make sure pupils understand and are doing the task. If pupils find it difficult, the x- and y-axes on the board and help them find a good scale. Tell them they can count by tens on the y-axis.
4. Invite different pairs to come to the board. Give each pair a different task to do until the graph is complete. For example: Draw the x- and y-axes, label the axes, plot the points, and draw the line (see graph to the right). Make corrections if necessary.



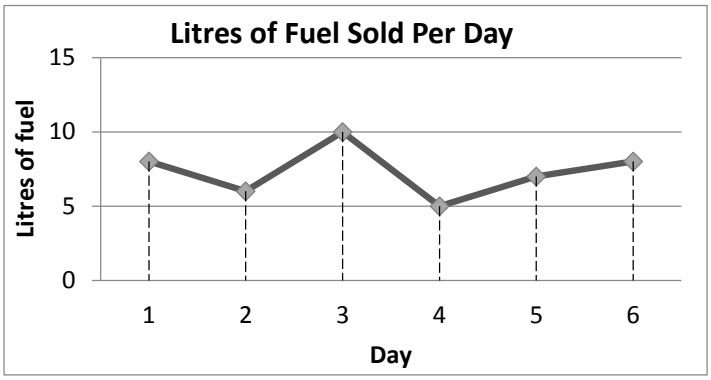
5. Ask pupils to check their answers with the line graph on the board.

Independent Practice *(10 minutes)*

1. Write the following problem on the board:
   The table below shows the litres of fuel Samuel sold each day for 6 days. Display the data in a line graph counting by 2's from 0 to 12 on the y-axis.

Litres of Gasoline Sold Per Day						
Day	1	2	3	4	5	6
Litres of fuel	8	6	10	5	7	8

2. Ask pupils to work individually to display the data on a line graph.
3. Move around the classroom to make sure pupils understand and are doing the task. If pupils are struggling, help them to begin their line graph.
4. After pupils have finished, ask them to share and compare their line graph with a partner.
5. Invite a volunteer to come to the board to draw the axes and scale. Invite another volunteer to come to the board to plot and draw the line. Make corrections if necessary. (Answer: see below)



Closing *(2 minutes)*

1. Ask pupils the following questions to revise the material:
   a) What is a graph?
   b) What is a line graph?
   c) What is the difference between a line graph and a bar graph?
2. Discuss the answers as a class. (Answers: a) A picture that shows information; b) A graph that uses points connected to lines to show how something changes over time; c) Bar graphs show bars to measure and compare amounts; line graphs use lines to show how something changes over time)

Lesson Title: Interpreting Charts and Graphs	**Theme:** Statistics and Probability	
Lesson Number: M-08-140	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to: 1. Make comparisons using pictograms, bar charts and line graphs. 2. Draw conclusions from charts and graphs.	**Teaching Aids** None	**Preparation** None

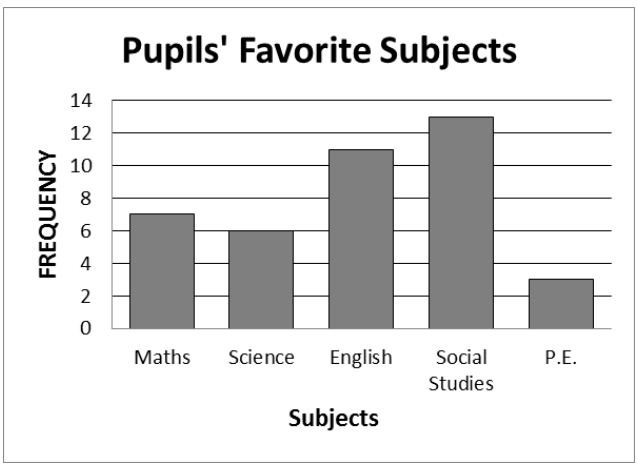
Opening *(3 minutes)*

1. Ask pupils to name and describe in their own words the types of graphs or charts in statistics that they have studied so far. (Example answers: a) Pictograms: Use pictures or symbols to represent data; b) Bar charts: Charts with rectangular bars of equal width, with equal space between the bars, and with the heights equal to the number of items being represented; c) Line graphs: Graphs that use points connected by a line to show how something changes in value as time goes on.)
2. **Say:** Today, we are making comparisons using pictograms, bar charts and line graphs. Then we will draw conclusions from the charts and graphs.

Introduction to the New Material *(12 minutes)*

1. Draw a table showing pupils' favorite subjects in school (see table to the right).
2. Ask pupils to read the frequencies aloud. (Answer: Maths 7, Science 6, English 11, Social Studies 13, P.E. 3)
3. Invite different pupils to come to the board and represent the data in a bar chart counting by 2s on the y-axis. For example: ask one pupil to draw the axes and title, and five pupils to come draw each of the five bars. Make corrections where necessary. (Answer: see bar graph to the right)
4. Ask the following questions to check for pupils' understanding of the bar chart:
   a) Which subject do the most pupils prefer? (Social Studies has the highest bar, 13)
   b) Which subject is the least popular? (P.E., 3)
   c) True or false, more than two times the number of pupils prefer Social Studies than Science? (True, 13 is more than two times 6.)
   d) True or false, more pupils prefer Maths to English? (False, 7 pupils prefer Maths and 11 prefer English)
   e) How many pupils were asked their favourite class? (Answer: 40)

Subject	Maths	Science	English	Social Studies	P.E.
Frequency	7	6	11	13	3

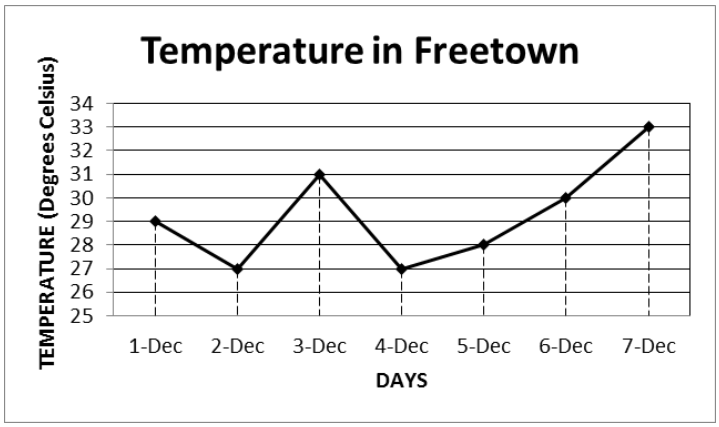


Guided Practice *(8 minutes)*

1. Write the following information on the board:
   The frequency table shows the temperature in Freetown over seven days.

Day	1	2	3	4	5	6	7
Temperature (degrees Celsius)	29	27	31	27	28	30	33

2. Draw the frequency table on the board (see table above).
3. Ask pupils to work in pairs to draw a line graph showing the temperature over the week of 1 December – 7 December.
4. Remind pupils they do not need to start the y-axis at 0.
5. Move around the classroom to make sure pupils understand and are doing the task. Assist pupils in writing the scale and axis, if needed.
6. Invite one pair to come to the board and present their line graph. Make corrections where necessary.
   (Answer: see line graph to the right)



7. Ask the follow questions to check for pupils' understanding of the line graph:
   a) What is being measured? (Answer: Daily temperature from 1st to 7th December)
   b) What is on the y-axis? (Answer: Temperature in Celsius)
   c) Which day was the warmest? (Answer: 7th December)
   d) What was the lowest temperature recorded? (Answer: 27 degrees Celsius)
   e) Which two days had the largest change in temperature between them? (Answer: 2-3 December and 3-4 December were both 4 degrees different)
   f) Did any days have the same temperature? (Answer: 2 December and 4 December were both 27 degrees Celsius)

Independent Practice *(10 minutes)*

1. **Say:** You will work independently to answer questions based on the pictograms, bar graphs and line graphs you made over the past four lessons.
2. Write the following questions on the board referencing the different graphs studied. Note: the graphs should be in pupils' exercise books. Draw the graphs on the board again if needed.
   Pictogram:

Favorite Football Teams

Barcelona:

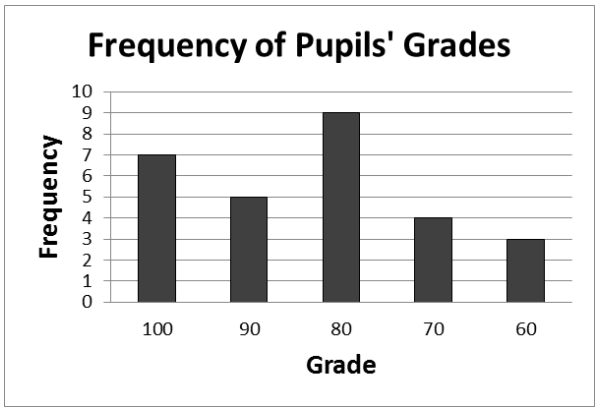
Chelsea:

Manchester United:

a) What football team was the most popular? (Answer: Barcelona)
b) True or false, the total of people who prefer Chelsea and Manchester United combined is more than the people who love Barcelona? (Answer: False, 10 people plus 2 people is only 12. 14 people support Barcelona.)

Bar Chart:

a) What is being measured? (Answer: The frequency of pupil's grades)
b) Which grade was the most common? (Answer: 80)
c) How many pupils scored either 100 or 90? (Answer: 12 in total)
d) True or false, more pupils received 90 than 70? (Answer: True, 5 is more than 4)
e) How many more pupils received 80 than 70? (Answer: 9 – 4 = 5)



3. After pupils have finished, ask them to work in pairs to share and compare their answers.
4. Read all of the questions aloud. Have pupils raise their hand to answer. Discuss the answers as a class.

Closing *(2 minutes)*

1. Ask pupils the following questions to revise the material:
   a) What is one thing you understand about pictograms, bar charts, or line graphs?
   b) What is one thing you still want to learn about pictograms, bar charts, or line graphs?
2. Discuss the answers as a class. (Example answers: a) The definitions of the types of charts, frequency, the parts such as x- and y-axes, title, and scale. b) When to use which kind of graph, etc.)

Lesson Title: Mean	**Theme:** Statistics and Probability	
Lesson Number: M-08-141	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes	**Teaching Aids**	**Preparation**
By the end of the lesson, pupils will be able to: 1. Calculate the mean of a set of data from a list, chart, or graph. 2. Interpret mean.	None	None

Opening *(3 minutes)*

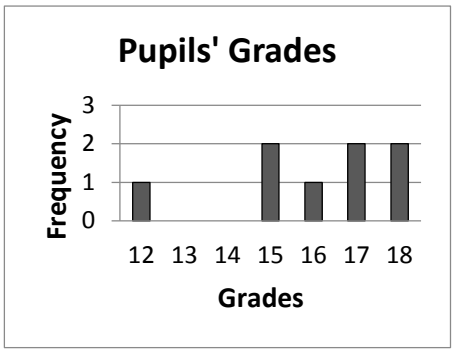
1. **Ask:** What does the term data mean? (Example answer: Data are any numerical facts, information, or measurement of something.)
2. **Ask:** What does the term frequency mean? (Example answer: The number of times something happens.)
3. **Say:** Today, we will calculate the mean of a set of data from a list, chart, or graph, and interpret what it means.

Introduction to the New Material *(8 minutes)*

1. Write: There are 5 pupils with ages 15, 14, 16, 15, and 15. What is the mean of their ages?
2. **Say:** The *mean* is a number that can tell us where the middle of the data is. It is also commonly known as 'average'.
3. **Say:** To find the mean of a set of data, add the numbers together and divide the total by the number of items. The quotient is the mean.
4. Write: $15 + 14 + 16 + 15 + 15 =$.
5. **Say:** When I add the numbers together, the answer is 75.
6. Finish the equation: $15 + 14 + 16 + 15 + 15 = 75$
7. **Say:** Now we will divide the sum, 75, by the number of items, 5.
8. Write: $75 \div 5 \ =$
9. **Say:** When we divide 75 by 5, our answer is 15.
10. Finish the equation: $75 \div 5 = 15$
11. **Say:** 15 years is the mean age of the 5 pupils. This is the average age of the pupils, and one way to find the approximate middle of their ages.

Guided Practice *(12 minutes)*

1. Draw the following bar chart and frequency chart and write the following question on the board: 8 pupils received the following marks on a 20-point exam: 18, 17, 18, 15, 16, 12, 15, and 17. Draw a bar chart to represent the data and then calculate the mean of their scores.



Grade	Frequency
12	1
15	2
16	1
17	2
18	2
Total	8

2. **Say:** This frequency chart shows the marks 8 pupils received on a 20-point exam.
3. **Say:** The bar chart displays the data from the frequency chart.
4. **Say:** Now we must calculate the mean of the scores.
5. Write on the board: $18 + 17 + 18 + 15 + 16 + 12 + 15 + 17 =$
6. **Say:** Please add the numbers in your exercise book.
7. **Ask:** What is the answer? (Answer: 128)
8. **Say:** Now we will divide the sum, 128, by the number of items, 8.
9. Write on the board: $128 \div 8$.
10. **Say:** Please divide the numbers in your exercise book.
11. **Ask:** What is the answer? (Answer: $128 \div 8 = 16$)
12. **Say:** 16 is the mean of the scores. It is the average score that the pupils received.
13. Write: What is the average amount of time in minutes pupils spend travelling to school every morning?
14. Write: 30, 40, 30, 60, 45, 40, 60, 35, 45, 20
15. **Say:** Here is the data set you will use for this problem.
16. **Say:** Using the model we used for the previous problem, we will find the average.
17. **Say:** Begin by adding the numbers together.
18. **Ask:** What is the total when the numbers are added together? (Answer: 405)
19. Write: 30, 40, 30, 60, 45, 40, 60, 35, 45, 20 = 405
20. **Say:** The total of minutes added together is 405.
21. Write: 405 ÷ 10 =
22. **Say:** Now divide the total number by 10, as there were 10 responses from pupils.
23. **Ask:** What is the average of the data set? (Answer: 40.5)
24. Finish the equation: Write: 405 ÷ 10 = 40.5
25. **Say:** The average amount of time pupils spend walking to school is 40.5 minutes.

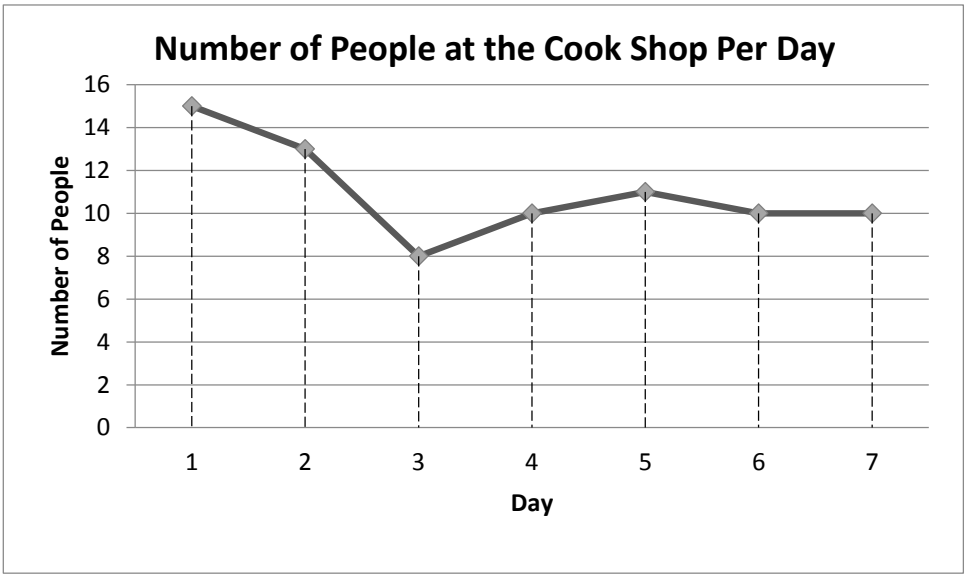
Independent Practice *(10 minutes)*

1. Write the problem and create the table: Gbesseh wanted to know the average number of people who eat at her cook shop per day, so she recorded the number of people for 7 days in the table below. Create a line graph and then find the average number of people each day.

Day	1	2	3	4	5	6	7
Number of people	15	13	8	10	11	10	10

2. **Say:** Work on your own to create a line graph based on the data in the frequency chart.
3. **Say:** Find the mean of the list of data.

4. Walk around the room and assist pupils when needed.
5. **Say:** When you are finished, you may compare answers with a partner.
6. **Ask:** Who would like to draw their line graph on the board?
7. Call on a pupil with hand raised to draw their line graph on the board.
8. **Ask:** Who would like to put the numbers in order and identify the mean?
9. Call on a pupil with hand raised to put the data set in order from least to greatest and identify the mean. (Answers: $15 + 13 + 8 + 10 + 11 + 10 + 10 = 77;\ 77 \div 7 = 11$ people)



Closing *(2 minutes)*

1. **Ask:** What information can we get from the mean? (Example answer: The approximate middle of a set of data; the average)
2. **Ask:** How do you calculate the mean? (Example answer: Add up all the numbers in the list and divide by the number of items in the list.)

Lesson Title: Median	**Theme:** Statistics and Probability	
Lesson Number: M-08-142	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes	**Teaching Aids**	**Preparation**
By the end of the lesson, pupils will be able to: 1. Calculate the median of a set of data from a list, chart, or graph. 2. Interpret median.	None	None

Opening *(3 minutes)*

1. **Ask:** What is the definition of mean? (Example answer: Mean is the average of a set of data, one way to determine the middle of a set of numbers.)
2. **Ask:** What is the process to calculate mean? (Add up the numbers in a list of data and divide by the number of items.)
3. **Say:** Today we will calculate the median of a set of data from a list, chart or graph, and interpret what it means.

Introduction to the New Material *(8 minutes)*

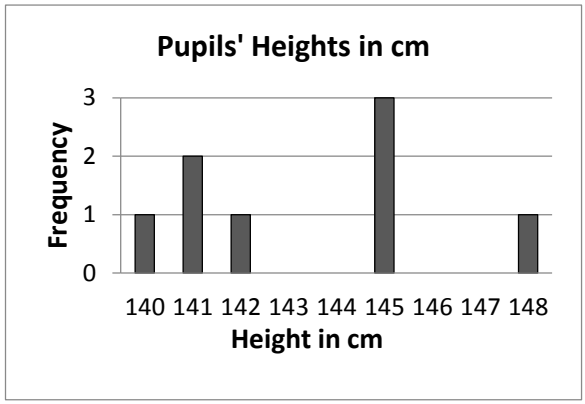
1. Write: There are 5 children in a family, aged 12, 5, 3, 7, and 10. What is the median of their ages?
2. **Say:** The number in the middle is called the *median*. The *median* is another number that can tell us where the middle of the data is.
3. **Say:** Remember that the *mean* is the other number that tells us where the middle of the data is. It is also commonly known as 'average'.
4. **Say:** To find the median of a set of data, we must arrange the numbers in order of size and then find the middle one.
5. Put the numbers in order of size. Write: 3, 5, 7, 10, 12
6. **Say:** I have put the numbers in order of size from least to greatest.
7. **Say:** The middle number is 7. 7 is the median of the ages.
8. **Say:** Most of the time the mean and median are not equal, but they are often close together.
9. **Say:** Now I will calculate the mean of the ages of the children, to see if the mean and median are similar.
10. Write: $3 + 5 + 7 + 10 + 12 = 37; 37 \div 5 = 7.4$
11. **Say:** I have added up the numbers in the list and divided by the number of items in the list.
12. **Say:** The mean is 7.4. It is close to the median number 7.
13. **Say:** Median and mean are two ways to look at the middle of a set of data.

Guided Practice *(12 minutes)*

1. Draw the frequency chart and bar graph and write the following question on the board:
   8 pupils measured themselves and wrote the following list of heights: 148 cm, 142 cm, 141 cm, 140 cm, 145 cm, 145 cm, 141 cm and 145 cm. Using the frequency chart and a bar graph, recalculate the median of their heights.

Height (in cm)	Frequency
140	1
141	2
142	1
145	3
148	1
Total	8

2. **Say:** The frequency chart shows how many times a response was recorded as part of the data.
3. **Say:** The bar graph displays the data from the frequency chart.
4. **Say:** Now we will calculate the median of the heights using the data in the frequency chart and bar graph.
5. **Say:** To find the median of a set of data, we must arrange the numbers in order of size and then find the middle one.

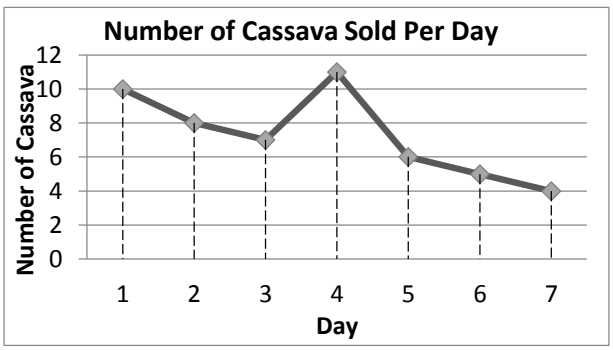


6. Write the heights on the board in order of size. 140, 141, 141, 142, 145, 145, 145, 148.
7. **Ask:** What is the middle number? (Answer: There is no middle number; 142 and 145 are both in the middle.)
8. **Say:** When we have an even number of items, there is no single middle number. We look at the two middle numbers and find their mean. We add the two numbers and divide by 2.
9. Add the two middle heights and divide by 2 on the board. (Example: $142 + 145 = 287;\ 287 \div 2 = 143.5\ \text{cm}.$)
10. **Say:** The median height is 143.5 cm.
11. Write the following question on the board: 15 pupils were asked how many siblings they had. Their responses were: 1, 2, 3, 5, 4, 5, 1, 3, and 3. Create a frequency chart and find the median number of siblings?
12. **Say:** Please create a frequency chart in your exercise book using the data found in the question.
13. While pupils are working, draw the frequency chart on the board.
14. **Say:** Now write the responses in your exercise book from least to greatest. Remember you will need to write the response the same number of times as listed in the frequency chart.
15. **Ask:** What are the responses from least to greatest? (Answer: 1, 1, 2, 3, 3, 3, 4, 5, 5)
16. Write: 1, 1, 2, 3, 3, 3, 4, 5, 5
17. **Ask:** What is the middle number? (Answer: 3)
18. Circle the 3.
19. **Say:** There is only one number in the middle of the set of data. Therefore the median is 3.

Number of Siblings	Frequency
1	2
2	1
3	3
4	1
5	2
Total	9

Independent Practice *(10 minutes)*

1. Write the following question and line graph on the board:
   Bendu sells cassava. She recorded the number she sold each day for a week. Create a frequency table and find the median number of cassava she sold in a day.
2. **Say:** Please create a frequency table and find the median of the list of data.



Day	1	2	3	4	5	6	7
Number of Cassava	10	8	7	11	6	5	4

3. Walk around the room and assist when needed.
4. **Say:** When you are finished you may compare your answers with a partner.
5. **Ask:** Who would like to draw their frequency table on the board?
6. Call on a pupil with hand raised to draw their frequency chart on the board.
7. **Ask:** Who would like to put the numbers in order and identify the median?
   Call on a pupil with hand raised to put the data set in order from least to greatest and identify the median. (Answers: 4, 5, 6, 7, 8, 10, 11; the median is 7 cassava.)
8. Class, please check your work to make sure you came up with the same answers and drew the frequency chart correctly.

Closing *(2 minutes)*

1. **Ask:** What is the difference between mean and median? (Example answer: The mean is the average; the median is the middle number when the numbers are put in order.)
2. **Ask:** What do you do if you have an even number of data? (Example answer: Find the mean of the middle two; add up the two middle numbers and divide by 2.)

Lesson Title: Mode and Range	**Theme:** Statistics and Probability	
Lesson Number: M-08-143	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to: 1. Calculate the mode and range of a set of data from a list, chart, or graph. 2. Interpret mode and range.	**Teaching Aids** None	**Preparation** None

Opening *(3 minutes)*

1. **Ask:** What two statistical measures have we learned so far this year? (Answers: Mean and median)
2. **Ask:** What do we use mean and median to find? (Answer: The middle of a set of data)
3. **Say:** Today, we will learn about two more statistical calculations, called mode and range.

Introduction to the New Material *(8 minutes)*

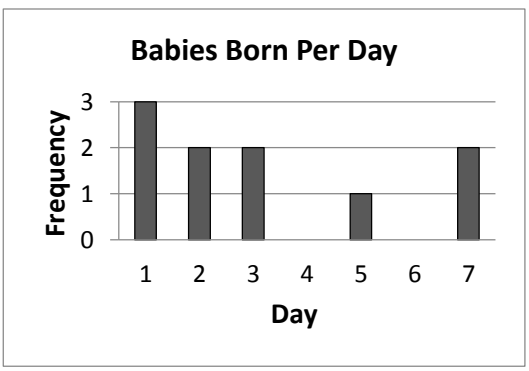
1. Write the following list of numbers on the board: 3, 5, 5, 6, 9, 5, 4, 7, 3.
2. **Say:** The range is the difference between the highest and lowest numbers. It tells us how spread apart our numbers are.
3. **Say:** The lowest number is 3.
4. **Say:** The highest number is 9.
5. **Say:** For the numbers on the board, the numbers will we subtract to find the range are 9 and 3.
6. Write: Range $= 9 - 3 = 6$.
7. **Say:** 9 minus 3 equals 6. The range of these numbers is 6.
8. **Say:** The mode is the number that appears most often in a list.
9. Circle the 5s in the list of numbers.
10. **Say:** 5 is the mode for this data as it appears three times in the list of numbers.
11. Write: Mode $= 5$

Guided Practice *(10 minutes)*

1. Write the following frequency table on the board:

Day	1	2	3	4	5	6	7
Number of babies born	3	2	2	0	1	0	2

2. **Say:** The frequency table shows the number of babies born each day at a clinic.
3. Draw the bar graph at right.
4. **Say:** The bar graph displays the data from the frequency chart.
5. **Say:** Begin by writing the numbers from the frequency chart in order from lowest to highest in your exercise books.



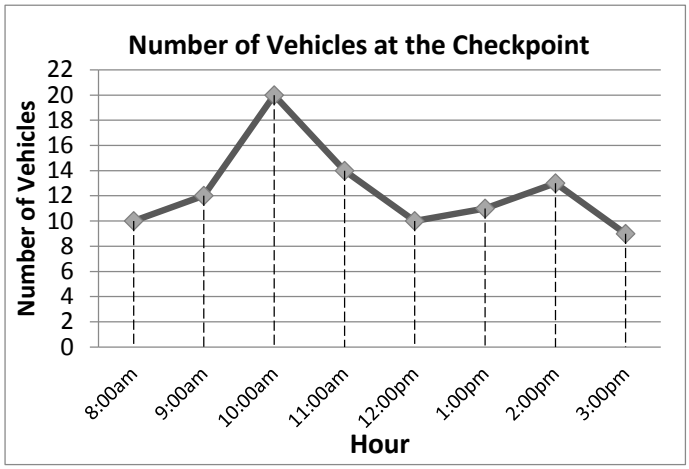
6. **Ask:** What order did you write the numbers in?
   (Answer: 0, 0, 1, 2, 2, 2, 3)
7. **Ask:** What is the highest number of babies born on one day? (Answer: 3)
8. **Say:** We can verify this is correct by looking at the bar chart. The bar for Day 1 goes all the way up to 3.
9. **Ask:** What is the lowest number of babies born on one day? (Answer: 0)
10. **Say:** We can verify this is correct by looking at the bar chart. There is no bar for Day 4 as 0 babies were born that day.
11. **Ask:** What is the range of the number of babies born? (Answer: 3)
12. **Say:** The range is 3 because we calculate 3 – 0 and the answer is 3.
13. **Ask:** What is the mode of the numbers? (Answer: 2)
14. **Say:** The mode is 2, because 2 babies were born on 3 different days. We can verify this data by looking at the bar chart. On three days the bar goes up to 2.
15. **Say:** If a number is not repeated in a list, then that list of numbers does not have a mode.
16. **Say:** There can also be two or more modes.
17. **Say:** If two different numbers are repeated the same number of times, they are both called the mode.
18. **Say:** You will now work with a partner.
19. Write: A pupil scored the following marks on their exams: 98, 87, 100, 75, 90, 84, and 92. Find the mode and range of the data.
20. **Say:** Please find the mode and range of the data. Write the answers in your exercise book.
21. **Say:** Remember to first arrange the numbers from lowest to highest.
22. **Ask:** What is the correct order of numbers from lowest to highest? (Answer: 75, 84, 87, 90, 92, 98, 100)
23. **Ask:** What is the range? (Answer: 25)
24. **Say:** The range is 25 because we calculate 100 minus 75 and the answer is 25.
25. **Ask:** What is the mode? (Answer: None)
26. **Say:** There is no mode because no number is repeated.

Independent Practice *(10 minutes)*

1. **Say:** You will now be working on your own.
2. Write the following question and frequency table on the board.
   The table shows the number of vehicles that passed the checkpoint for each hour. Draw a line graph counting by 2s on the y-axis, and then calculate the mode and range of the data.

Hour	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm	3:00pm
Number of vehicles	10	12	20	14	10	11	13	9

3. **Say:** Remember to first arrange the numbers from lowest to highest.
4. Walk around and assist pupils when needed.
5. **Ask:** Who would like to draw the line graph?
6. Call on a pupil with hand raised to draw the line graph on the board.
7. **Ask:** Who would like to find the mode? (Answer: 10)
8. Call on a pupil with hand raised to write the mode on the board.
9. **Say:** The range is 11 because 20 – 9 = 11
10. **Ask:** Who would like to find the range? (Answer: 11)
11. Call on a pupil with hand raised to calculate the range on the board.



Closing *(4 minutes)*

1. Ask questions to review mean, median, mode, and range. Make sure pupils understand the differences.
   a) Which statistical measure is the number that appears most often in a list? (Answer: Mode)
   b) Which statistical measure is the middle number in the list in order from lowest to highest? (Answer: Median)
   c) Which statistical measure is the average? (Answer: Mean)
   d) Which statistical measure is the difference between the highest and lowest numbers? (Answer: Range)

Lesson Title: Interpreting Pie Charts	**Theme:** Statistics and Probability	
Lesson Number: M-08-144	**Class/Level:** JSS 2	**Time:** 35 minutes

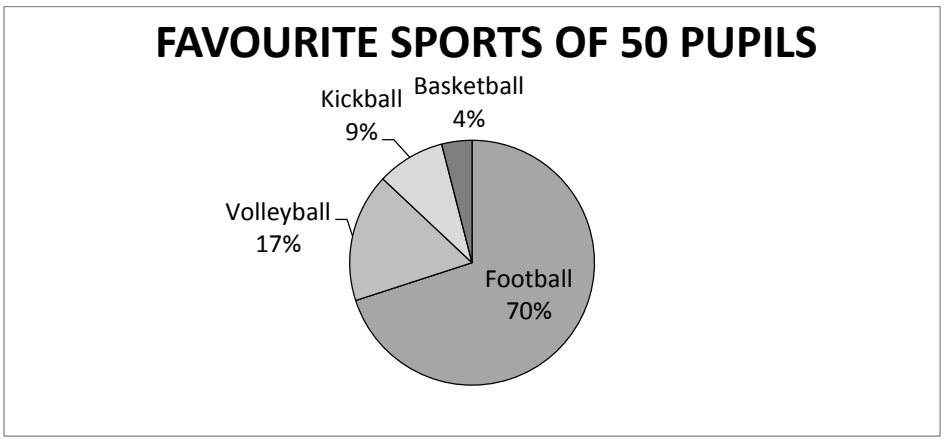
Learning Outcomes By the end of the lesson, pupils will be able to interpret information from a pie chart.	**Teaching Aids** None	**Preparation** None

Opening *(2 minutes)*

1. Ask pupils to name and describe in their own words the types of graphs or charts in statistics that they have studied so far. (Example answers: a) Pictograms: when we use pictures or symbols to represent data; b) Bar charts: charts with rectangular bars of equal width, with equal space between the bars, and with the heights equal to the number of items being represented; c) Line graphs: graphs that use points connected by a line to show how something changes in value as time goes by.)
2. **Ask:** What is percentage? Have pupils raise their hand to answer. (Answer: Percentage is any part or share of a whole.)
3. **Say:** Today, we are going to learn how to interpret information from another type of chart, a pie chart.

Introduction to the New Material *(13 minutes)*

1. **Ask:** What is a pie chart?
2. Allow pupils to come up with their own definitions and discuss as a class.
3. **Say:** A pie chart is a type of graph in which a circle is divided into sectors that each represents a portion of the whole.
4. **Say:** A pie chart is also known as circle chart.
5. Draw and label the pie chart below.

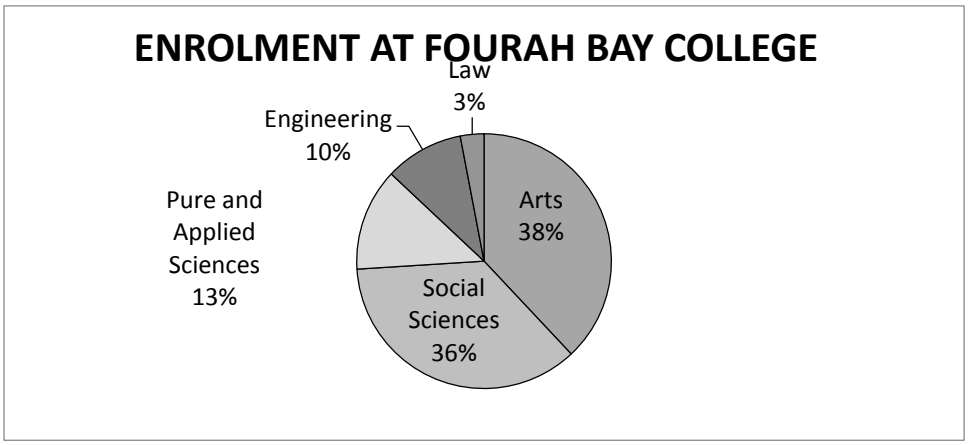


6. **Say:** This pie chart shows the percentages of favourite sports for a group of 50 pupils.
7. **Ask:** Who can remind us what percentage (%) mean? (Answer: Percentage means a part out of 100.)
8. **Say:** Let's add the percentages on this pie chart.
9. Write on the board: $70\% + 17\% + 9\% + 4\%$

10. Ask pupils to sum the numbers and raise their hand to give the answer. (Answer: 100%)
11. **Say:** The percentages in a pie chart always add up to 100%. Remember that 100% is the same as one whole. A bigger percentage takes up more space in the pie chart. It is a bigger piece of the pie chart. We call the different pieces of the pie chart sectors.
12. Ask pupils questions to check for understanding of the pie chart. Discuss each question and explain as needed.
    a) Which sport has the lowest percentage? (Answer: Basketball)
    b) Which sport has the highest percentage? (Answer: Football)
    c) What percentage of pupils say kickball is their favourite? (Answer: 9%)
    d) What percentage of pupils say volleyball is their favourite? (Answer: 17%)
13. Ask: How many pupils in this group of 50 say football is their favourite sport?
14. **Say:** Notice that this question asks us how many, not what percentage. We will need to figure out the number of pupils that said football out of 50 pupils. This means we need to find 70% of 50 pupils.
15. Solve the problem on the board with pupils' participation. (Answer: $\frac{70}{100} \times 50 = 35$ pupils)
16. **Ask:** How many pupils in this group prefer a sport other than basketball as their favourite?
17. **Ask:** What is the first thing we need to do to solve this problem?
18. Invite pupils to share their ideas. Guide them to understand that we first need to find the percentage of pupils who did not choose basketball.
19. **Say:** If the percentage of pupils who chose basketball is 4%, then we need to subtract this number from 100%. This will tell us the percentage of pupils who did not choose basketball.
20. Write on the board: $100\% - 4\% = 96\%$
21. **Say:** 96% of pupils did not choose basketball.
22. Ask pupils to find 96% of the 50 pupils in their exercise books. **(**Answer: $\frac{96}{100} \times 50 = 48$ pupils)
23. Write the answer on the board and ask pupils to check their answers in their exercise books.

Guided Practice *(8 minutes)*

1. Draw the pie chart below and write the following information on the board:
   This pie chart shows the percentages of undergraduate students enrolled in each of the different faculties at Fourah Bay College, out of 1,290 pupils total enrolled.



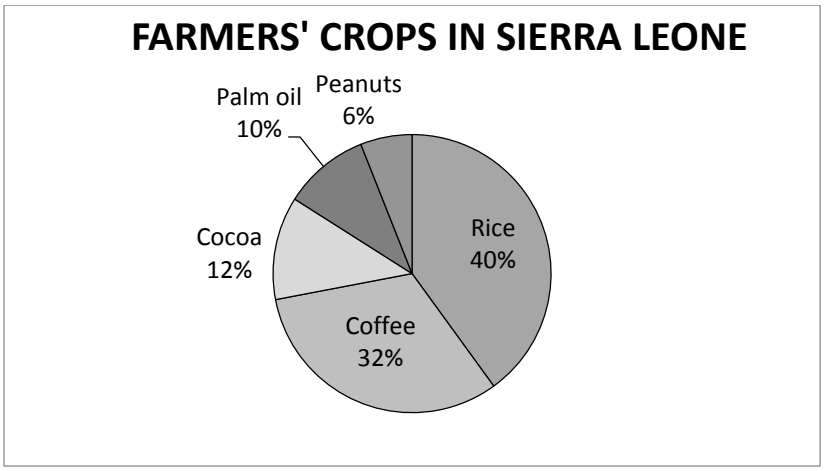
2. Write the following questions on the board (questions only – not answers):
   a) Which faculty has the lowest enrolment? (Answer: Law – 3%)

b) Which faculty has the highest enrolment? (Answer: Arts – 38%)
c) What percentage of students is enrolled in Engineering? (Answer: 10%)
d) What percentage of students is enrolled in Pure and Applied Sciences? (Answer: 13%)
e) How many pupils are enrolled in Engineering? (Answer: $\frac{10}{100} \times 1290 = 129$)
f) How many pupils are enrolled in the Arts? (Answer: $\frac{38}{100} \times 1290 = 490.2 = 491$)

3. Ask pupils to work in pairs to answer the questions on the board.
4. Move around the classroom to make sure pupils understand and are doing the task. Remind pupils how to find the number of students from a percentage, if needed.
5. Read the questions aloud. Have pupils raise their hand to answer.
6. Write the answers on the board. (Answers: See above)

Independent Practice *(10 minutes)*

1. Draw the pie chart below and write the following information on the board:
   This pie chart shows the percentages of farmers who grow each of the following crops, using data from a survey of 1,000 people.



2. Write the following questions on the board (questions only – not answers):
   a) What crop do the most farmers grow? (Answer: Rice)
   b) What crop do the fewest farmers grow? (Answer: Peanuts)
   c) What percentage of farmers grows palm oil? (Answer: 10%)
   d) What percentage of farmers does not grow rice? (Answer: 60%)
   e) What is the difference between the percentage of farmer who grow rice and coffee? (Answer: $40 - 32 = 8\%$)
   f) How many farmers grow palm oil? (Answer: $\frac{10}{100} \times 1000 = 100$ farmers)
   g) How many farmers grow cocoa? (Answer: $\frac{12}{100} \times 1000 = 120$ farmers)
3. Ask pupils to work independently to answer the questions on the board.
4. Move around the classroom to make sure pupils understand and are doing the task. Remind pupils how to find the number of students from a percentage, if needed.
5. After pupils are finished, ask them to work in pairs to share and compare their answers.
6. Read the questions aloud. Have pupils raise their hand to answer.
7. Write the answers on the board. (Answers: See above)

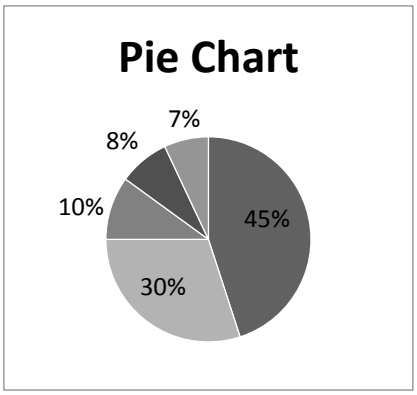
Closing *(2 minutes)*

1. Ask pupils the following questions to revise the material:
   a) What is a pie chart? Why are they useful?
   b) What percentage should the pie chart add up to?
2. Allow pupils to share their ideas and discuss the answers as a class. (Answers: a) A pie chart is a type of chart in which a circle is divided into sections; they help us compare parts of a whole. b) 100%)

Lesson Title: Pie Chart Angles	**Theme:** Statistics and Probability	
Lesson Number: M-08-145	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes	**Teaching Aids**	**Preparation**
By the end of the lesson, pupils will be able to find the sectoral angles of a pie chart and relate them to the whole (360°).	None	None

Opening *(2 minutes)*



1. Draw the pie chart to the right on the board.
2. Ask pupils the following questions:
   a) How many sectors is the pie chart divided into? (Answer: 5)
   b) Where do all the sectors meet? (Answer: The centre of the circle.)
   c) What does it mean if one sector has a bigger angle in the centre, making a larger sector? (Answer: A larger percentage falls in that category.)
3. **Say:** Today, we are going to learn how to find the sectoral angles of a pie chart.

Introduction to the New Material *(13 minutes)*

1. Draw a blank frequency table on the board (see table to the right).
2. **Say:** We are going to collect data about our class and determine the sectors in a pie chart.
3. **Say:** We will create a frequency table out of this data.
4. Ask one pupil to come to the board to write numbers of pupils in the table as they vote.

Fruit	**Frequency**
Pineapple	
Orange	
Banana	
Mango	
TOTAL	

5. **Ask:** What is your favourite fruit: pineapple, orange, banana or mango?
6. Ask pupils to raise their hands as you name the fruits so they can vote for their favourite. (Example answer at right - change numbers to reflect your class.)
7. **Ask:** How many pupils are in the class? (Example answer: 40)
8. **Say:** We need to find the percentage of 100% that each fruit received.
9. Remind pupils that the pie charts in the previous lesson had labels of percentages.

Fruit	**Frequency**
Pineapple	12
Orange	7
Banana	5
Mango	16
TOTAL	40

10. **Ask:** How do we find the percentage? (Answer: Divide the portion by total and multiply by 100.)
11. Write on the board: $\text{Pineapple} = \frac{12}{40} \times 100\% = 30\%$
12. **Say:** We should divide the portion of the class that chose pineapple by the total in the class, and then multiply by 100%.
13. Ask pupils to calculate the rest of the percentages in their exercise books for the other fruits.

14. Write the answers on the board:

$$\text{Orange} = \frac{7}{40} \times 100\% = 17.5\%$$

$$\text{Banana} = \frac{5}{40} \times 100\% = 12.5\%$$

$$\text{Mango} = \frac{16}{40} \times 100\% = 40\%$$

15. **Say:** We can check that our maths is correct because all the percentages must add up to 100%.
16. Ask pupils to add up all the percentages in their exercise books.
17. Write on the board: $30\% + 17.5\% + 12.5\% + 40\% = 100\%$
18. **Say:** Now that we know the percentages, we need to calculate the size for each piece of the pie chart.
19. **Say:** Each piece of the pie chart is called a sector. To figure out how large each sector will be, we need to determine how many degrees for the angle at the centre for each sector.
20. Remind pupils that angles are measured in degrees.
21. **Ask:** How many degrees are in a full circle? (Answer: 360°)
22. Write on the board: $\text{Pineapple} = \frac{12}{40} \times 360° = 108°$ or $\frac{30}{100} \times 360° = 108°$
23. **Say:** To find the degrees for the angle at the centre of each sector we can multiply the ratio for each fruit by 360. This is the same as multiplying the percentage we just found by $360°$.
24. **Say:** Depending on what information you have, you can calculate the angle measure either way.
25. Ask pupils to calculate the rest of the degrees for the other fruits.
26. Calculate the rest of the sectors on the board:

$$\text{Orange} = \frac{7}{40} \times 360° = 63°; \text{ or Orange} = \frac{17.5}{100} \times 360° = 63°$$

$$\text{Banana} = \frac{5}{40} \times 360° = 45°; \text{ or Banana} = \frac{12.5}{100} \times 360° = 45°$$

$$\text{Mango} = \frac{16}{40} \times 360° = 144°; \text{ or Mango} = \frac{40}{100} \times 360° = 144°$$

27. **Say:** We can check that we did our maths correctly because all the sectors must add up to 360°.
28. Ask pupils to add up all the sectors' angle measures in their exercise books.
29. Write on the board: $108° + 63° + 45° + 144° = 360°$

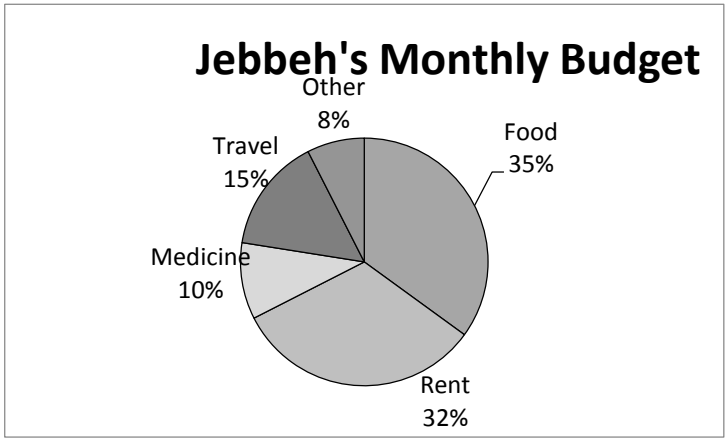
Guided Practice *(8 minutes)*

1. Write the following information and draw the frequency table at the right on the board:
   This table contains data showing pupils' methods of transportation to school.
2. Ask pupils to work in pairs to calculate the degrees for the angles at the centre of each sector for the methods of transportation in a pie chart.
3. Move around the classroom to make sure pupils understand and are doing the task. Help pupils calculate the degrees, if needed.
4. Invite different pairs to come to the front and write their answers on the board. Make corrections if necessary. (Answers*:* $\text{Car} = \frac{6}{40} \times 360° = 54°$; $\text{Bus} = \frac{4}{40} \times 360° = 36°$; $\text{Bike} = \frac{9}{40} \times 360° = 81°$; $\text{Walking} = \frac{21}{40} \times 360° = 189°$)
5. Ask pupils to check their answers with the answers on the board.

Transportation	Frequency
Car	6
Bus	4
Bike	9
Walking	21
TOTAL	40

Independent Practice *(10 minutes)*

1. Write the problem and draw the pie chart on the board (see pie chart to the right):
   The pie chart contains data showing how Jebbeh spends her 200,000 Leones monthly budget. Calculate the degrees for each angle at the centres of the sectors of a pie chart.



2. Ask pupils to work individually to calculate the degrees.
3. Move around the classroom to make sure pupils understand and are doing the task. Help pupils calculate the degrees, if needed.
4. Allow pupils to work in pairs if they need assistance.
5. Invite five pupils to come to the board and share their answers for each of the degree measurement for the centre angle of the sectors. Make corrections if necessary. (Answers: $\text{Food} = \frac{35}{100} \times 360° = 126°; \text{Rent} = \frac{33}{100} \times 360° = 118.8°; \text{Medicine} = \frac{10}{100} \times 360° = 36°; \text{Travel} = \frac{15}{100} \times 360° = 54°; \text{Other} = \frac{7}{100} \times 360° = 25.2°$)
6. Ask pupils to check their answers with the answers on the board.

Closing *(2 minutes)*

1. Ask pupils the following questions to revise the material:
   a) How do you calculate the angle at the centre for each sector?
   b) What percentage should the pie chart add up to?
   c) How many degrees should the centre angles of all the sectors add up to?
2. Discuss the answers as a class. (Answers: a) Multiply the percentage out of 100% by 360° for each sector, or multiply the ratio of the portion over the total by 360° for each sector. b) 100% c) 360°)

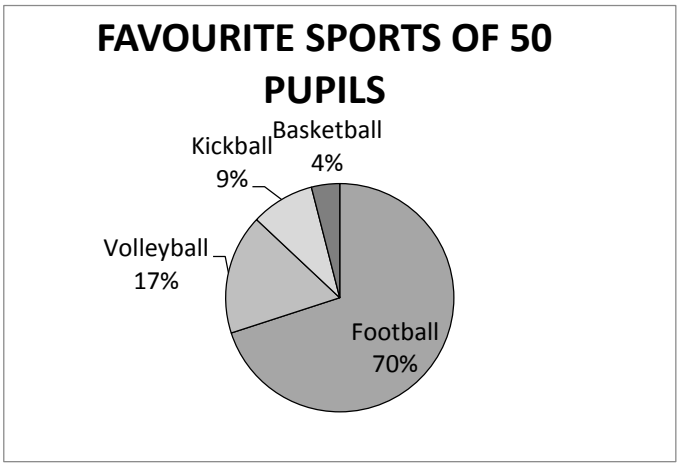
Lesson Title: Creating Pie Charts	**Theme:** Statistics and Probability	
Lesson Number: M-08-146	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to display data collected from the class in a pie chart.	**Teaching Aids** Protractors at the end of the lesson plan	**Preparation** Ask pupils to bring mathematical sets to class if they have them. For pupils who do not have them, see the pages at the end of the lesson plan on how to make them.

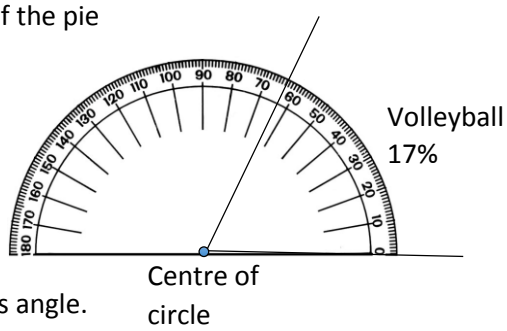
Opening *(2 minutes)*

1. Ask pupils the following questions:
   a) What do you call the pieces of a pie chart? (Answer: sectors)
   b) What should the centre angles of all the sectors of a pie chart add up to? (Answer: 360°)
2. **Say:** Today, we are going to practise displaying data collected from the class in a pie chart.

Introduction to the New Material *(13 minutes)*



1. **Say:** We are going to collect data about our class and represent it in a pie chart.
2. Draw the pie chart to the right on the board.
3. **Say:** This pie chart shows the percentages of favourite sports for a group of 50 pupils.
4. Hold up a protractor (either a plastic or paper one).
5. **Ask:** What is this? (Answer: A protractor)
6. **Ask:** What is a protractor used for? (Answer: It is used for measuring angles in degrees.)
7. **Say:** A protractor is used to measure angles. Angles are measured in degrees, and this protractor can measure any angle less than 180 degrees. Look at the numbers on the protractor. They count by tens from 0 to 180. This is like a ruler, but instead of measuring length we use it to measure how much an angle opens.
8. **Say:** We will use a protractor to measure the angles at the centre of each of the sectors of this pie chart. You place the centre of the protractor on the centre of the pie chart and place the bottom of the protractor exactly along one line of one sector of the pie chart.
9. Follow the instructions as you explain (see example to the right).
10. **Say:** Now look at the other line of the angle. It crossed the protractor at a number. That number is the angle's measure in degrees. Let's count the degrees between the two lines of this angle.
11. Count by tens from 0° to find the angle measure.
12. Follow the same steps for each angle in the pie chart on the board to demonstrate for pupils.



13. **Say:** Now we will create our own pie chart using the data we collected about the class in our last lesson.
14. Write the frequency chart on the board (see example on the right).
15. **Ask:** How many degrees are in a full circle? (Answer: 360°)
16. Write on the board:

$$\text{Pineapple} = \frac{12}{40} \times 360° = 108°$$

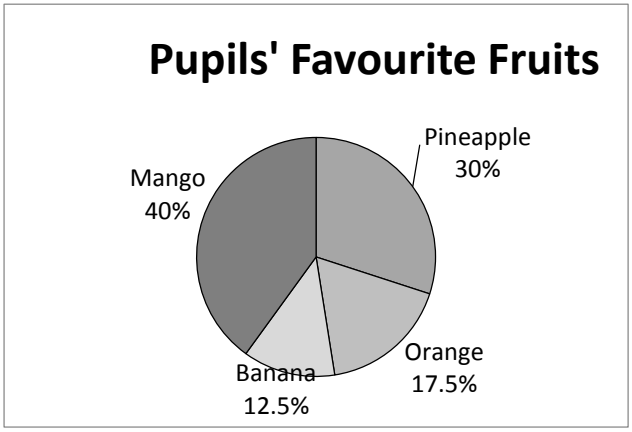
$$\text{Orange} = \frac{7}{40} \times 360° = 63°$$

$$\text{Banana} = \frac{5}{40} \times 360° = 45°$$

$$\text{Mango} = \frac{16}{40} \times 360° = 144°$$

Fruit	Frequency
Pineapple	12
Orange	7
Banana	5
Mango	16
TOTAL	40

17. **Say:** Using these measurements, we can create a pie chart representing our class.
18. Draw an empty pie chart (circle) on the board.
19. **Say:** Place the centre of the protractor at the centre of the pie chart and place the bottom of the protractor exactly along one radius of the circle.
20. Demonstrate for pupils as you give the instructions.
21. **Say:** Now find the angle measure for the first fruit.



22. Make a mark at $108°$. Use a straightedge to draw another radius from the centre at $108°$.
23. **Say:** This sector represents the number of people who prefer pineapples.
24. Repeat these steps for each of the sectors until the pie chart is complete.
25. **Say:** We must always label the sectors of the pie chart.
26. Write the labels for percentages and fruits on each of the sections.

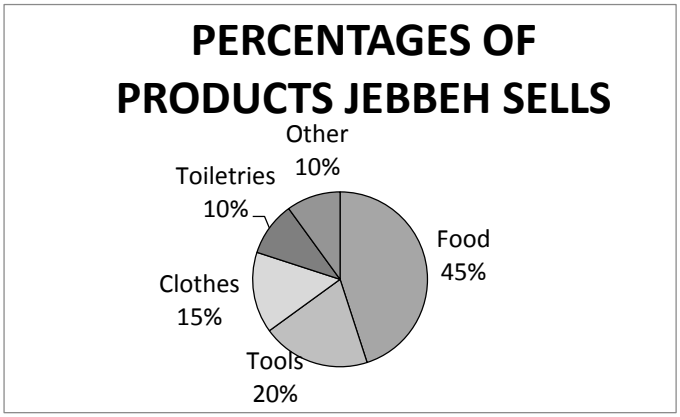
Guided Practice *(8 minutes)*

1. Draw the table (see table to the right) and write the following information on the board: Jebbeh recorded what products she sold for a week. This table contains the percentages for each product Jebbeh sells.
2. Ask pupils to work in pairs to calculate the inside angle measures at the centre for each of the sectors.
3. Move around the classroom to make sure pupils understand and are doing the task. Help pupils calculate the inside angle measures, if needed.
4. Invite five pairs to come to the front and write their answers on the board. Make corrections if necessary. (Answers: $\text{Food} = \frac{45}{100} \times 360° = 162°;\ \text{Tools} = \frac{20}{100} \times 360° = 72°;\ \text{Clothes} = \frac{15}{100} \times 360° = 54°;\ \text{Toiletries} = \frac{10}{100} \times 360° = 36°;\ \text{Other} = \frac{10}{100} \times 360° = 36°$)
5. Ask pupils to check their answers with the answers on the board.

PERCENTAGES OF PRODUCTS JEBBEH SELLS	
Type of Product	Percent of Sales
Food	45%
Tools	20%
Clothes	15%
Toiletries	10%
Other	10%

Independent Practice *(10 minutes)*

1. Ask pupils to use the inside angle measures for each of the sectors that they just found to construct their own pie charts showing the percentages of products that Jebbeh sells.
2. Ask pupils to work individually to construct the pie chart.
3. Move around the classroom to make sure pupils understand and are doing the task. Help pupils calculate the inside angle measures, if needed.
4. If pupils are having difficulties, allow them to work in pairs.
5. After pupils have finished, ask them to work in pairs to share and compare their charts.
6. Discuss the pie chart as a class. Make corrections if necessary. (Answer: see pie chart to the right)

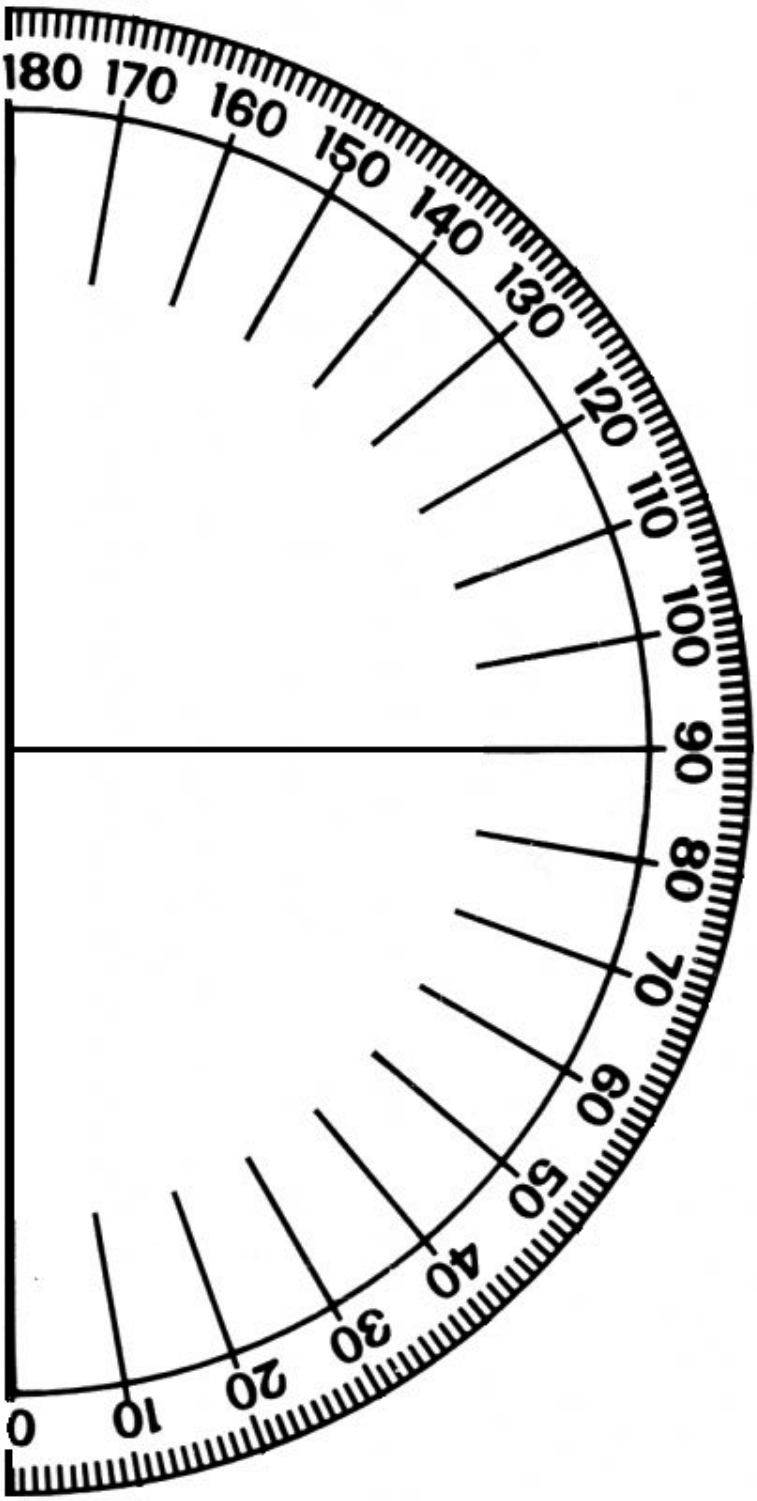


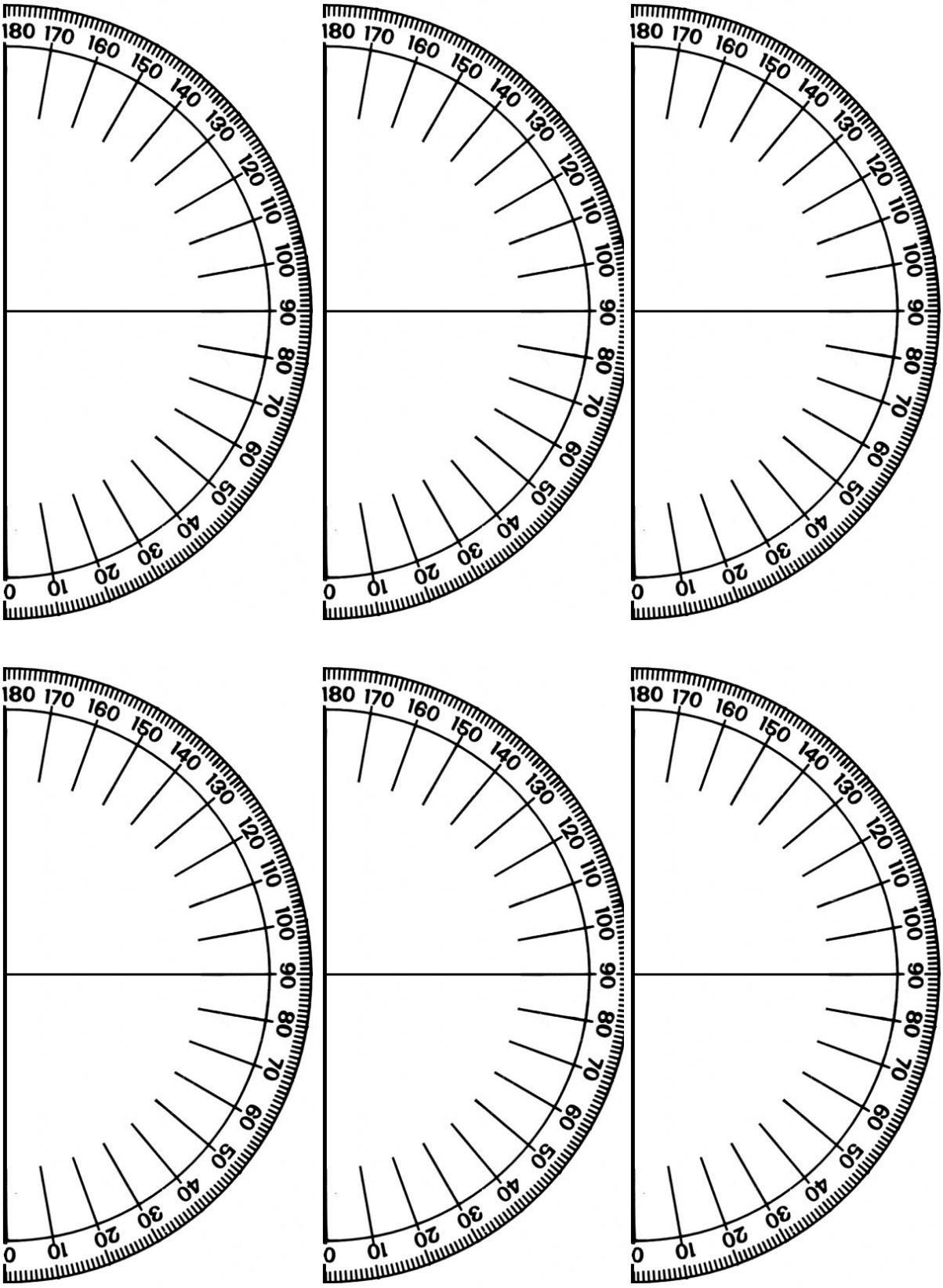
Closing *(2 minutes)*

1. Ask pupils the following questions to revise the material:
   a) What percentage of Jebbeh's sales are either food or clothes?
   b) What percentage of Jebbeh's sales are 'other'?
   c) What type of product is the most popular?
2. Discuss the answers as a class. (Answers: a) $45\% + 15\% = 60\%$ b) 10% c) Food, because 45% is the largest percentage)

[MAKING TEACHING AIDS: PROTRACTORS]

Teachers can use the large protractor below to show pupils how to measure angles on the board. Pupils can use the small protractors on the next page to measure angles in their exercise books. Teachers do not need to cut out the protractors from this book. These can be traced with a pen onto a sheet of paper, and then cut out with scissors. Teachers do not need to trace each of the 180 lines. If you trace the tens lines (0, 10, 20, etc.) it will be enough to estimate the measure of angles. The page with small protractors can also be photocopied to provide protractors to more pupils.




180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

Lesson Title: Creating Stem Diagrams	**Theme:** Statistics and Probability	
Lesson Number: M-08-147	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to display data collected from the class in a stem diagram.	**Teaching Aids** None	**Preparation** None

Opening *(2 minutes)*

1. Ask pupils to describe in their own words the process to create a pie chart. Guide pupils to the correct response. (Example answer: For each sector of the pie chart, divide the portion of data by the total of the data and multiply by 360°. That will be the angle measure for the centre of the sector. Use a protractor to draw the angles inside a circular pie chart.)
2. **Say:** Today, we are going to learn another way to display data - called stem diagrams.

Introduction to the New Material *(13 minutes)*

1. **Say:** Stem diagrams are a special type of table to display data.
2. Remind pupils that a table is a way to organise data in rows and columns.
3. **Say:** The data is divided between two columns. The first digit (or digits) goes in the left column, and the last digit goes in the right column.
4. Write the following question on the board:
   How old is your mother or father?
5. Invite 10 pupils to volunteer the ages of one of their parents.
6. Write the ages on the board in a list as pupils share them. (Example answers: 29, 30, 41, 37, 29, 28, 33, 31, 35, 45)
7. Ask pupils to arrange the list in order from lowest to highest. (Answer: 28, 29, 29, 30, 31, 33, 35, 37, 41, 45)
8. **Say:** Now we will create a stem and leaf diagram with this data.
9. Draw the stem diagram to the right on the board.
10. **Say:** The stem is the first digit in the left column and the leaf is the last digit in the right column.
11. Write the key on the board as well.
12. **Say:** It is important to include a key with your stem diagram so that people can understand what it means.
13. **Say:** 2|8= 28 shows us that the stem column is in the ten's place and the leaf column is in the one's place.
14. **Say:** Think of a stem on a plant, one stem can have many leaves. That is the same way a ten's digit on a stem diagram may have many one's digits.

AGES OF MOTHERS AND FATHERS

Stem	Leaf
2	8, 9, 9
3	0, 1, 3, 5, 7
4	1, 5

Key: 2|8= 28

15. Write the following information on the board:
    The following list is the number of pupils enrolled in JSS at eight different schools: 205, 208, 245, 218, 227, 236, 222, 217.
16. Ask pupils to arrange the list from lowest to highest. (Answer: 205, 208, 217, 218, 222, 227, 236, 245)
17. **Say:** Now we will create a stem and leaf diagram with this data.

18. **Say:** Stem diagrams can also have two digits in the stem column.
19. Draw the stem diagram to the right on the board.
20. **Say:** The stem is the hundred's and ten's digits in the left column and the leaf is the one's digit in the right column. The key shows us how to read it.

PUPILS ENROLLED IN JSS

Stem	Leaf
20	5, 8
21	7, 8
22	2, 7
23	6
24	5

Key: 20|5 = 205 pupils.

Guided Practice *(8 minutes)*

1. Write the following problem on the board:
   The following is the list of heights of twelve pupils in cm.: 135 cm., 136 cm., 137 cm., 141 cm., 145 cm., 150 cm., 142 cm, 143 cm., 147 cm., 141 cm., 139 cm., 140 cm. Create a stem diagram from the data.
2. Ask: What place value should you put in the stem column? (Answer: hundred's and ten's)
3. Ask: What place value should you put in the leaf column? (Answer: one's)
4. Ask pupils to work in pairs to create the stem diagram.
5. Move around the classroom to make sure pupils understand and are doing the task. If necessary, remind pupils to create a key.
6. Invite one pair to come to the front and share their stem diagram on the board. Make corrections if necessary.
7. Ask pupils to compare their stem diagram with the one on the board. (Answer: See stem diagram to the right)

HEIGHTS OF PUPILS IN CM.

Stem	Leaf
13	5, 6, 7, 9
14	0, 1, 1, 2, 3, 5, 7
15	0

Key: 13|5 = 135 cm.

Independent Practice *(10 minutes)*

1. Write the following problem on the board:
   The following are the marks received by 20 pupils in a recent exam: 97, 95, 78, 72, 100, 80, 92, 85, 90, 90, 68, 70, 90, 85, 75, 75, 78, 80, 95, and 97. Create a stem diagram from the data.
2. Ask pupils to work individually to create a stem diagram.
3. Move around the classroom to make sure pupils understand and are doing the task. If necessary, help pupils to determine the stem and leaf values.
4. After pupils have finished, ask them to share and compare their diagram with a partner.
5. Invite one pair to come to the front and share their stem diagram on the board. Make corrections if necessary.
6. Discuss the stem diagram as a class. (Answer: See stem diagram to the right)

PUPILS' MARKS IN EXAMS

Stem	Leaf
6	8
7	0, 2, 5, 5, 8, 8
8	0, 0, 5, 5
9	0, 0, 0, 2, 5, 5, 7, 7,
10	0

Key: 6|8 = 68

Closing *(2 minutes)*

1. Ask pupils the following questions to revise the material:
   a) What is the stem in a stem diagram?
   b) What is the leaf in a stem diagram?
   c) What do you do if you have the same number in a set of data?
2. Discuss the answers as a class. (Answer: a) The first digit or digits; b) The last digit; c) List the last digit, the leaf, as many times as the same number appears.)

Lesson Title: Interpreting Stem Diagrams	**Theme:** Statistics and Probability	
Lesson Number: M-08-148	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes By the end of the lesson, pupils will be able to: 1. Interpret information from a stem diagram. 2. Calculate mean, median, mode and range from a stem diagram.	**Teaching Aids** None	**Preparation** None

Opening *(3 minutes)*

1. Ask pupils to define the following words:
   a) Mean
   b) Median
   c) Mode
   d) Range
2. Discuss the answers as a class. (Answers: a) Average of a set of data; b) The middle number in a set of data arranged from lowest to highest; c) The number that appears most often; d) The difference between the highest and lowest numbers)
3. **Say:** Today, we will learn to interpret information from a stem diagram, and calculate the mean, median, mode and range.

Introduction to the New Material *(13 minutes)*

1. Write the following problem on the board:
   The following is a list of distances to eight nearby villages in km.: 4.5 km., 3 km., 5.1 km., 2.8 km., 1.6 km., 2 km., 2.5 km., 1.5 km. Create a stem diagram from the data.
2. **Say:** We can include decimals in a stem diagram as well. We just need to make sure there is a digit (leaf) in the right column for every piece of data even if it is a zero.
3. Ask pupils to help create a stem diagram on the board from the data. Remind pupils that the data is divided between two columns. The first digit or digits goes in the left column, and the last digit goes in the right column.
4. Write the stem diagram on the board. (Answer: See stem diagram to the right)
5. **Say:** We can calculate the same statistical measures of mean, median, mode and range from data in a stem diagram.
6. If necessary, remind pupils how to calculate each of the statistical measures.
7. **Ask:** What is the mean of the distances?
8. Calculate the mean on the board to show pupils.
   (Answer: Mean: $1.6\text{ km.} + 1.7\text{ km.} + 2\text{ km.} + 2.5\text{ km} + 2.8\text{ km} + 3\text{km.} + 4.5\text{ km.} + 5.1\text{ km.} = 23.2\text{ km.};\ 23.2\text{ km.} \div 8 = 2.9\text{ km.}$)
9. **Ask:** What is the median of the distances?
   (Answer: Median: $2.5\text{ km.} + 2.8\text{ km.} = 5.3\text{ km.};\ 5.3\text{ km.} \div 2 = 2.65\text{ km.}$)

Distances to Villages in km.

Stem	Leaf
1	6, 7
2	0, 5, 8
3	0
4	5
5	1
Key:	1|6 = 1.6 km.

10. **Say:** The stem diagram can make it easy to find the median, because the numbers are already in order from lowest to highest.
11. **Ask:** What is the mode of the data? (Answer: There is no mode.)
12. **Say:** If you are looking for a mode in a stem diagram you should look for the same leaf in the right side column repeating.
13. **Ask:** What is the range of the data? (Answer: $5.1\ \text{km.} - 1.6\ \text{km.} = 3.5\ \text{km.}$)

Guided Practice *(6 minutes)*

1. Write the following problem and draw the stem diagram (see diagram to the right) on the board:
   This stem diagram displays the data for the number of malaria nets distributed per day for 20 days by the Ministry of Health. Find the mean, median, mode and range of the data.
2. Ask pupils to work in pairs.
3. Move around the classroom to make sure pupils understand and are doing the task. Help struggling pupils.
4. Invite different pairs of pupils to come to the front and write one of their answers on the board. Make corrections if necessary.

Malaria Nets Distributed per Day

Stem	Leaf
9	6, 9
10	0, 1, 8
11	0, 0, 2, 6
12	0, 1, 3,
13	3, 4, 5, 9, 9, 9
14	0, 0

9|6 = 96 nets

5. Discuss the answers as a class. (Answers: Mean: $96 + 99 + 100 + 101 + 108 + 110 + 110 + 112 + 116 + 120 + 121 + 123 + 133 + 134 + 135 + 139 + 139 + 139 + 140 + 140 = 2415 \div 20 = 120.75;$ Median: $120 + 121 = 241 \div 120.5$; Mode: 139; Range: $140 - 96 = 44$)

Independent Practice *(10 minutes)*

1. Write the following problem and draw the stem diagram (see diagram to the right) on the board:
   Miatta recorded the number of mangos she collected from her tree every day for 14 days. This stem diagram displays the data. Find the mean, median, mode and range of the data.
2. Ask pupils to work individually to find the answers.
3. Move around the classroom to make sure pupils understand and are doing the task. Help struggling pupils.
4. Invite four pupils to come to the front and write one of their answers on the board. Make corrections if necessary.
5. Ask the rest of the class to check their answers with the answers on the board.
6. Discuss answers as a class. (Answers: $Mean = 9 + 9 + 10 + 13 + 18 + 18 + 19 + 22 + 23 + 27 + 29 + 30 + 31 + 36 = 294 \div 14 = 21;$ $Median = 19 + 22 = 41 \div 20.5$; Mode: 9 and 18; $Range$: $36 - 9 = 27$)

Mangos Collected Per Day

Stem	Leaf
0	9, 9
1	0, 3, 8, 8, 9
2	2, 3, 7, 9
3	0, 1, 6

0|9 = 9 mangos

Closing *(3 minutes)*

1. Ask pupils the following questions to revise the material:
   a) What are the parts of a stem diagram?
   b) Name the other ways to organise data that we have studied.
2. Discuss answers as a class. (Answers: a) stems, leaves, key, title; b) pictograms, frequency tables, bar charts, line graphs)

Lesson Title: Choosing a Graph or Chart	**Theme:** Statistics and Probability	
Lesson Number: M-08-149	**Class/Level:** JSS 2	**Time:** 35 minutes

Learning Outcomes	**Teaching Aids**	**Preparation**
By the end of the lesson, pupils will be able to collect data and decide on the best type of graph or chart to represent it.	None	None

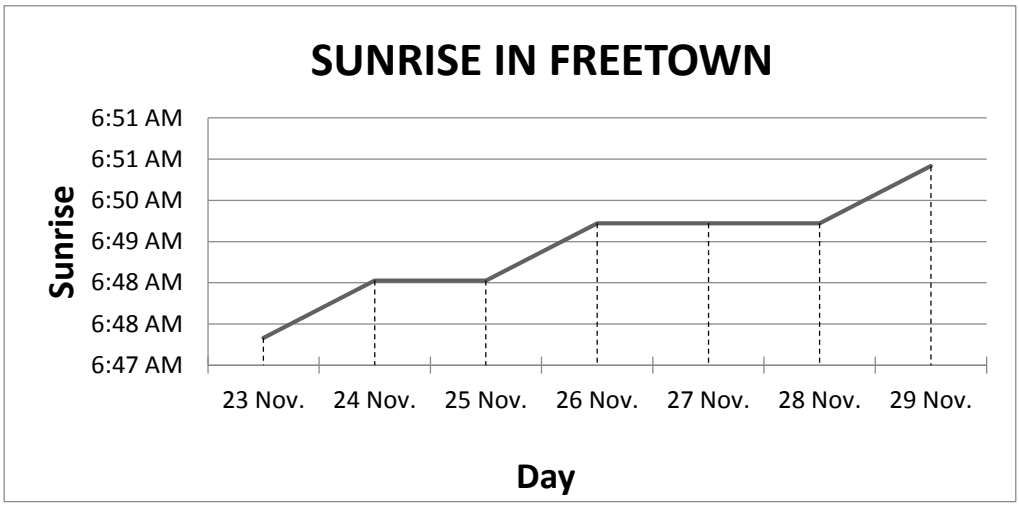
Opening *(3 minutes)*

1. Ask questions to revise charts and graphs. For example:
   a) What is a bar chart? (Answer: A chart with rectangular bars of equal width that interpret statistical information)
   b) What is a line graph? (Answer: A graph used to display data or information that changes continuously over time)
   c) What is a pie chart? (Answer: A type of graph in which a circle is divided into sectors that each represents a proportion of the whole)
   d) What is a stem diagram? (Answer: A special type of table with data divided between two columns. The first digit or digits are in the left column. The last digit is in the right column.)
2. **Say:** Today we are going to learn how to decide on the best type of graph or chart to represent data we collect.

Introduction to the New Material *(12 minutes)*

1. **Say:** Bar chart and line graph are used to compare different amounts. Pie charts (circle graphs) are use when you are trying to compare parts of a whole. They do not show changes over time. Stem diagrams show the frequency of which certain numbers occur.
2. Write the following problem and table (see table at right) on the board:
   The table shows the time of sunrise recorded in Freetown for seven days. Construct a graph which best demonstrates the time of sunrise for each day.
3. **Ask:** What is the appropriate chart or graph for this data?
4. Discuss the answers as a class. Have pupils share their ideas and explain why they think that a particular chart or graph is best. (Example answers: bar chart, pie chart, line graph)
5. **Say:** The table does not indicate any parts in relation to a whole, so a pie chart (or circle graph) is not the right choice.
6. **Say:** We want to compare different values, and we can see that the data is changing over time. A line graph would be the best choice for displaying this data.
7. Have pupils help to draw the line graph on the board (see line graph below).

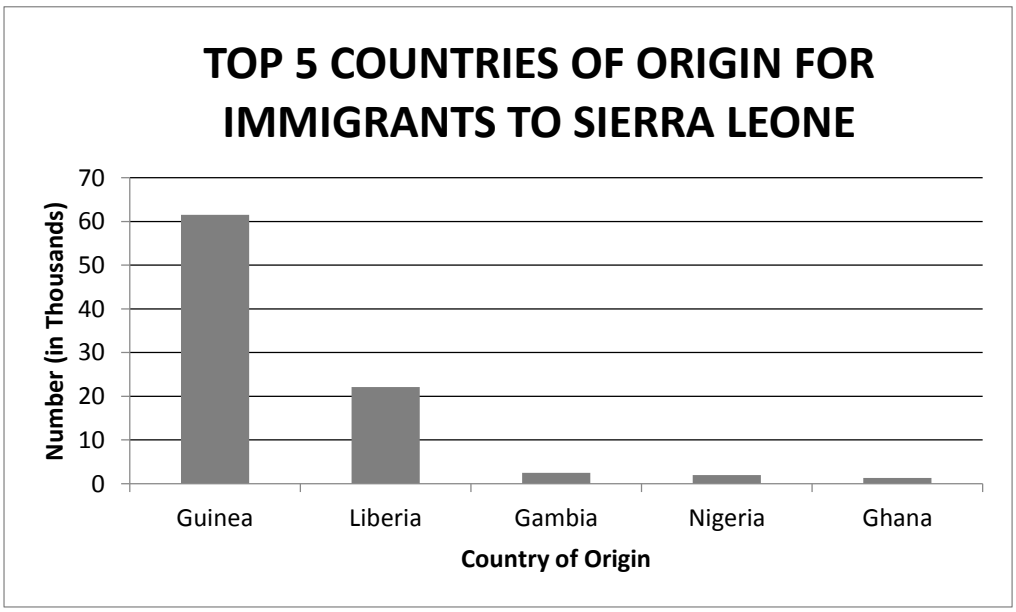
TIME OF SUNRISE IN NOV. 2015	
Date	**Time of Sunrise**
23 Nov.	6.48 am
24 Nov.	6.49 am
25 Nov.	6.49 am
26 Nov.	6.50 am
27 Nov.	6.50 am
28 Nov.	6.50 am
29 Nov.	6.51 am



Guided Practice *(8 minutes)*

TOP 5 COUNTRIES OF ORIGIN FOR IMMIGRANTS TO SIERRA LEONE (2013)	
Country	**Frequency (in Thousands)**
Guinea	61.5
Liberia	22.1
Gambia	2.5
Nigeria	2
Ghana	1.3
Total	89.5

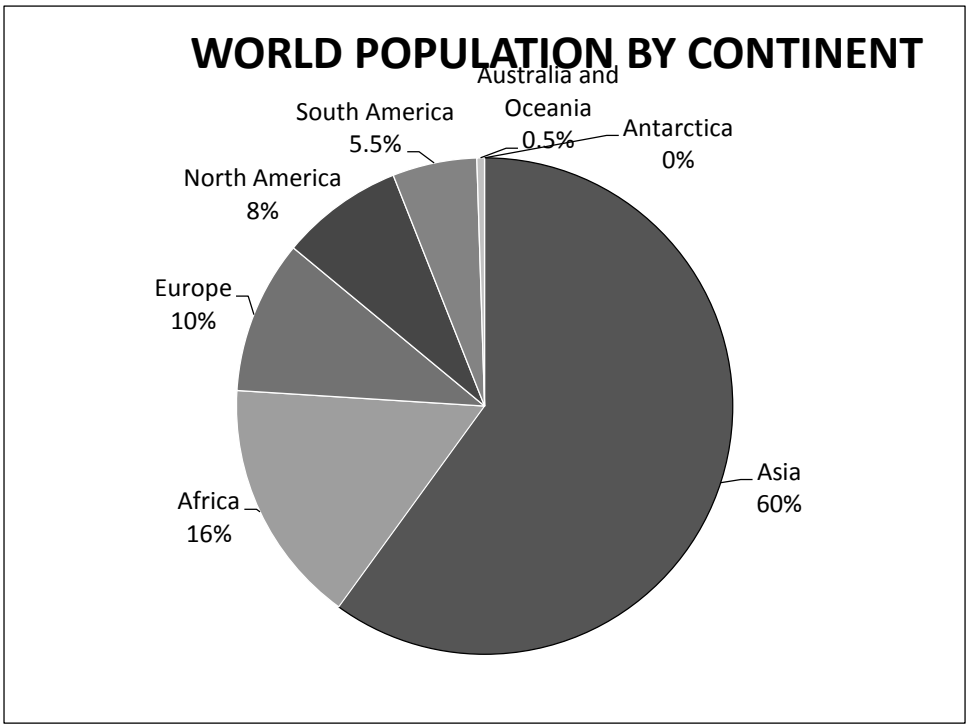
1. Draw the table to the right on the board.
2. **Say:** This table shows the top five countries of origin for immigrants coming to Sierra Leone.
3. Ask pupils to work in pairs.
4. **Say:** With your partner, draw the graph or chart that best displays this information.
5. Move around the classroom to make sure pupils understand and are doing the task. If they have difficulty deciding which graph or chart to use, guide them to use a bar chart. Encourage them to count by ten's on the y-axis.
6. Draw the empty bar graph on the board.
7. Invite different pairs to come to the front and draw the five bars on the chart. Make corrections if necessary. (Answer: see below)



Independent Practice *(10 minutes)*

WORLD POPULATION BY CONTINENT	
Continent	**Percentage of Population**
Asia	60%
Africa	16%
Europe	10%
North America	8%
South America	5.5%
Australia and Oceania	0.5%
Antarctica	0%

1. Write the problem and the table (see table to the right) on the board:
   The table shows the approximate percentages of the population of the world divided by continent. Draw the graph or chart that best shows the population by continent.
2. Ask pupils to work individually to solve the problem.
3. Move around the classroom to make sure pupils understand and are doing the task. For example, make sure pupils understand that a pie chart is the best way to represent the data because it shows percentages of a whole.
4. When they have finished, ask pupils to work in pairs to share and compare their answers.
5. Invite a volunteer to come to the board and present the answer. Make corrections if necessary.
6. Discuss answers as a class. (Answers: see below)
   $\text{Asia} = \frac{60}{100} \times 360° = 216°;\ \text{Africa} = \frac{16}{100} \times 360° = 57.6;\ \text{Europe} = \frac{10}{100} \times 360° = 36°;$
   $\text{North America} = \frac{8}{100} \times 360° = 28.8°; \text{South America} = \frac{5.5}{100} \times 360° = 19.8°; \text{Australia} = \frac{0.5}{100} \times 360° = 1.8°$



Closing *(2 minutes)*

1. Ask the following questions about the graphs to revise the material:
   a) Approximately how many Nigerians immigrated to Sierra Leone in 2013?
   b) What percentage of the population of the world lives in Asia?
   c) What percentage of the population of the world lives in North or South America?
   d) What time did the sun rise on 26 November 2015?
2. Discuss the answers as a class. (Answers: a) 2000; b) 60%; c) $8 + 5.5 = 13.5\%$; d) 6.50 am)

Lesson Title: Practise Making Statistical Calculations	**Theme:** Statistics and Probability	
Lesson Number: M-08-150	**Class/Level:** JSS 2	**Time:** 35 minutes

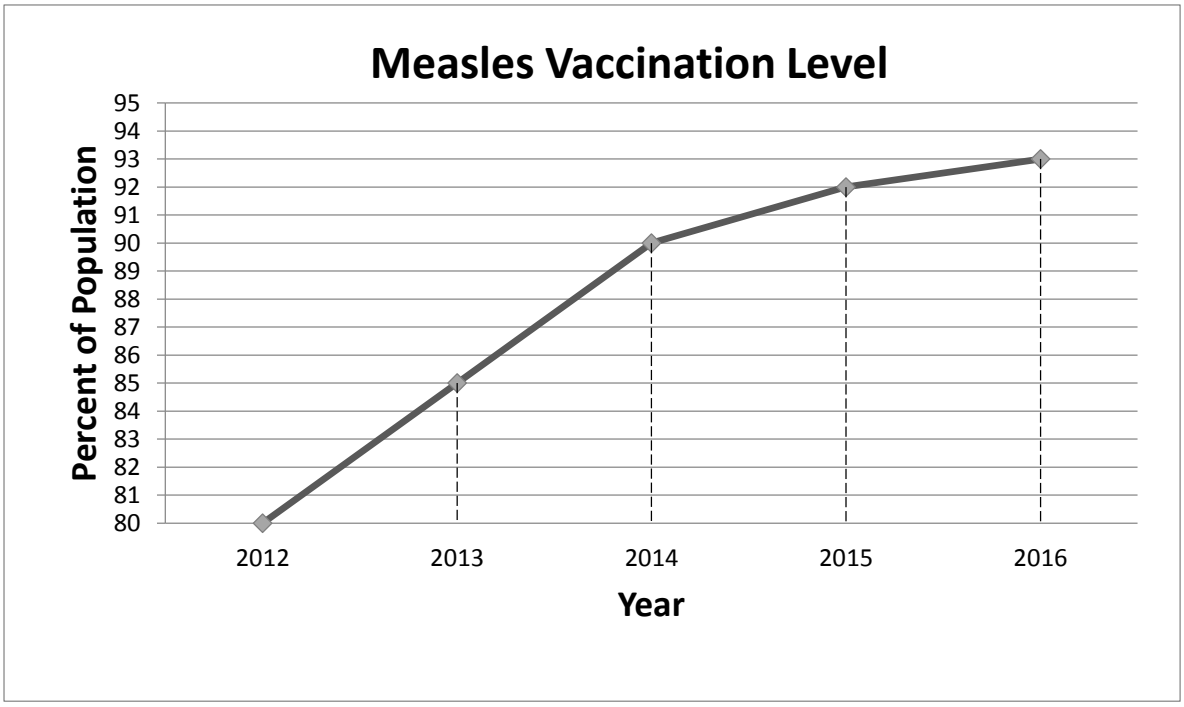
Learning Outcomes By the end of the lesson, pupils will be able to calculate the mean, median, mode from various types of graphs and charts.	**Teaching Aids** None	**Preparation** None

Opening *(2 minutes)*

1. Ask pupils the following questions:
   a) What statistical measures have we learned?
   b) Why are these measures useful?
2. Have pupils raise their hand to answer. (Answers: a) Mean, median, mode and range; b) They help us to understand the data better, to see the middle of the data, etc.)
3. **Say:** Today, we will practise calculating mean, median, mode and range from different types of charts and graphs.

Introduction to the New Material *(12 minutes)*

1. Draw the following line graph on the board:

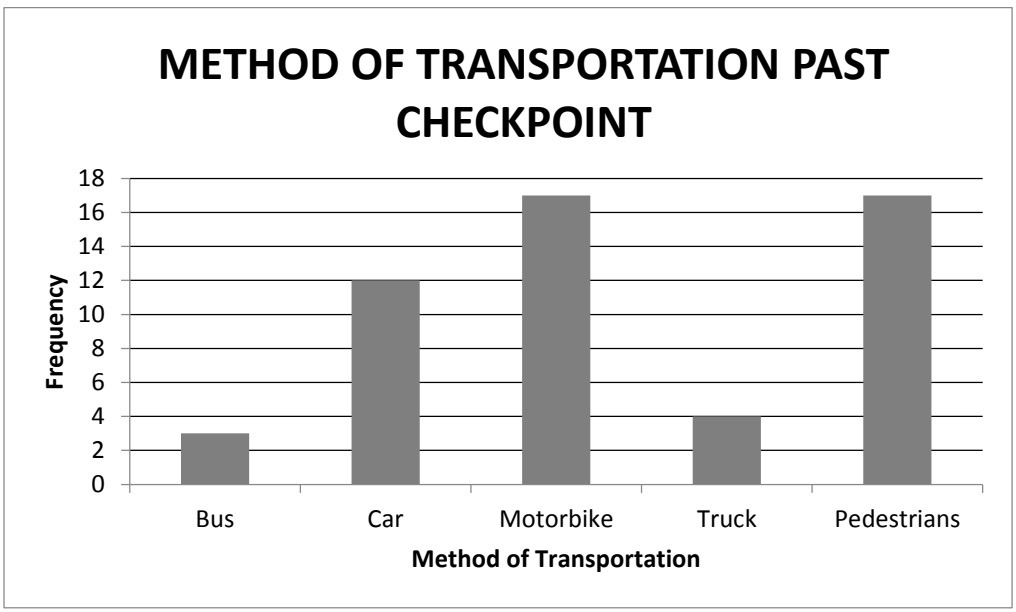


2. Discuss the meaning of the graph as a class. (Answer: It shows the percent of the population that received the measles vaccination rising over the last several years).
3. **Say:** Let's calculate the mean, median, mode and range of the numbers on the graph.
4. **Ask:** Who can tell me how to calculate the mean? (Answer**:** Add the numbers together and divide by the number of items, 5.)

5. Ask pupils to make a list of the numbers for each year by reading the line graph. Write the answers on the board. (Answer: 80%, 85%, 90%, 92%, and 93%)
6. Ask pupils to find the sum of the numbers in their exercise books. Write the answer on the board. (Answer: $80\% + 85\% + 90\% + 92\% + 93\% = 440$)
7. **Ask:** What is 440 divided by 5? (Answer**:** 88%)
8. **Say:** The percentage of the population who received the vaccination is 88%.
9. Ask pupils how they interpret this information. Discuss ideas as a class. (Example answer: Between 2012 and 2016, an average of 88% of the population received the vaccination.)
4. **Ask:** What is the median? (Answer: 90%)
5. **Ask:** What is the mode of the data? (Answer: There is no mode)
6. **Ask:** How can we calculate the range of the data? (Answer**:** Subtract the lowest number from the highest number.)
7. Ask pupils to calculate the range in their exercise books.
8. Invite a volunteer to calculate the range on the board. Make corrections if necessary. (Answer: $93\% - 80\% = 13\%$)
9. **Say:** The range in the percentage of the population that received the vaccination was 13%.
10. Write the four statistical values together on the board in summary:
    Mean $= 88\%$ Median $= 90\%$ Mode$=$ None Range$= 13\%$

Guided Practice *(9 minutes)*

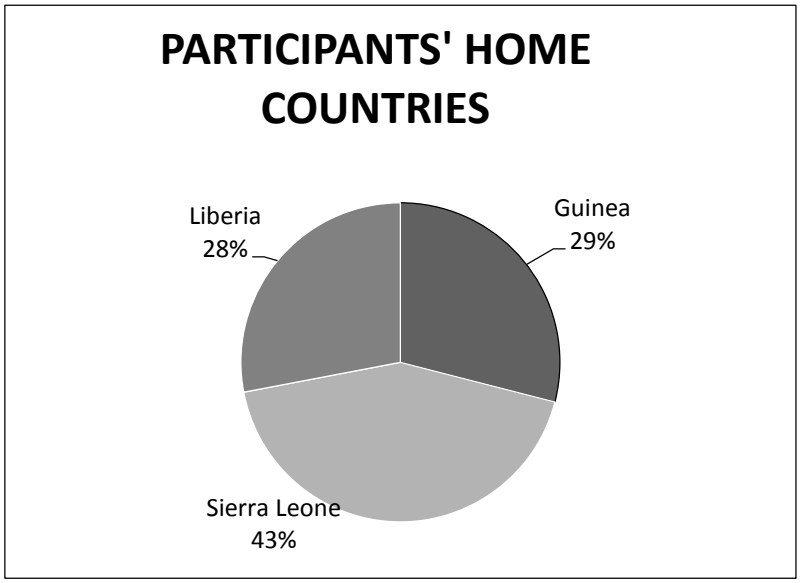
1. Write the following bar chart on the board:



2. Ask pupils to work in pairs to find the mean, median, mode and range of the data.
3. Move around the classroom to make sure pupils understand and are doing the task. Help struggling pupils.
4. Invite four different pairs to come to the board and write the answers for the calculations. Make corrections if necessary. (Answers: Mean $= 3 + 12 + 17 + 4 + 17 = \frac{53}{5} = 10.6$; Median $= 12$; Mode $= 17$; Range $17 - 3 = 14$)
5. Ask pupils to compare their answers with the answers on the board.

Independent Practice *(10 minutes)*

1. Draw the pie chart (circle graph) to the right on the board.
2. Write the following problem on the board:
   There are 100 participants in an event held by the Mano River Union Youth Parliament in Freetown. The pie chart shows which countries participants are from. Find the mean, median, mode and range.
3. Ask pupils to work individually to find the mean, median, mode and range.
4. Move around the classroom to make sure pupils understand and are doing the task. Help struggling pupils.



5. When pupils have finished, ask them to share and compare their answers with a partner.
6. Invite four different pupils to come to the board and write the answers. Make corrections if necessary. (Answers: Mean: $28 + 29 + 43 = \frac{100}{3} = 33.3$; Median: 29; Mode: None; Range: $43 - 28 = 15$)
7. Ask pupils to compare their answers with the answers on the board.

Closing *(2 minutes)*

1. Ask pupils the following questions about the charts and graphs to revise the material:
   a) What percentage of the population of Sierra Leone had received the measles vaccination in 2015?
   b) What method of transportation was the most common past the checkpoint?
   c) What percentage of the participants at the Mano River Union Youth Parliament event came from Sierra Leone?
2. Discuss answers as a class. (Answers: a) 92%; b) Motorbike and pedestrian both had the highest number: 17; c) 43%)

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