

# CBC Grade 10 Mathematics Lesson Plan

## Multiplication Rule

<b>Strand</b>	<b>Statistics and Probability</b>
<b>Sub-Strand</b>	Probability 1: Multiplication Rule
<b>Specific Learning Outcome</b>	Apply the laws of probability in different situations
<b>Key Inquiry Questions</b>	How is probability applied in real life situations?
<b>Learning Resources</b>	CBC Grade 10 textbooks, dice, coins, calculators
<b>Lesson Duration</b>	40 minutes

### Lesson Structure Overview

Phase	Activity	Duration
Phase 1	Problem-Solving and Discovery (Anchor Activity)	15 minutes
Phase 2	Structured Instruction (Key Takeaways)	10 minutes
Phase 3	Practice and Application (Worked Examples)	15 minutes
Phase 4	Assessment (Exit Ticket)	5 minutes

### Phase 1: Problem-Solving and Discovery (15 minutes)

#### Anchor Activity: Quality Control Problem

#### Work in groups

A factory produces 90% good items and 10% defective items. A quality check is performed on two randomly selected items.

Tasks:

- (a) Find the probability that both items are good.
- (b) Find the probability that at least one item is defective.
- (c) Are these events independent? Explain.

#### Teacher Guidance for Anchor Activity

This anchor activity introduces students to the multiplication rule through a real-world quality control scenario. Students must reason about compound events and discover how to calculate probabilities when multiple events occur together.

Facilitation Strategy:

- Allow students to explore different approaches (tree diagrams, lists, calculations)
- Circulate and observe student strategies
- Ask probing questions: "How do you find the probability of TWO things happening?"  
"Does the first selection affect the second?"
- Guide students to see that probabilities can be multiplied
- For part (b), help students recognize "at least one defective" means  $1 - P(\text{both good})$
- Use student discoveries as a bridge to formal multiplication rule

## Phase 2: Structured Instruction (10 minutes)

### Key Takeaways

After students have explored through the anchor activity, formalize their discoveries with these key concepts:

#### 1. The Multiplication Rule

The multiplication rule is used to find the probability of two events happening together (both occurring).

#### 2. Independent Events

When two events are independent (one does not affect the other), the probability of both occurring is:

$$P(\mathbf{A \text{ and } B}) = P(\mathbf{A}) \times P(\mathbf{B})$$

Examples of independent events:

- Tossing a coin and rolling a die
- Weather on Monday and weather on Tuesday
- Rolling two dice simultaneously

#### 3. Dependent Events

When two events are dependent (the first event affects the probability of the second), we use:

$$P(\mathbf{A \cap B}) = P(\mathbf{A}) \times P(\mathbf{B|A})$$

Here,  $P(\mathbf{B|A})$  is the conditional probability—the probability that B happens given that A has already occurred.

Examples of dependent events:

- Drawing two cards without replacement
- Selecting two students from a class without replacement

#### 4. Key Distinction

Independent: The outcome of one event does NOT affect the other

Dependent: The outcome of one event DOES affect the other

#### Scaffolding Strategies

Address common misconceptions revealed during the anchor activity:

- Clarify when to multiply vs. add probabilities (multiply for "and", add for "or")
- Emphasize that multiplication makes probabilities smaller (compound events are less likely)
- Use tree diagrams to visualize compound events
- Connect to real-world contexts: quality control, weather forecasting, genetics

#### Phase 3: Practice and Application (15 minutes)

##### Worked Examples

##### *Example 1: Die and Coin (Independent Events)*

A student in Modegashe primary school was instructed to roll a die and toss a coin. What was the probability of rolling a 4 on the die and getting heads on the coin?

Solution:

Step 1: Identify the events

- Event A: Rolling a 4 on the die
- Event B: Getting heads on the coin

Step 2: Find individual probabilities

- $P(\text{rolling a 4}) = 1/6$
- $P(\text{getting heads}) = 1/2$

Step 3: Check if events are independent

Yes! The die roll does not affect the coin toss.

Step 4: Apply multiplication rule

$$P(4 \text{ and } H) = P(4) \times P(H) = 1/6 \times 1/2 = 1/12$$

Answer: The probability is  $1/12$  or approximately 8.33%

##### *Example 2: Bus Problem (Dependent Events)*

A person has a 60% probability of catching the first bus and an 80% probability of catching the second bus (if they miss the first one).

(a) Find the probability that the person catches the first bus.

Solution:  $P(A) = 0.6$  or 60%

(b) Find the probability that the person misses the first bus but catches the second.

Solution:

- $P(\text{miss first}) = 1 - 0.6 = 0.4$
- $P(\text{catch second} \mid \text{miss first}) = 0.8$
- $P(\text{miss first AND catch second}) = 0.4 \times 0.8 = 0.32$  or 32%

(c) Find the probability that the person misses both buses.

Solution:

- $P(\text{miss first}) = 0.4$
- $P(\text{miss second} \mid \text{miss first}) = 1 - 0.8 = 0.2$
- $P(\text{miss both}) = 0.4 \times 0.2 = 0.08$  or 8%

### **Example 3: Anchor Activity Solution**

Factory problem: 90% good items, 10% defective items. Two items selected.

(a) Probability both items are good:

$P(\text{both good}) = P(\text{first good}) \times P(\text{second good}) = 0.9 \times 0.9 = 0.81$  or 81%

(b) Probability at least one item is defective:

$P(\text{at least one defective}) = 1 - P(\text{both good}) = 1 - 0.81 = 0.19$  or 19%

(c) Are events independent?

Yes, assuming the factory produces many items, selecting one item does not significantly affect the probability for the next item.

### **Individual Practice (Students work independently)**

Provide students with similar problems to solve:

1. Two coins are tossed. Find  $P(\text{both heads})$
2. A die is rolled and a coin is tossed. Find  $P(6 \text{ and tails})$
3. Two seeds each have 75% germination rate. Find  $P(\text{both germinate})$

### **Phase 4: Assessment - Exit Ticket (5 minutes)**

Students complete individually to demonstrate understanding:

Question 1: A coin is tossed twice. What is the probability of getting heads on both tosses?

Question 2: A die is rolled, and a coin is tossed. What is the probability of rolling a 6 and getting tails?

Question 3: A weather forecast predicts a 60% chance of sunshine on Monday and a 70% chance of sunshine on Tuesday. Assuming these forecasts are independent, what is the probability of sunshine on both Monday and Tuesday?

Question 4: A farmer in Gakuonyo plants two seeds. Each seed has a 75% chance of germinating. What is the probability that both seeds germinate?

#### Exit Ticket Answer Key

Question 1:  $P(H \text{ and } H) = 1/2 \times 1/2 = 1/4$  or 25%

Question 2:  $P(6 \text{ and } T) = 1/6 \times 1/2 = 1/12$  or 8.33%

Question 3:  $P(\text{sun both days}) = 0.6 \times 0.7 = 0.42$  or 42%

Question 4:  $P(\text{both germinate}) = 0.75 \times 0.75 = 0.5625$  or 56.25%

### Differentiation Strategies

#### For Struggling Learners:

- Use tree diagrams to visualize all outcomes
- Start with simple two-event problems
- Provide formula cards for reference
- Use concrete examples (coins, dice) before abstract problems
- Allow calculators for multiplication
- Practice converting percentages to decimals

#### For Advanced Learners:

- Introduce three or more compound events
- Explore dependent events with conditional probability
- Challenge with "at least one" problems requiring complement rule
- Investigate real-world applications (genetics, reliability engineering)
- Combine multiplication rule with addition rule
- Explore Bayes' theorem as an extension

### Extension Activity

#### Real-World Probability Investigation

Objective: Apply multiplication rule to analyze real-world scenarios.

Activity Description:

1. Research a real-world application of the multiplication rule (choose one):

- • Medical testing accuracy (true positive and true negative rates)
  - • Weather forecasting (multiple day predictions)
  - • Quality control in manufacturing
  - • Sports (probability of winning multiple games)
  - • Genetics (probability of inheriting traits)
5. 2. Identify the compound events involved.
  6. 3. Determine if events are independent or dependent.
  7. 4. Calculate relevant probabilities using the multiplication rule.
  8. 5. Present findings to the class with visual aids.

### Game Design Challenge

Students design a probability game:

- • Create a game involving multiple random events (dice, coins, spinners)
- • Define winning conditions based on compound events
- • Calculate the probability of winning using the multiplication rule
- • Adjust game rules to make it fair or challenging
- • Test the game with classmates and verify calculated probabilities

### Post-Lesson Reflection for Teachers

- • Did students successfully distinguish between independent and dependent events?
- • Were students able to apply the multiplication rule correctly?
- • What misconceptions emerged during the lesson?
- • How well did students understand when to multiply vs. add probabilities?
- • Did the anchor activity effectively introduce the concept?
- • What adjustments are needed for future lessons on this topic?