Lesson Plan: Derivatives as Rates of Change

Subject: Mathematics
Course: IB Mathematics Analysis and Approaches
Level: IB SL
Topic: Derivatives Interpreted as Rates of Change
Duration: 60 minutes

Lesson Objectives

By the end of the lesson, students will be able to:

1. Interpret the derivative as a rate of change.
2. Apply the concept of derivatives to real-world scenarios, such as velocity, profit, and volume changes.
3. Differentiate between average and instantaneous rates of change.

Resources

- PowerPoint presentation: *"Derivatives as Rates of Change"*
- Graphing tools (desmos, TI calculators, or similar)
- Worksheets for practice problems
- Whiteboard and markers

Lesson Outline

1. Starter Activity (5 minutes)

- **Objective:** Engage students and recall prior knowledge.
- **Activity:**
  Pose the question:
  "What does the slope of a line represent in a graph? Can you relate it to something in the real world?"
  Facilitate a brief discussion connecting the gradient to concepts like speed, growth rates, etc.

---

2. Introduction to Concept (10 minutes)

- **Objective:** Explain the derivative as a rate of change.
- **Activity:**
  - Use the first few slides of the PowerPoint to explain:
    - The derivative $f'(x)$ measures how $f(x)$ changes as x increases.
    - Real-life examples (e.g., velocity as the rate of change of distance with respect to time).
  - Discuss the difference between average and instantaneous rates of change.
  - Introduce the formula and notation for derivatives in context.

3. Inquiry-Based Activity (25 minutes)

- **Objective:** Develop understanding through exploration.
- **Activity 1 (15 minutes):**
  - **Scenario:** A diver jumps off a platform; their height is modeled by $s(t) = -4.9t^2 + 4.9t + 10$.
  - **Task:**
    - Calculate the average velocity over various intervals (e.g., [1, 2], [1, 1.5], etc.).
    - Find the instantaneous velocity at $t = 1$using the derivative.
  - Students work in pairs using graphing tools to visualize the secant and tangent lines.
- **Activity 2 (10 minutes):**
  - **Scenario:** Profit of a mining company is modeled by $P(x) = 2.3x - 0.05x^2 - 12$.
  - **Task:**
    - Determine the profit at different production levels (e.g., $x = 0, 6, 23$).
    - Interpret the results in terms of profitability and decision-making.

---

4. Class Discussion (10 minutes)

- **Objective:** Reflect on findings and deepen understanding.
- **Activity:**
  - Discuss results from both scenarios.
  - Highlight how the derivative provides critical insights into changes and decisions in real-world contexts.
  - Address misconceptions, if any.

---

5. Conclusion and Plenary (10 minutes)

- **Objective:** Reinforce learning and provide closure.
- **Activity:**
  - Quick quiz: Three questions on interpreting the derivative as a rate of change.
  - Exit ticket:
    "Write one real-world scenario where you think derivatives could be applied and why."

Homework/Extension

- Complete a worksheet involving scenarios such as changes in water volume, profit maximization, and distance-time relations.