

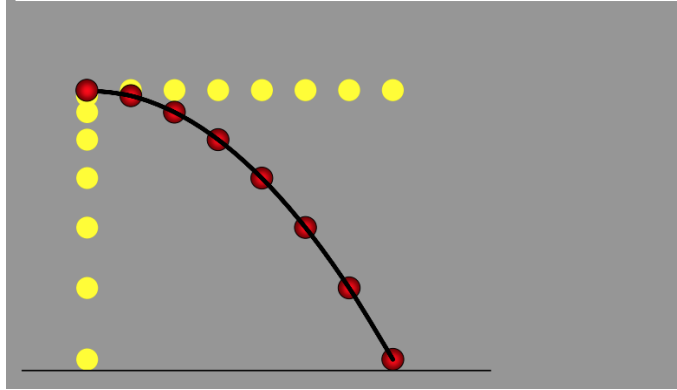
Lesson Plan: Motion of projectile

Teacher: Pedro Blaya

Subject: PHYSICS

Title : Lesson	Time : 1 class period (50')
Subject : <i>PHYSICS</i>	
Aim: Analyze projectile motion in perpendicular directions to understand one-dimensional motion and decomposition.	
Key CS elements: decomposition, pattern recognition, abstraction, algorithm design	
Age group : 3st -4nd ESO, 15 year olds	
Learning situations: <ul style="list-style-type: none">● Apply computational thinking skills to design and implement a method for understanding the motion of a projectile.● Analyze and interpret graphics.	Activity type : Drawing the motion of a projectile in two forms, horizontal motion and vertical motion.
Resources : <ul style="list-style-type: none">● They employ tools such as a ruler● Writing pencil,● and calculator to analyze the curvilinear trajectory that forms a parabolic shape.	
Learning development:	
First we identify the problem: An excellent example that promotes computational thinking in physics is the study of projectile motion, specifically the topic of a horizontal shot. This complex motion can be effectively understood by breaking it down into simpler motions along two perpendicular directions.	
1. Decomposition: Discuss about the movement (30 minutes) The session begins by explaining the concept of horizontal projectile launch and its relevance in physics and practical applications. Briefly discuss the variables involved, such as initial velocity, height, and launch angle. Presents students with the problem to be solved: simulating the trajectory of a projectile launched horizontally from a certain height with a known initial velocity.	

Projectile motion_Horizontale shot (HH)



Explain that horizontal motion occurs with constant velocity (since there's no acceleration), while vertical motion occurs under constant acceleration (due to gravity).

Ask students to decompose the motion of a projectile into these two components on their worksheet

2. Pattern recognition:

Show that horizontally, the object moves with constant velocity, and vertically, it accelerates under gravity.

Have students compare projectile motion with other physics concepts they've learned (e.g., free fall in the vertical motion)

Decomposing the two-dimensional complexity of the horizontal shot into one-dimensional segments allows students to identify recognizable patterns. The fields in both directions are interconnected, and each segment follows an exact physical law where time serves as the initial variable. Students measure field values in both the x and y directions, considering various combinations of fields. They form pairs of field values for each individual time interval, observe changes in the values as the total elapsed time progresses, and add the accumulated field values to subsequent segments in the x direction.

Table 1. Values of quantities specific to HH, especially for each segment when breaking down a shot into simple movements.

Δx (cm)	2,4	2,4	2,4	2,4	2,4
Δy (cm)	1,2	1,8	2	4	7

Table 2. Values of quantities specific to HH, for each subsequent segment when breaking down a shot into simple movements.

Δx (cm)	2,4	2,4	2,4	2,4	2,4
y (cm)	1,2	3	5	9	16

Table 3. Values of quantities characteristic of HH, in relation to equal time intervals, when breaking down a shot into simple movements.

x (cm)	2,4	4,8	7,2	9,6	12
y (cm)	1,2	3	5	9	16

Data Analysis (25 minutes):

- Guide students in organizing and analyzing the data
- Explain the meaning of each parameter. Introduce concepts velocity, acceleration.

3. Abstraction:

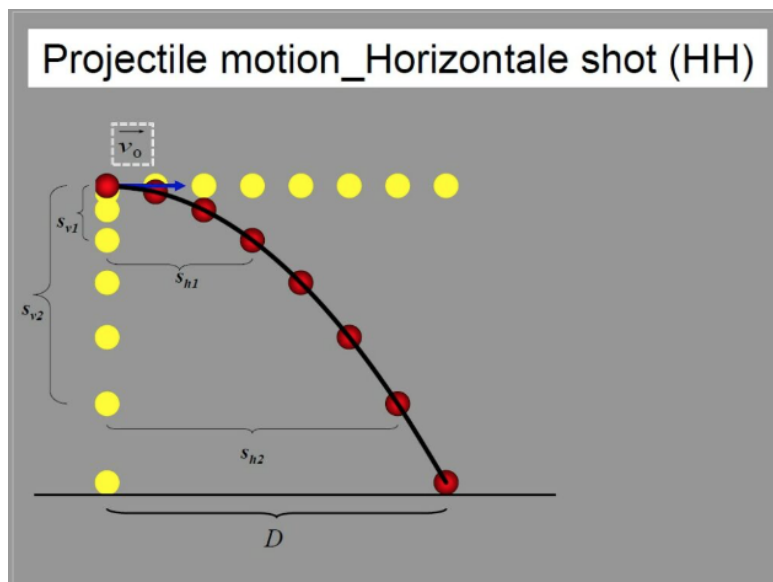
Focus on core factors like initial velocity, angle, gravitational acceleration, and time.

Ignore factors such as air resistance to simplify the model.

Abstract the horizontal and vertical equations of motion.

Graphing and Interpretation (20 minutes):

- Assist students in creating graphs of their data using graphing software or a spreadsheet program.
- Instruct them to interpret their graphs and draw conclusions about the accuracy of their measurements



Analyze the curvilinear trajectory that forms a parabolic shape. By applying physical laws, the trajectory is divided into segments or fields, with equal segments in the horizontal (x) and vertical (y) directions. Each horizontal segment determines the length of the corresponding field in the vertical direction.

the equations for each direction are:

$$x = x_0 + v \cdot t$$

$$y = H - \frac{1}{2}gt^2$$

4. Create the Algorithm

Activity: Create a step-by-step plan to solve projectile motion problems.

Step 1: Identify known quantities (initial velocity, height, etc.).

Step 2: Separate horizontal and vertical motions.

Step 3: Use kinematic equations to calculate vertical displacement and time of flight.

Step 4: Use time of flight to calculate horizontal range.

Step 5: Predict the projectile's trajectory and final position.

Have students work through a sample problem using these steps.

Conclusion (10 minutes):

- Summarize the main takeaways from the lesson, highlighting the integration of computational thinking.
- Provide opportunities for further exploration or applications of computational thinking in real-world scenarios.

Expected results: Students will be able to apply computational thinking principles—decomposition, pattern recognition, abstraction, and algorithm design—to the study of projectile motion. They will break the problem into manageable parts, recognize motion patterns, focus on essential variables, and solve projectile motion problems systematically. Students will gain both a deeper understanding of the physics involved and improved problem-solving skills, with connections to computational approaches.

Assessment: Monitoring the students responses, and try to elicit from them the correct answers.

Assessment Test

Instructions:

Answer the following questions based on your understanding of projectile motion and how we can use computational thinking to solve problems related to it. Show all work where necessary.

Section 1: Multiple Choice (5 Questions)

- 1. Which of the following best describes horizontal motion in projectile motion?**
 - A) Constant acceleration
 - B) Constant velocity
 - C) Increasing velocity due to gravity
 - D) Decreasing velocity due to gravity
 - 2. What force primarily affects the vertical motion of a projectile?**
 - A) Friction
 - B) Gravity
 - C) Wind resistance
 - D) Tension
 - 3. In projectile motion, how do the horizontal and vertical components of motion relate to each other?**
 - A) They depend on each other.
 - B) They are independent of each other.
 - C) They both accelerate at the same rate.
 - D) The horizontal component causes the vertical component.
 - 4. Which of the following is an example of decomposition in projectile motion?**
 - A) Ignoring air resistance
 - B) Separating the motion into horizontal and vertical components
 - C) Focusing only on the velocity
 - D) Repeating steps in solving the problem
 - 5. What does pattern recognition help with in solving projectile motion problems?**
 - A) Identifying initial velocity
 - B) Understanding that horizontal velocity remains constant
 - C) Measuring distance
 - D) Determining the mass of the object
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Section 2: Short Answer (2 Questions)

6. **Explain how the principle of abstraction is used when solving projectile motion problems. Provide an example.**
(2-3 sentences)
 7. **Describe one real-life example where you would see projectile motion. Break the motion into horizontal and vertical components. How would you use decomposition to analyze this situation?**
(3-4 sentences)
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Section 3: Problem Solving (2 Questions)

8. **A ball is shot horizontally from the top of a 50-meter cliff with a horizontal velocity of 10 m/s.**
 - **a)** How long does it take for the ball to hit the ground?
 - **b)** How far from the base of the cliff will the ball land?
(Show all steps and calculations using decomposition principles.)
 9. **Design a simple algorithm for solving projectile motion problems. Use the following situation: An object is launched horizontally from a height of 100 meters. Break down the process step-by-step and include the key equations you would use to solve for the time of flight and the range of the object.**
(Write 4-5 clear steps as part of the algorithm.)
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Section 4: True/False (3 Questions)

10. **True or False:** In projectile motion, the time it takes for an object to hit the ground only depends on its initial vertical velocity, not its horizontal velocity.
11. **True or False:** The horizontal and vertical motions of a projectile are independent of each other.
12. **True or False:** When decomposing projectile motion, gravity affects both the horizontal and vertical components of the motion equally.

Total Score: 25 points

- Section 1: Multiple Choice (1 point each) – 5 points
- Section 2: Short Answer (3 points each) – 6 points
- Section 3: Problem Solving (7 points each) – 14 points
- Section 4: True/False (1 point each) – 3 points