

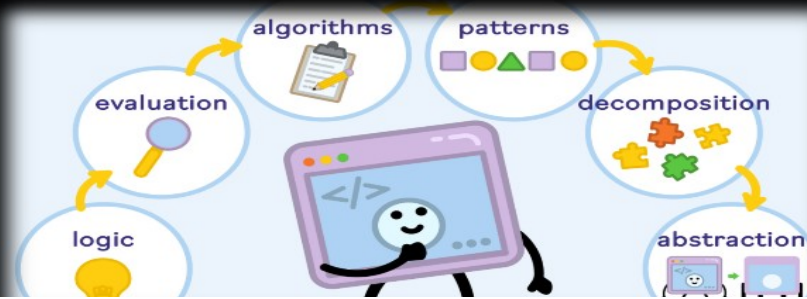
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Lesson Plan Including the 4 principles of Computational Thinking

“Skills to Catch the Future”

Erasmus+ KA220

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Objective: To understand Newton's first law of motion and apply the four principles of computational thinking (decomposition, pattern recognition, abstraction, and algorithms) to explore the concepts of motion and force.

Materials:

Time: 1 hour

Ruler or meter stick


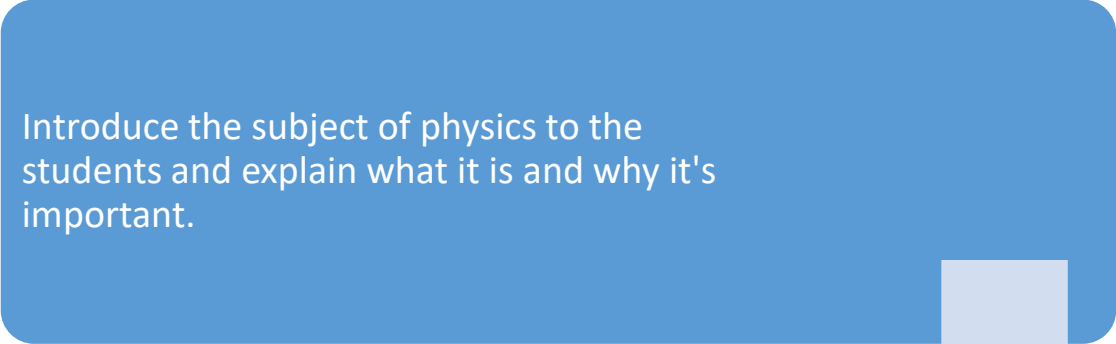
Ball or other small object

Whiteboard/Blackboard and markers


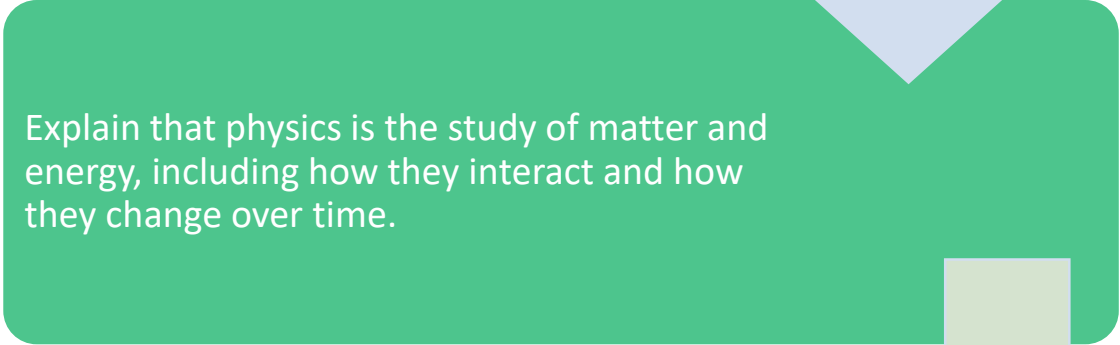
Internet access

Introduction (5-10 minutes):

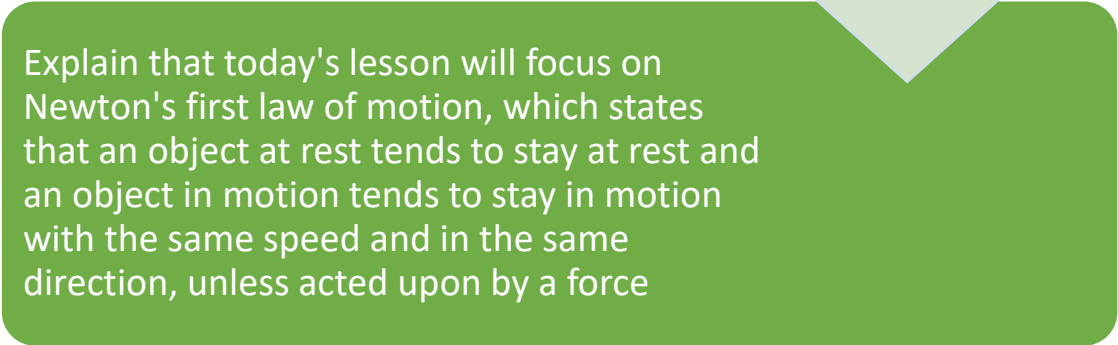
Introduce the subject of physics to the students and explain what it is and why it's important.



Explain that physics is the study of matter and energy, including how they interact and how they change over time.



Explain that today's lesson will focus on Newton's first law of motion, which states that an object at rest tends to stay at rest and an object in motion tends to stay in motion with the same speed and in the same direction, unless acted upon by a force



Part 1: Motion and Force (10-15 minutes):

Explain	Explain the concept of motion, including position, velocity, and acceleration.
Use	Use the ruler or meter stick to demonstrate the different components of motion.
Use	Use a timer in addition to the ruler or meter stick to calculate the velocity of an object.
Discuss	Discuss the concept of force and how it affects motion, including friction, gravity, and air resistance.

**Part 2:
Newton's
First Law of
Motion (15-
20 minutes):**

Explain Newton's first law of motion in more detail, including how it applies to objects at rest and objects in motion.

I. Decomposition

Use **decomposition** to break down the law into smaller parts and examine each part in detail. For example, ask students to identify the components of the law and examine how they relate to each other.

The components of Newton's first law of motion are:

- An object at rest tends to stay at rest
- An object in motion tends to stay in motion with the same speed and in the same direction
- Unless acted upon by a force

These components can be related to each other as follows:

- The first component establishes the natural tendency of an object to remain at rest or in motion.
- The second component defines the motion of an object in motion as constant and unchanging, unless acted upon by a force.
- The third component emphasizes that forces can change an object's motion and thus, interrupt the natural tendency established in the first component

II. Pattern Recognition

Use **pattern recognition** to identify and analyze examples of Newton's first law in the physical world, such as a book on a table or a ball rolling down a hill. For example, ask students to look for patterns in how different objects respond to the law and how the law applies to different types of motion.

Here are a few **examples** of patterns that students could look for in their examination of Newton's first law of motion:

a) Inertia and Mass: Students can observe how objects with different masses respond to the same force. They can look for patterns in how more massive objects have more inertia and are more difficult to move, while less massive objects have less inertia and are easier to move.

Patterns: The pattern is that objects with more mass have more inertia, making them more difficult to move, and objects with less mass have less inertia, making them easier to move

b) Motion of Objects in a Vacuum: Students can observe the motion of objects in a vacuum and look for patterns in how objects in a vacuum move in a straight line, with constant speed, and without any external forces acting on them.

Patterns: The pattern is that objects in a vacuum move in a straight line, with constant speed, and without any external forces acting on them.

III. Abstraction 1/3

Use **abstraction** to simplify the law and focus on its essential elements, such as the relationship between motion and force. For example, ask students to simplify the law to its most basic components and describe how it applies to different situations.

Abstraction in the context of teaching Newton's first law of motion involves simplifying the law to its essential elements and focusing on the relationship between motion and force. This helps students understand the underlying principles of the law more easily.

Here are a few **examples** of how students can simplify the law to its most basic components:

- **Inertia:** Students can simplify the law to its most basic component by focusing on the concept of inertia. They can describe how objects tend to resist changes in their motion, and how more massive objects have more inertia and are more difficult to move.
- **Abstractions:** Inertia is an essential concept in understanding Newton's first law of motion. It refers to an object's tendency to resist changes in its state of motion, meaning it will remain at rest or continue moving at a constant speed and in a straight line unless acted upon by an unbalanced force.

III. Abstraction 2/3

To simplify the concept of inertia, teachers can focus on the following abstractions:

Resistance to Change: Students can simplify the concept of inertia by focusing on its resistance to change. They can describe how objects tend to resist changes in their motion, and how more massive objects have more inertia and are more difficult to move.

Straight Line Motion: Students can simplify the concept of inertia by focusing on its effect on the motion of an object. They can describe how objects tend to move in a straight line, and how this is related to their resistance to changes in their motion.

Constant Speed: Students can simplify the concept of inertia by focusing on its effect on the speed of an object. They can describe how objects tend to move at a constant speed, and how this is related to their resistance to changes in their motion.

III. Abstraction 3/3

b) Motion and Force: Students can simplify the law to its most basic component, which is the relationship between motion and force. They can describe how objects tend to remain at rest or continue moving at a constant speed and in a straight line, unless acted upon by an unbalanced force.

Abstractions: Motion and force are central concepts in understanding Newton's first law of motion. Motion refers to the change in an object's position over time, while force refers to a push or a pull on an object that changes its motion.

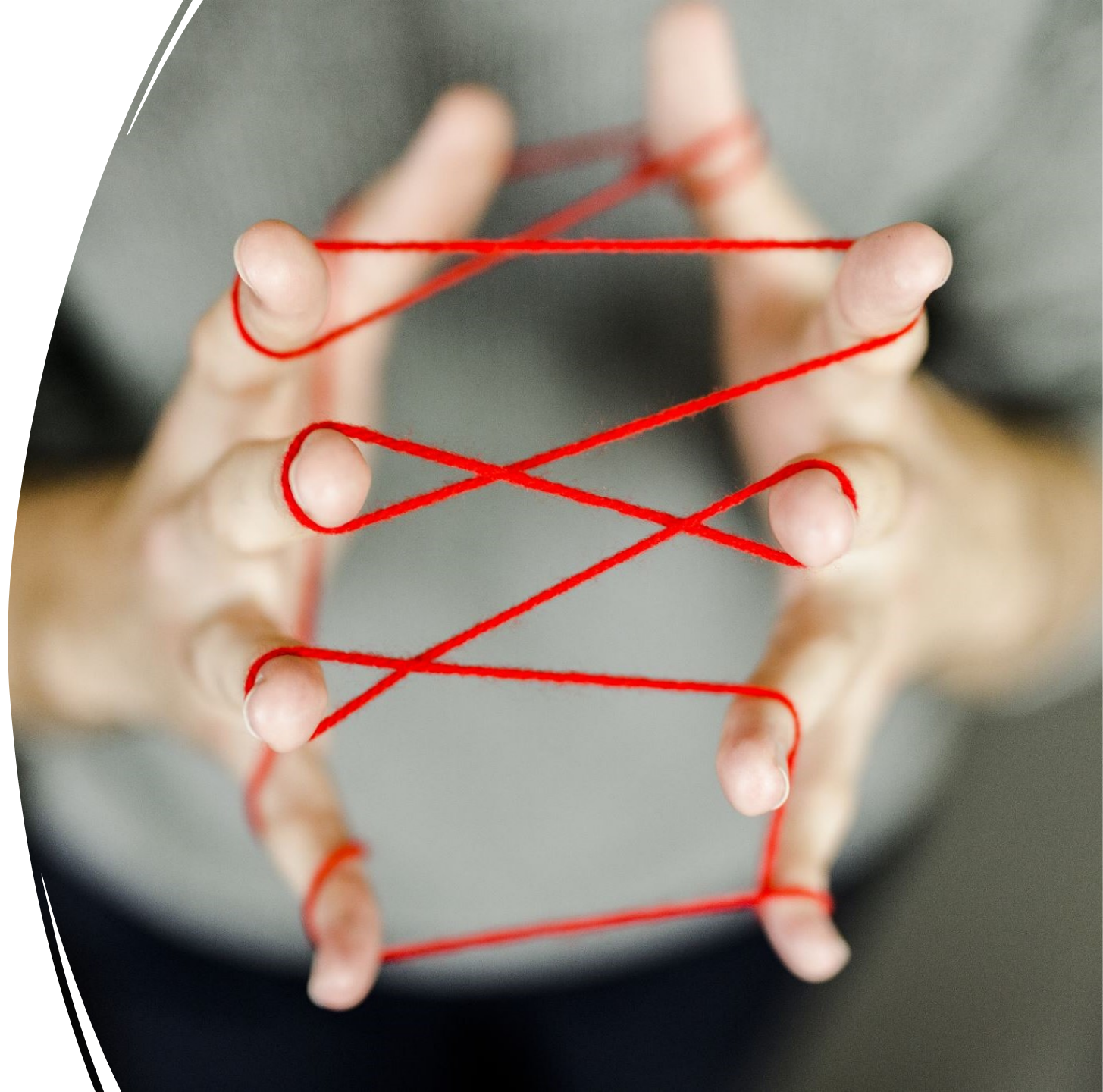
Change in Position: Students can simplify the concept of motion by focusing on its definition as a change in an object's position over time. They can describe how an object's motion can be measured by its displacement, speed, and acceleration.

Push or Pull: Students can simplify the concept of force by focusing on its definition as a push or pull on an object. They can describe how forces can cause objects to accelerate, decelerate, or change direction.

Direction and Magnitude: Students can simplify the concept of force by focusing on its properties of direction and magnitude. They can describe how forces can act in different directions, and how their magnitude determines the extent to which they change an object's motion.

IV. Algorithm Design 1/4

Use **algorithms** to develop a step-by-step process for determining the effect of a force on an object's motion. For example, ask students to develop a process for determining the speed and direction of an object in motion, or for determining the amount of force needed to change an object's motion.



IV. Algorithm Design 2/4

Algorithm for Determining the Effect of a Force on an Object's Motion:

1. Identify the initial state of the object, including its position, velocity, and mass.
2. Determine the force being applied to the object, including its direction and magnitude.
3. Calculate the position of the object using Newton's first law of motion:
When $SF=0$, the object has no velocity ($v=0$) or it has a constant velocity ($v=\text{constant}$). SF is the total force applied on the object.
4. Use the equation of motion to calculate the change in position of the object over time:
 $x = v * t$, where v is the velocity, x is the change in position, and t is the time.
5. Repeat steps 3-4 to calculate the object's position and velocity at different points in time, until the desired time has been reached.
6. Analyze the results to determine the effect of the zero total force on the object's motion, including its speed and direction, and any changes in its position over time.

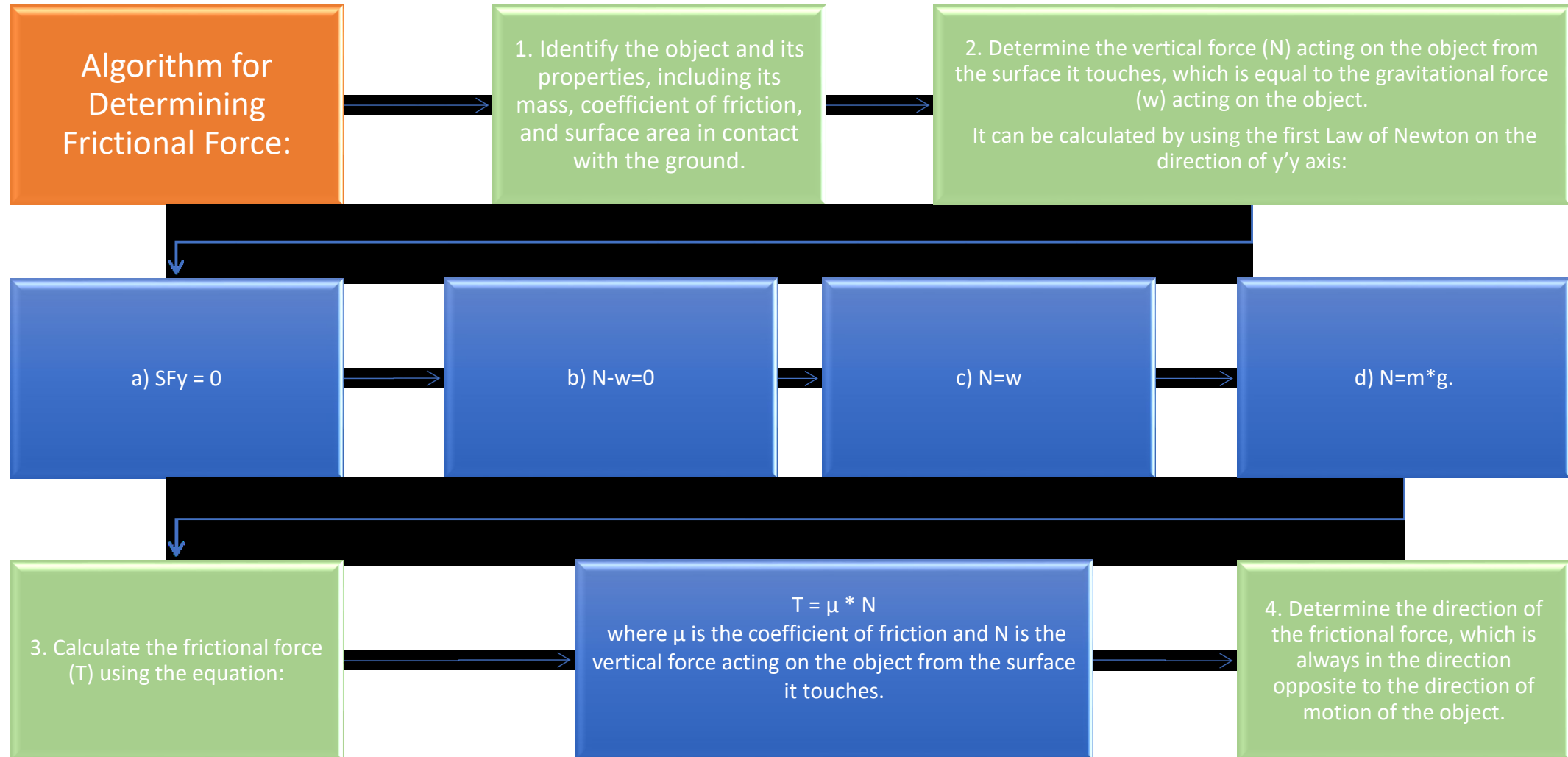
$$p(x) = \frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

c^2

$$ds \geq 0$$

$$\frac{df}{dt} = \lim_{h \rightarrow 0} \frac{f}{h}$$

IV. Algorithm Design 3/4



IV. Algorithm Design 4/4

