

Lesson Topic: Reference Frames and Scale Units

Objective:

Students will be able to:

1. Learn about the concept of movement as it relates to your frame of reference
2. Use a game of movement to describe motion and frame of reference
3. Understand the different terms of motion and record in journal

Time Required: 65 mins

Materials Needed:

- Laptops or Chromebooks
- Science notebook/journal
- Reference Frames and Scale Units handout
- Gym or outdoor open area

Teacher Preparation:

- Watch the video [Relative Motion and Inertial Reference Frames](#)
- Print out and make copies of worksheets at the bottom of lesson plan (1 per student)

Engage (15 minutes):

1. Take students to the gym or an open area and tell them that you will be playing a game of "[Redlight, Greenlight](#)". Line students up on one end of the gym/field in a straight line.
2. When one student gets very close to the finish line, tell everyone to stop.
3. Walk from the finish line to the starting line and tell students that the goal has switched to the other side (the side they came from).
4. Ask students "Are you now further to the finish line or closer than you were before? Who is the closest to winning? Has the race changed and why?"
5. Finish the game of "Redlight, Greenlight" by having students race to the new finish line.

Explore (10 minutes):

1. After returning to the classroom, let students talk about what happened during the game.
 - a. Let students know that how you view the motion and position of objects is all based on your frame of reference. During the game, the frame of reference changed, which completely altered the game and who was closer or further away from winning.
2. Have your students [sign in to Legends of Learning](#). Instruct students to complete the instructional playlist.
3. Have students right down definitions of key vocabulary words in their Reference Frames and Scale Units handout.

Explain (10 minutes):

1. Students will watch a video to recap what was learned through the instructional game.

Stop the video during examples to see if students can relate what was done in the game to the video.

- a. [Relative Motion and Inertial Reference Frames](#)

Elaborate (20 minutes):

1. With students in pairs, have them answer the scenarios provided in the Reference Frames and Scale Units handout.
2. Discuss answers with students to help clarify any misconceptions.
3. Ask students if they have ever encountered this scenario: “You’re sitting in a car that is not moving and the car is next to a tractor trailer, like sitting in traffic for example. You’re looking at the tractor trailer, daydreaming about getting home and playing video games, and then suddenly you are moving backwards! In a panic, you look at the other cars around you and notice they are sitting still and somehow, you have not crashed into the car behind you. Then, you realize that you’re not moving backwards, but the tractor trailer starting moving forward. Why do you think you had that feeling of moving backwards when the tractor trailer started moving?”
 - a. Answer: Your frame of reference, which usually is something stationary, starts moving and motion is relative. Having your frame of reference suddenly start moving “tricks” your brain into thinking you are actually the one moving, not the truck.

Evaluate (10 minutes):

1. Have your students [sign in to Legends of Learning](#). Instruct students to complete the Content Review playlist.
2. [Analyze student results](#) to determine what concepts need to be a focus for reteaching.

Additional Lesson Strategies:

- To use Legends for additional instruction, create a [custom playlist](#) with an [instructional game](#) and pre and post [assessment](#).
- To use Legends for a quick formative assessment, create a 5-question [assessment](#) in a [playlist](#).
- To use Legends for a student-directed experience, create a [targeted freeplay](#) playlist.
- Encourage students to play on their own at home in [Legends of Learning: Awakening](#) for a student-driven experience including avatars, battling, and quests all centered around topics they are covering in class.



Reference Frames and Scale Units

While playing the game in Legends of Learning, write down the definition of the following key vocabulary words:

Motion-

Velocity-

Position-

Time-

Think about each scenario and answer accordingly.

1. You are in the backseat of a car moving in a straight line at a constant speed. You toss a tennis ball straight up. Where does it land?

In your hand in front of you behind you

2. You toss the tennis ball straight up again. While it is in the air, the car accelerates forward. Where does the ball land?

In your hand in front of you behind you

3. You toss it again. While it is in the air, the car slams on its brakes. Where does the ball land?

In your hand in front of you behind you



Reference Frames and Scale Units

Answer Key

While playing the game in Legends of Learning, write down the definition of the following key vocabulary words:

Motion- the change in the position of an object

Velocity- measure of the speed of an object and the direction of which it travels

Position- where an object is located

Time- a point of time as measured in hours and minutes past midnight or noon

Think about each scenario and answer accordingly. (Answers in bold)

2. You are in the backseat of a car moving in a straight line at a constant speed. You toss a tennis ball straight up. Where does it land?

In your hand *in front of you* *behind you*

3. You toss the tennis ball straight up again. While it is in the air, the car accelerates forward. Where does the ball land?

In your hand *in front of you* ***behind you***

4. You toss it again. While it is in the air, the car slams on its brakes. Where does the ball land?

In your hand ***in front of you*** *behind you*