Name _____ Hour _____

Relative Motion
A look at "Frames of Reference"
http://webphysics.davidson.edu/Applets/TaiwanUniv/relativeVelocity/relativeVelocity.html

Introduction
An object may appear to have one motion to one observer and a different motion to a second observer, depending on how the two observers are moving with respect to one another.
This java applet let you view objects from different frames of reference. Imaging there is a river in the center of the screen (yellow dots are moving with water – green area) a red boat is also moving with respect to the river. There is a person (blue) walking close to one side of the river, (S)he can swim across the river. You can easily change frame of reference by moving your mouse to different regions. e.g. If you move your mouse within the river, YOU will become an observer moving with water. If you move your mouse into the boat region, You are on the boat (boat is your frame of reference and the boat appears to you to be at rest!) watching other objects that have motion. **The object that is the frame of reference has a velocity of 0.0 m/s.**

Frame of Reference Chart

frame of reference	Ground	Person	River	Boat
Object color code	Gray	Blue	dark Green	Red

Program Note:

- You can press the mouse button to suspend the animation.
- If you press with left mouse button, animation will resume when you release it.
- If you press with right mouse button, you need to click it again to resume animation.

The velocity vector arrows shown do not remain the same colors. When the ground is the frame of reference the vector arrow is BLACK. What arrow color is used for the other frames of reference? Fill in the chart below:

Frame of Reference	Ground	Person	River	Boat
Vector Color Code(Arrow	Black			

Color)				

Click on the Info box at the top of the Applet.   Place your mouse arrow on the ground and click your right mouse button. Determine the relative speed of the man, river, and boat. Record these values in the data table.
Observation #1

Frame of Reference is the GROUND

Frame of Reference	Ground	Person	River	Boat
Relative Speed	0.0 m/s	m/s	m/s	m/s

Click the right mouse button to resume the animation.

Observation #2
Place your mouse arrow on the river and click your right mouse button. Determine the relative speed of the ground, man, and boat. Record these values in the data table.

Frame of Reference is the RIVER

Frame of Reference	Ground	Person	River	Boat
Relative Speed	m/s	m/s	0.0 m/s	m/s

Analysis:
 How much velocity change (dV) occurred to the ground, man, river and boat when the frame of reference was switched from the ground to the river? dV = _____

 What factor determines the velocity (speed and direction) measured of an object?

 When stating the speed of an object on earth, what is the frame of reference commonly used by observers? _____

How to change the velocity vectors?
Press the right mouse button to suspend the animation. Now click near the tip of the
vector arrow, and drag it left or right. This procedure can be used on ground, river, man,
or boat to change their velocity.
Observation #3   The Motion of an Object is Relative
With the mouse cursor on the ground (gray area) click your right mouse to stop the
animation. Place your mouse arrow on the boat vector and click-and-Drag the boat vector
so that it has a velocity of 0.0 m/s (negative values indicates the direction is upstream).
Click the right mouse button to resume the animation.
Determine the relative speed of the boat when the mouse cursor is on the river, ground,
boat and man. Record these values in the data table.

Frame of Reference is the RIVER

Frame of Reference	Ground	Person	River	Boat
Boat Speed	m/s	m/s	m/s	m/s

Analysis:
The speed of the boat is not the same from each frame of reference. True or False?
From what frame(s) of reference is the boat stationary? _____
From what frame of reference(s) is the boat moving with negative velocity?

_____
_____

From what frame of reference(s) is the boat moving with positive velocity?

_____
_____

Observation #4   The Motion of Person in Two Dimensions

Refresh the webpage – Press the "Refresh" button at the top or the monitor screen.
 Notice there are two number near the person (0.0 and 5.0). Those are vertical and
horizontal velocity of that person at your frame of reference. The vertical velocity is 0.0
m/s and the horizontal velocity is 5.0 m/s. (Positive values indicated the direction is to
the right and down on the monitor screen, negative values indicate the direction is up or
left on the screen.)

While the animation is suspended :
Click near the left leg of that person and drag the mouse up and down, you are changing
her (his) vertical speed. Set the vertical motion to +10 m/s and the horizontal speed to
0.0 m/s. Place the mouse cursor arrow on the ground and …
Click with right mouse button to resume the animation,

That person will move toward the river, then, swim across the river and return to the
ground. The motion is repeated as the animation runs.

Record the vertical and horizontal velocity of the man on ground and in the water from each of these frames of reference.

frame of reference =	Ground	River	Boat
Person's Horizontal Velocity When on the GROUND	m/s	m/s	m/s
Person's Vertical Velocity When on the GROUND	m/s	m/s	m/s
Person's Horizontal Velocity When in the WATER	m/s	m/s	m/s
Person's Vertical Velocity When in the WATER	m/s	m/s	m/s

1. When does the person have only a vertical speed?
_____
Why is the horizontal speed = 0.0 m/s?
_____

2. When does the person have a vertical and horizontal seed?
_____

3. When is his horizontal speed negative? _____ Why is it negative?
_____

Observation #4   Two Dimension Relative Motion – Launching a Projectile

In order to demonstrate 2D (two dimensional) relative motion, a 2D checkbox were added.

Refresh the web page again.

Part A) Click the right mouse button to suspend the animation. Click the 2D checkbox. Place the mouse cursor on the ground and click the right mouse button to resume the animation.   Notice a ball will be thrown upward from the barge moving in the river. Your frame of reference is the ground.
The trajectory of the ball (blue) will be shown to you from the frame of reference of the ground.
Describe the trajectory of the ball seen on the screen.
_____

Where does the ball land when it falls?

_____

Does the ball have motion in two dimension (vertical and horizontal)?

_____

What do you observe to be the velocity of the barge?

_____

What do you observe and conclude the horizontal velocity of the ball must be?

_____

Part B. Refresh the webpage again.
Click the right mouse button to suspend the animation. Click the 2D checkbox. Place the mouse cursor on the River and click the right mouse button to resume the animation.
Your frame of reference is now the river.
The trajectory of the ball (blue) will be shown to you from the frame of reference of the river.
Describe the trajectory of the ball seen on the screen.

_____

Where does the ball land when it falls?

_____

Does the ball have motion in two dimension (vertical and horizontal)?

_____

What do you observe to be the velocity of the barge?

_____

What do you observe and conclude the horizontal velocity of the ball must be?

_____

Part C. Refresh the web page again.
Click the right mouse button to suspend the animation. Click the 2D checkbox. Place the mouse cursor on the boat and click the right mouse button to resume the animation.
Notice a ball will be thrown upward from the barge moving in the river. Your frame of reference is the boat.
The trajectory of the ball (blue) will be shown to you from the frame of reference of the ground.
Describe the trajectory of the ball seen on the screen.

_____

Where does the ball land when it falls?

_____

Does the ball have motion in two dimension (vertical and horizontal)?

_____

What do you observe to be the velocity of the barge?

_____

What do you observe and conclude the horizontal velocity of the ball must be?

_____

Summarize the Main Ideas you learned in this virtual lab regarding how the description of motion depends on the frame of reference.

Also try:
http://webphysics.davidson.edu/Applets/TaiwanUniv/trafficControl/trafficControl.html

http://webphysics.davidson.edu/Applets/TaiwanUniv/Reaction/reactionTime.html

RELATIVE VELOCITY

http://www.grc.nasa.gov/WWW/K-12/airplane/Animation/airrel/anrela.html

http://www.saburchill.com/physics/chapters/00044.html

http://www.saburchill.com/physics/chapters/00045.html

http://www.saburchill.com/physics/chapters/00046.html

http://www.saburchill.com/physics/chapters/0083.html

http://www.saburchill.com/physics/chapters/0084.html

VECTORS

http://webphysics.davidson.edu/Applets/TaiwanUniv/vector/vector.html

http://www.physicsclassroom.com/mmedia/vectors/plane.html

http://www.physicsclassroom.com/mmedia/vectors/rb.html

http://www.physicsclassroom.com/Class/vectors/U3L1a.html