Physics   **Name:** _____
Investigation #X Human Ticker Tape   **Section:** _____

With GPS and the iSENSE Data Walk app, we will recreate the ticker tape lab on a human scale. You will take a tablet computer to the football field with your group and record your assigned motion with the app. When we return to class the data will be uploaded for analysis. Although other groups will see what you are doing please don't discuss the exact details of the motion your group is assigned with the others. We will see if they can characterize your motion by looking at your data after you have uploaded it to the iSENSE web site.

Procedure Inside:
1) Before we go outside meet with your group and discuss the assigned motion. Decide how you will have to move to create the motion. Record your ideas below using words like steady, increasing, decreasing, stop, etc.

   a) Write your assigned motion _____

   _____

   How will you move? _____

   _____

2) Open the Data Walk app. Enter your group's identifying information per your teacher's instruction.
3) Click the recording interval on the upper right corner of the screen. **Set the interval at 2 seconds**.

Procedure Outside:
4) **Wait for the GPS to lock**. You will see a latitude and longitude at the bottom left corner of the screen.
5) Have each person do the run. Make sure that you stop the app from collecting data at the end of the run.
6) If you complete your assigned motion make up your own. Write what you plan to do below then record the run.

My motion: _____

Data Analysis:
1) Open the data for your group's run. Enlarge the map so you see your individual data points. Switch over to the satellite view. Deselect the 45° view so you have an overhead view of the field. Pick the "best" representation of the run from your group.

2) Does the spacing of the dots make sense in terms of the motion you were assigned? Explain your motion by filling in the dot pattern of your motion on the ticker tape segment below. Choose enough dots to show your motion and any changes in your motion if there were any. Highlight the interesting data with arrows and a written explanation (stopped, moving fast, moving slow, speeding up, slowing down, etc.) You will use this information to explain your motion to the class.

3) Open a run from each of the other groups. Discuss their motion within your group. Draw the idealized ticker tape for each group and describe their motion in words in the spaces on the back page.

Group ____

Group ____

Group ___

Group ___

Group ___

4) Once you have analyzed the other groups' motions pick one of the made up motions that you performed. See if your motion matches the picture. Draw and describe your motion here.

5) Class discussion: Listen to the explanations of motion by each of the other groups. Does your analysis above match their description? If not ask questions to resolve your differences.

Suggested Data Runs. There are many more. These give a good range of data.

1) Start at the back of the end zone. Walk at a steady pace. Count 1,2,3,4 or use the second timer on the app to time your pace. Before you cross the goal line start recording your motion by pressing the button on the screen. Walk to the 30-yard line. Stop the recording after you cross the 30-yard line.

2) Start at the back of the end zone. Jog (move faster than walking) at a steady pace. Count 1,2,3,4 or use the second timer on the app to time your pace. Before you cross the goal line start recording your motion by pressing the button on the screen. Keep jogging to the 30-yard line. Stop the recording after you cross the 30-yard line.

3) Start at the back of the end zone. Walk at a steady pace. Before you cross the goal line start recording your motion by pressing the button on the screen. As you move towards the 30-yard line steadily increase your speed so you are running by the time you reach the 30-yard line. Stop the recording after you cross the 30-yard line.

4) Start at the back of the end zone. Start running so when you cross the goal line you are running at a steady pace. Before you cross the goal line start recording your motion by pressing the button on the screen. As you move towards the 30-yard line steadily decrease your speed so you are walking by the time you reach the 30-yard line. Stop the recording after you cross the 30-yard line.

5) Start at the back of the end zone. Start running so when you cross the goal line you are running at a steady pace. Before you cross the goal line start recording your motion by pressing the button on the screen. Slow down to a stop as you reach the 20-yard line. **Do not move for 5 seconds**. Then walk at a steady pace to the 30-yard line. Stop the recording after you cross the 30-yard line.

6) Start at the back of the end zone. Start walking so when you cross the goal line you are walking at a steady pace. Before you cross the goal line start recording your motion by pressing the button on the screen. Start slowing your pace so you stop at the 15-yard line. **Do not move for 5 seconds**. Start running so you are at a full sprint when you cross the 30-yard line. Stop the recording after you cross the 30-yard line.

Teacher notes:

If you are using computer-based labs this is a good opportunity to mention the history of science and data collection. In our study of motion we have recorded the Position-time, Velocity-time, and Acceleration-time graphs of moving carts using computer software. Analysis of the graphs yields information about how the cart was moving over time.

Before computers, people studied motion using ticker tapes. A paper tape was attached to a cart and pushed or pulled as we have done in our cart labs. As the cart moved the tape was pulled through a ticker that would leave a pattern of dots on the tape. The spacing of the dots allowed people to make a similar analysis of the cart's motion however it required much more work as calculations had to be done by hand, after the spacing of the dots was measured.

Students could also walk/run from the 30-yard line to emphasize the importance of the point of reference when examining motion data.

The goal and 30-yard lines are arbitrary reference points. The main emphasis is to have the students start before and stop after they reach the area where you want them to collect data. The start/stop on the app has to be held for about a second so you really want the collection to start before they are focusing on the motion. This is another opportunity to emphasize ignoring the push and the catch.

For students who are walking or running a steady pace will yield better data. Remind students to count a cadence as they move.

Depending on how far you have to walk this is 15-20 minutes outside. The kids really have fun making up their own motion. If time permits it is good to let them play.

Depending on how things go with instruction, getting to a field, uploads, analysis time, etc, this lesson easily fills a 55-minute block. The presentation and discussion of group data to the class will probably take part of the next class. The follow up work sheet can be used to make this a two-day lesson if time permits.