20 Minute Experiments You Can Accomplish With RowingSTEM for iOS

All of the following experiments can be accomplished by using RowingSTEM by choosing the **Collect Data** button and pairing the machine monitor with the app via Bluetooth.

Each experiment has a protocol and then the data can be analyzed using the **Access Data From Labs** option and choosing the data that the student has created.

Instructions for processing the data on the data analysis screen with the scatter plot are included in each experiment in the **Data Analysis** section.

Please ensure that the students are well warmed up before each experiment.

Time/Distance Graph Experiment

Protocol

Instruct the students to collect data using the following rowing protocol:

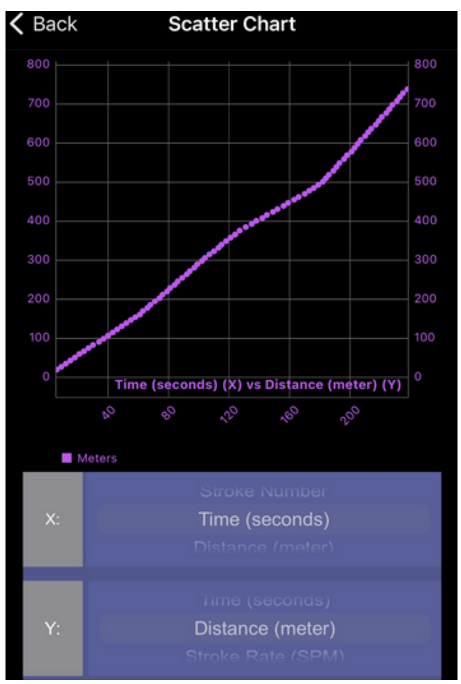
1-minute medium pace rowing (5 out of 10 effort)
1-minute really slow rowing (2 out of 10 effort)
1-minute fast pace rowing (8 or 9 out of 10 effort)

Data Analysis

Access Data From Labs → select data. Then select **TIME** for the x-axis and **DISTANCE** for the y axis.

Discussion

Discuss with the students why the slope of the line is less steep in the middle and is steepest for the last section. The slope of the line is distance divided by time which equals speed. Students should be able to connect their experience of rowing faster and slower on the machine with the slope of the graph.



Example Plot

Accuracy and Precision Experiment

Instruct the students to collect data using the following rowing protocol:

3 minutes of rowing at a particular stroke rate of your choosing. (for example 20 strokes per minute). Instruct the students to row as consistently as possible to ensure that their pace is as consistent as possible and their stroke or drive length is as consistent as possible.

Data Analysis

Access Data From Labs → select data. Choose the scatterplot (will be the default graph)Then select **DRIVE LENGTH** for the x-axis and **STROKE RATE** for the y axis.

Discussion

Discuss with the students the spread of the points on the scatterplot. How close are they together (**precision**)? How close are they to the chosen rate? (20 spm for example - this is the **accuracy**)

Definitions

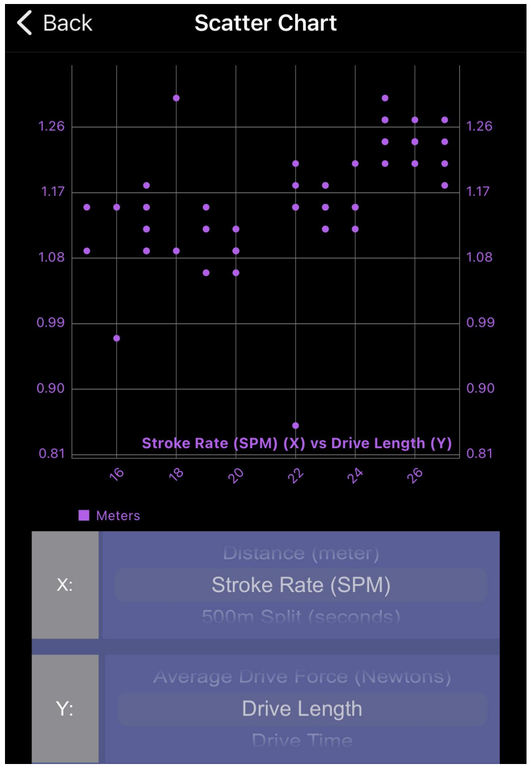
Accuracy: The darts or dots are located within the bullseye of the dartboard. In other words, a measurement is an actual amount being measured.

Precise: Each dart or dot is clustered close together. In other words, measurements that are repeatable and consistent.

If your rowing stroke data points are close together then this is an example of **precision**.
If your rowing stroke data points (in this case stroke cadence) are close to the selected rate you choose for them, then that is an example of **accuracy**.

Extension

Organize a competition to see who can get the points closest to the desired rate and who can get their data points as close together as a group as possible. To progress the activity, try to row for a longer period of time, which should make the difficulty harder.



Example Plot

Stroke Length and Power

Instruct the students to collect data using the following rowing protocol:

1 minute of rowing with just legs
1 minute of rowing with legs and back but no arms
1 minute of rowing with the whole body

Data Analysis

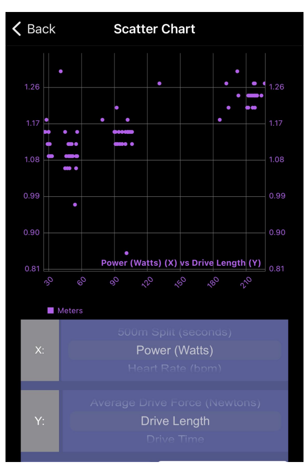
Access Data From Labs → select data. Then select **DRIVE LENGTH** for the x-axis and **POWER** for the y-axis.

Discussion

Ideally, as long as the students are rowing consistently, they should see that the longer the stroke is the more power that they create. Point out the general trend, which should **suggest** a **linear relationship**. Discuss how closely the data points make a straight line and involve the students in a conversation. If the student data is not looking like a straight line, discuss ways to make their rowing more consistent and try the experiment again.

Definitions

A linear relationship is when if one variable increases by a factor then the variable that is related to increases or decreases by a factor in proportion. For example, if you increase the side of a square shape, the area inside the square will increase in proportion to the increase in the side of the square.



Example Plot

The Relationship Between Power and Pace

Instruct the students to collect data using the following rowing protocol:

1-minute of light rowing (think 2 out of 10 effort)
1-minute of light/medium rowing (think 4 out of 10 effort)
1-minute of medium effort rowing (think 6 out of 10 effort)
1-minute of hard effort rowing (think 8 out of 10 effort)

Data Analysis

Access Data From Labs → select data. Then select **500M PACE (SPLIT)** for the x-axis and **POWER** for the y-axis.

Discussion

Ideally, the students should observe a relationship that is not linear. It takes increasingly more power to create the same decrease in pace (which is actually rowing faster!). The point here is that the relationship is an example of an **inversely proportional** relationship rather than a **linear** relationship. It might appear to the students initially that this is a linear relationship, but engage them in conversation about the shape of a line or curve in this case that would fit the points best. Essentially, as one variable **increases** the other variable **decreases**.

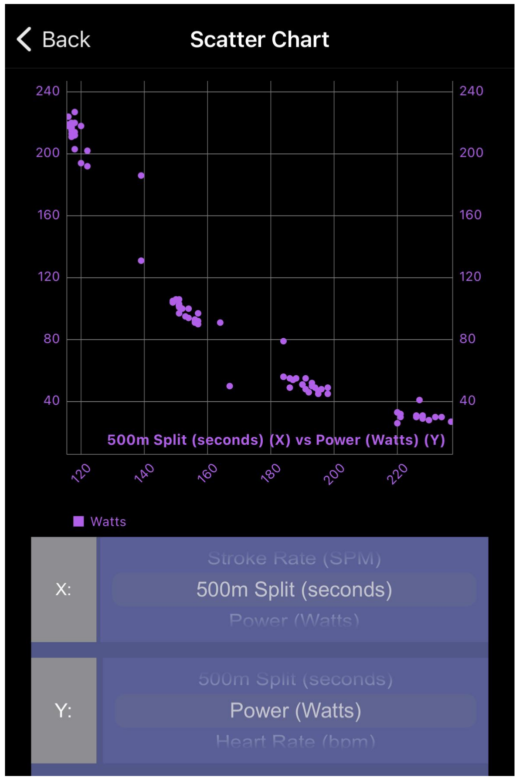
The actual formula for this relationship is power = $2.80/pace^3$
Therefore power is inversely proportional to the cube of the pace.
As a result, the faster you the row, the amount of power needed increases at a faster rate for each increase in pace (or decrease in numeric value).

Definitions

An **<u>inversely proportional relationship</u>** is one in when an increase in one variable results in a decrease in another variable. For example, the time taken to complete a certain task will decrease when the number of people involved in completing the task increases.

gROW TULSA

Pulling Together • Developing Understanding • Creating Opportunities



Example Plot