Acceleration Activity

**Introduction**

**Purpose:** To perform a simple investigation showing acceleration.

**Discussion**

An unbalanced force produces acceleration (*change in motion*). Force and motion (speed) are in the same direction, but acceleration and motion (velocity) do not have to be. A change in motion (speed) over time equals the rate of change of motion. This change in motion (speed) can be slowing down or speeding up or keeping the same speed but changing direction. Remember, velocity is a vector (magnitude + direction). Therefore, if direction changes, that changes the velocity and is considered acceleration.

**Materials**: Stop Watch

**Procedures**:

1. You will use the hallway, gymnasium or outdoors for this activity … whatever the teacher decides.
2. Assign a “timer” and a “recorder” for your group. You need two “runners” who will actually perform the activity. You can use different runners for the different distances.
3. Mark off a starting position and pace off three large steps (~1 m each) for the finish line. Have the “timer” stand at the finish line.
4. The timer will call out “ready, set, go” at a steady cadence. The first runner will race **the 3-meter distance** while the timer keeps time to the nearest TENTH of a second. Record the time in the chart below.
5. Have the second runner run the **3 meters**. Record the times in the chart below. Calculate the speed for both runners, showing your work below the chart.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Distance (m) | Time (s) | Speed (d/t) in m/s |
| Runner #1 |  |  |  |
| Runner #2 |  |  |  |

6. Repeat procedures # 3-5 using a distance of **10 meters** (ten large paces). Record all the times in the chart below. Calculate the speed for both runners, showing your work below the chart.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Distance (m) | Time (s) | Speed (d/t) in m/s |
| Runner #1 |  |  |  |
| Runner #2 |  |  |  |

7. Repeat procedures # 3-5 using a distance of **20 meters** (20 large paces). Record all the times in the chart below. Calculate the speed for both runners, showing your work below the chart.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Distance (m) | Time (s) | Speed (d/t) in m/s |
| Runner #1 |  |  |  |
| Runner #2 |  |  |  |

**Calculations and Data:**

1. Be sure to complete the charts above, showing your work directly below the charts. Make sure you put units to all your measurements.
2. Copy the calculated SPEEDS from the “Speed” column from the chart on page 1 onto the chart below. Also copy the TIME it took to run that particular distance (*copy the “Time” column from the charts on page 1*). **USE UNITS** for all your measurements.

|  |  |  |  |
| --- | --- | --- | --- |
| **Runner #1** | for 3 m | for 10 m | for 20 m |
| Speed (m/s) |  |  |  |
| Time (s) |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Runner #2** | for 3 m | for 10 m | for 20 m |
| Speed (m/s) |  |  |  |
| Time (s) |  |  |  |

1. Make TWO straight line graphs below:
2. Use the speed and time for RUNNER #1 [*plot points using an “X”*] … instantaneous acceleration
3. Use the speed and time for RUNNER #2 [*plot points using a “.”*].
4. Draw a **straight line** for each runner, representing the 3 points you plotted … average acceleration

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Speed m/s

Time (s)

**Conclusions and Questions:**

1. Compare the 3 speeds one runner only. Were all the speeds close or were they different? Assuming the runner ran 100%, explain why this occurs.

2. What title should be given to the graph from the Calculations and Data section?

3. Give at least two factors that could account for the speeds being different?

a.

b.

4. If the speed changed over time, what scientific term describes this? What are the units of this change in motion?

5. Explain why in a true sprint race (i.e. 100 m dash) the velocity time graph would look something like:

*velocity versus time*

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Constant velocity

Speed m/s

Acceleration

0

0

Time (s)

ANSWERS

5. Have the second runner run the **3 meters**. Record the times in the chart below. Calculate the speed for both runners, showing your work below the chart.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Distance (m) | Time (s) | Speed (d/t) in m/s |
| Runner #1 |  |  |  |
| Runner #2 | 3 m | 1.5 s | 2.0 m/s |

*v = d/t = 3 m / 1.5 s = 2.0 m/s*

6. Repeat procedures # 3-5 using a distance of **10 meters** (ten large paces). Record all the times in the chart below. Calculate the speed for both runners, showing your work below the chart.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Distance (m) | Time (s) | Speed (d/t) in m/s |
| Runner #1 |  |  |  |
| Runner #2 | 10 m | 3.3 s | 3.0 m/s |

*v = d/t = 10 m / 3.3 s = 3.0 m/s*

7. Repeat procedures # 3-5 using a distance of **20 meters** (20 large paces). Record all the times in the chart below. Calculate the speed for both runners, showing your work below the chart.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Distance (m) | Time (s) | Speed (d/t) in m/s |
| Runner #1 |  |  |  |
| Runner #2 | 20 m | 4.0 s | 5.0 m/s |

*v = d/t = 20 m / 4.0 s = 5.0 m/s*

**Calculations and Data:**

Copy the calculated SPEEDS from the “Speed” column from the chart on page 1 onto the chart below. Also copy the TIME it took to run that particular distance (*copy the “Time” column from the charts on page 1*). **USE UNITS** for all your measurements.

|  |  |  |  |
| --- | --- | --- | --- |
| **Runner #1** | for 3 m | for 10 m | for 20 m |
| Speed (m/s) | 2.0 m/s | 3.0 m/s | 5.0 m/s |
| Time (s) | 1.5 s | 3.3 s | 4.0 s |

1. Make TWO straight line graphs below:

a. Use the speed and time for RUNNER #1 … instantaneous acceleration

c. Draw a **straight line** for each runner, representing the 3 points you plotted … average acceleration

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5

4

Speed m/s

3

2

1

0

4

3

0

1

2

Time (s)

**Conclusions and Questions:**

1. The speeds for all runners most likelychanged for each distance (acceleration). There is a minimum distance required for a runner to reach his/her highest velocity. For sprinters, this is usually 40-50 m.

2. The graph in the Calculations and Data section should be titled “acceleration” (which is speed/time). Titles are often the dependent variable versus the independent variable.

3. Two factors that could account for the speeds being different

a. *longer distance allows more acceleration to “full speed”*

b. *runners run at different intensity for each distance (3 m, 10 m, 20 m)*

c. *tripped, fell, didn't run “for real”*

4. If the speed changed over time, the scientific term that describes this is *acceleration*, having the following units: *a = ∆v/t … m/s / s = m/s2.*

5. In a true sprint race (i.e. 100 m dash) the velocity time graph would look something like the graph below because a sprinter will reach his/her top velocity and then maintain constant velocity. The reason the 100 m dasher is considered the fastest runner in the world is because only at that distance, can a runner maintain their highest velocity.

*velocity versus time*

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Constant velocity

Speed m/s

Acceleration

0

0

Time (s)