

A legend.
A legacy.
A lifetime of inspiration.

Reaction time challenge

Key Information

Subject area: Science

Time required: This resource is planned to be taught as one 50 minute lesson.

Activity: Data Collection and Processing

Eric Liddell values: Integrity

Curriculum Links: Mathematics

Key skills:

- Observing, collecting, measuring and recording evidence.
- Presenting, analysing and interpreting data to draw conclusions.
- Making predictions, generalisations and deductions.

Learning intentions:

- To investigate human reaction time in different situations.

Success criteria:

- I can undertake experiments and record data appropriately.
- I can use a spreadsheet to record and analyse data.

Experiences and outcomes:

- (*SCN 2-12b*) I have explored the structure and function of sensory organs to develop my understanding of body actions in response to outside conditions.
- (*TCH 2-01a*) I can extend and enhance my knowledge of digital technologies to collect, analyse ideas, relevant information and organise these in an appropriate way.
- (*MNU 3-20a*) I can work collaboratively, making appropriate use of technology, to source information presented in a range of ways, interpret what it conveys and discuss whether I believe the information to be robust, vague or misleading.

Equipment:

- 30cm rulers (1 between 2 pupils)
- Devices pupils can access the internet from (1 between 2 pupils)
- A device to access the shared data collection spreadsheet (this can either be pupils' individual devices or a shared device in the classroom).

Supporting Materials:

- [Presentation](#)
- [Video of false start 1](#)
- [Video of false start 2](#)
- [Online reaction timer](#)
- [Data collection spreadsheet](#)



Uncle Eric Fact

Eric Liddell was one of the fastest men in the World over 100m leading up to the 1924 Olympic Games. In those days, athletes would dig small holes behind the start line to place their feet in. This would help give runners a good start. False start detection systems were not introduced until 1979. Until then the start of a race relied heavily on runners' integrity to not start before the gun went off as false starts were determined solely by the visual capabilities of the officials.

Reaction time challenge

Lesson Format

In this lesson pupils will develop their understanding of body actions in response to outside conditions by investigating reaction time in both an online and physical reaction test. They will compare individual and class reaction times to the allowed reaction time of 0.1 seconds used in Olympic athletics races. Pupils will discuss the honesty and integrity that was needed by athletes before false start detection systems were introduced.

If the class hasn't seen the '[Eric Liddell 100 introductory video](#)' please show this now.

Start the lesson by showing these two video clips ([video 1](#) and [video 2](#)) of false starts in athletics races. Ask pupils to describe what they have seen and how they think the officials are able to tell when a false start has happened.

Discuss with the class the evolution of false starts in athletics. Refer to the Uncle Eric fact.

- Pre 1948 - Athletes would dig small holes in the track to place their feet in. This would help give runners a good start. False starts were determined solely by the visual capabilities of the officials and each runner was allowed one false start. If a runner committed a second false start they would be disqualified from the race.
- 1948 - Starting blocks were used for the first time at the Olympic Games.
- 1979 - False start detection systems were introduced and used to determine false starts.
- 2003 - One false start was allowed between all runners in the race. If any runner false started in the second race start they would be disqualified, even if they hadn't been the runner who committed the first false start.
- 2010 - Anytime a runner false starts they are immediately disqualified.

Ask the class to discuss with a partner why they think the false start rule has changed over the years. Get pupils to share their ideas with the class. Explain that the false start rule has adapted through the years to try to limit runners trying to gain an unfair advantage by predicting when the gun is going to go off and to limit runners purposely false starting to put their opposition off. It is well documented that Eric Liddell lived his life with integrity, ask pupils if they think Eric Liddell would have tried to predict when the gun went off or purposefully false start to put his opposition off?

The allowed reaction time of 0.1 seconds is used in Olympic athletics races to determine a false start. The reason behind this limit is that humans are not believed to be capable of reacting to the starting gun at a speed faster than that.

Have a class discussion on false starts. You could use some of the following questions to aid your discussions:

- What is a false start?
- Why does it matter if someone false starts?
- How would you feel if someone you were racing against started before the given signal and won?
- How would you feel if you started a race before the given signal and won?

Pupils will now test their own reaction times using two reaction tests, an online reaction test and a physical test to see how their reaction times compare to the current 0.1s false start reaction time rule. Pupils will repeat each reaction test five times using their left hand and five times using their right hand. Each time a pupil completes one of the experiments they should input their data into the data collection spreadsheet. They can do this by using a shared device in the classroom (e.g. teacher's computer) or by accessing the shared document on their individual devices. The spreadsheet will calculate an average of the numbers they input, giving pupils a mean result from each of their five results. For more able pupils you could challenge them to create their own formula and spreadsheet. Discuss with the class how they think they could analyse the data. You could use some of the following to aid your discussions:

- How could we analyse the data?
- Can we share the data all in one place? What would be the benefit to this?

Reaction time challenge

Task 1 - Online reaction test

Introduce the online reaction test to the class. Ensure they are aware that they should carry out the test just once, having five attempts using each hand. Pupils should complete the test on their own device or take turns on the teacher device depending on resources.

Once all pupils have calculated their mean reaction time for both their hands, discuss the class's results. You could use some of the following to aid discussions:

- Did you have quicker reactions with your left or right hand?
- Why do you think this is?
- What hobbies and activities do those in the class with the quickest reaction times do?
- Do those who play computer games more often have better reactions?

Task 2 - Physical reaction test

Introduce the test to the class. Pupils should work in pairs to drop a ruler for their partner in order to measure reaction time.

- Ensure pupils are aware that they should have five attempts only using each hand.
- Give each pair a ruler and ask pupils to number themselves partner 1 and 2.
- Partner 1 should hold the ruler near the end (highest number) and let it hang down. Partner 2 should put their hand at the bottom of the ruler so they are ready to grab it. They should not be touching the ruler.
- Partner 1 should drop the ruler sometime within the next five seconds and partner 2 should try to catch the ruler as fast as they can after it is dropped.
- Pupils should record the number of cm at which they catch the ruler. It may be worth providing a demonstration for your pupils to ensure they understand the right protocols to follow.
- Partner 1 should drop the ruler for partner 2 five times. Partner 1 should vary the time of dropping the ruler within the five second drop-zone window so their partner cannot guess when the ruler will fall.
- Once partner 1 has dropped the ruler for partner 2 five times they should drop the ruler another five times but partner 2 should catch the ruler in the opposite hand.
- Now partner 2 should drop the ruler for partner 1 so they are able to test their reaction time.
- Once each pupil has completed five attempts with their left and right hands they should use this table to convert their cm scores into reaction times and then input them into the data collection spreadsheet.

Once all pupils have calculated their mean reaction time for both their hands, discuss the class's results. You could use some of the following to aid discussions:

- Did you have quicker reactions with your left or right hand?
- Why do you think this is?
- Did the same group of students who had the quickest reaction times in the online reaction test have the quickest reaction times in the physical reaction test?
- Did your attempts get better from your first to fifth attempt?
- Why do you think that is?
- Would anyone in the class have been disqualified in the Olympic 100m for any of their reaction times in either of the reaction time tests?

Reaction time challenge

Why does it take time to react?

Discuss with the class the process the body goes through from the moment someone hears or sees something to the moment their body responds to what they are hearing or seeing.

- In order to catch a ruler, press a button or move your body a lot of messages have to be passed along different nerves:
- The eye sees the ruler drop or the ear hears the sound of the gun indicating the start of the race.
- The eye sends a message to the visual cortex in the brain or the ear sends a message to the auditory cortex in the brain.
- The visual cortex or the auditory cortex sends a message to the motor cortex in the brain.
- The motor cortex sends a message to the spinal cord.
- The spinal cord sends a message to the hand and finger muscles or leg muscles to move.
- The hand and finger muscle contract to catch the ruler or leg muscles contract to push off the starting blocks.

When comparing hands, students will usually find that their dominant hand is faster. Because the dominant hand is used more often every day, the neurons that carry messages between that hand and the brain are faster at transmitting electrochemical signals. They are communicating along well-worn pathways. By running the same messages along the same pathway repeatedly, students can improve their motor skills. The phrase “practice makes perfect” is scientifically accurate.

Ask pupils to think of activities they think athletes could do to help improve their reaction time. Ask pupils to share their ideas with the class.

Integrity discussion

Once the class has discussed their results ask the class if anyone took more than 5 attempts on each hand. Discuss with the class the implications of someone taking more than the 5 attempts the experiment asked you to take. You could use some of the following to aid your discussions?

- Why do you think the reaction test guidelines specified that you take a set number of attempts on each hand?
- What effect could someone taking more than the set number of attempts have on the results?
- Does having more attempts and using your best five results make the test invalid?
- Does having more attempts and using your best five results mean you are unable to fairly compare your results to the results of others?
- If you knew you could take 10 attempts and use your five best attempts without anyone finding out would you do it?