



Activity description

Pupils design an experiment to measure reaction times and use it to test people's reaction times.

Pupils can use any equipment available in the classroom, but they will need to consider the reliability of the experiment and how any data collected will be analysed and presented.

Suitability

Pupils working at all levels in small groups

Time 1-3 hours

AMP resources Pupil stimulus

Equipment

Timing devices
Graph paper
Spreadsheet facility

Key mathematical language

Measurement, units, validity, averages, mean, mode, median, sample size, variation, range, statistical inference, consistency, reliability

Key processes

Representing

Selecting mathematical features for their experiment to measure reaction times and for the analysis of data.

Analysing

Recording and analysing the data to inform the refinement of the experiment and the conclusions.

Interpreting and evaluating

Interpreting the data and considering the validity and reliability of the experiment and the sample used.

Communicating and reflecting

Describing the approach, presenting conclusions, discussing how the experiment could be improved.

Reaction times

How fast do you react?



Try it on some friends.





Design an experiment to measure reaction times.



Display your results in a clear and interesting way.

Nuffield Applying Mathematical Processes (AMP) Practical exploration 'Reaction times'
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Teacher guidance

Pupils can test their reactions by playing one of the online tests such as

www.bbc.co.uk/blogs/theoneshow/consumer/2009/01/22/brain_training_how_fast_are_you.html

Emphasise that the activity is not simply to measure reaction times for a group of people but to **design an experiment** that does this **purely using the equipment available in the class**.

Discuss the task with pupils, bringing out the following points to help the pupils understand the problem.

Do people react instantly, and if not, do they react at the same speed?

(examples from sport, braking a vehicle, catching a falling object)

What makes people react? (they see, hear, feel, taste, smell something)

What particular difficulties are there in measuring the speed of a reaction?

(small units of time, designing an experiment that can be performed repeatedly with consistency and accuracy, measuring the reaction time in a way that is not biased by a particular skill, ...)

Designing a robust meaningful experiment simply using stopwatches is not a straightforward task. One could provide the pupils with an experiment or choice of experiments (a couple are presented at the end of these notes) and treat the activity as being one of taking measurements, reaching conclusions, and reflecting on the validity and accuracy of these. But having discussions on methods proposed by the pupils, their strengths and weaknesses, whether they serve the remit and do so reliably, is an invaluable learning opportunity for mathematical representation.

During the activity

During the early stages of the activity, check that each group of pupils considers the following points before beginning the experiments:

- How will my experiment result in the measurement of reaction times?
- What resources are required?
- Do I need to record more than one time per pupil and if so, what is most meaningful?
- How is the data to be collected and recorded?
- What is the role of each member of the group?
- As the activity progresses, groups may need reminding of the need to:
 - describe their experiments in as much detail as they are able and to consider the best ways of displaying their results
 - agree on what their results show, evaluate their experiment as a test of reaction times and modify as necessary/feasible
 - present clearly the outcomes of their experiment and their conclusions

Probing questions and feedback

AMP activities are well suited to formative assessment, enabling pupils to discuss their understanding and decide how to move forward. See www.nuffieldfoundation.org/whyAMP for related reading.

- How will you make sure you have enough reliable data?
- What will be the most representative form of average to use?
- What does your data/analysis tell you about your experiment?
- Does the spread of results tell you anything about the experiment as a test of reaction times?
- Do your conclusions take into account reliability of results and sample size?

Sample experiments

Below are two methods. One approach would be to demonstrate the first one to the pupils, have a discussion on how distance is being used as a 'proxy' for time, what type of reaction is being measured, and strengths and weaknesses of the approach. The pupils' task could be to design an experiment that directly measures time via stopwatches. After the pupils have worked on this, and if necessary, one could share and discuss the second method with them.

Method 1: The subject places thumb and first finger on either side of, but not touching, the bottom of a ruler, which is held vertically by the experimenter. The experimenter lets the ruler go and the subject closes thumb and first finger to catch it as soon as possible. The distance the ruler has fallen is then a proxy for reaction time.

Method 2: Two stopwatches are started at the same time by the experimenter and one is handed to the subject. The experimenter visibly presses the stop button and/or gives some other simultaneous cue. The subject reacts by stopping his or her stopwatch. The reaction time is given by the difference between the times shown on the two stopwatches.

Extensions

Compare and contrast the data from the different experiments developed by the class.

Investigate whether people can improve reaction times on your test by practising.

Consider a similar activity for measuring people's speed at 'subitising' – recognising of the number of objects in a group at a glance –

<http://news.bbc.co.uk/1/hi/uk/6577241.stm>

Research existing data on reaction times and present a report to the class on the findings.

Progression table

The table below can be used to:

- share with pupils the aims of their work
- facilitate self- and peer-assessment
- help pupils review their work and improve on it

The table supports formative assessment but does not provide a procedure for summative assessment. It also does not address the rich overlap between the processes nor the interplay of processes and activity-specific content. Please edit it as necessary.

Representing <i>Choices about type of experiment and statistical methods</i>	Analysing <i>Recording, presentation and analysis of data and experiment</i>	Interpreting and evaluating <i>Interpreting the data and considering the validity and reliability of the experiment</i>	Communicating and reflecting <i>Presentation of experiment and conclusions, reflecting on the approach</i>
Carries out an experiment designed by someone else	Records some data for each participant	Makes some observations about the results	Communicates some basic results and/or observations
Designs an experiment where the quantity measured is meaningfully related to reaction time	Records all the data from the experiment	Uses all the data and some statistical analysis to draw conclusions	Describes the experiment(s) and all the outcomes
Makes an appropriate choice about how many measurements to take for each person	Organises data to enable meaningful analysis	Considers accuracy and reliability of results and conclusions	Presents experiment, data and conclusions using appropriate methods of communication
Chooses forms of representation suitable for interpretation of results	Uses measures such as range and averages purposefully	Justifies conclusions with consideration given to statistical measures used and the validity and reliability of results	Communicates the approach, experiment and results clearly and gives rationale for approach taken
Recognises limitations of chosen representations and attempts to address it	Systematically and iteratively analyses results to improve the design of the experiment	Evaluates the approach and considers alternative experiments	Reflects on forms of representation, quality and quantity of data, outcomes and modifications



No sample responses are included in this version. We would be delighted to have and incorporate samples of your pupil work in future versions. Please contact us and/or look for updates at www.nuffieldfoundation.org/AMP .