**ACTIVITY: n-back test**

**Activity idea**

In this activity, students practise and then design n-back tests.

By the end of this activity, students should be able to:

* understand how the n-back test works
* explain the role of MRI in testing brain function.

[Introduction/background notes](#Introduction)

[What you need](#need)

[What to do](#Do)

[Extension ideas](#extension)

**Introduction/background**

The n-back test tests your working memory. The test helps to determine how well a person can use information held in their short-term memory. The subject is presented with a sequence of letters and asked if the current letter matches the letter presented ‘n’ letters ago. Performing the task accurately requires the subject to hold the identity of the letter presented ‘n’ letters ago in their short-term memory, while comparing it against the current letter.

Matching the last-but-one letter (n=2) is quite difficult, and matching letters further back is even harder. This test is used to show which parts of the brain are involved in working memory and recall. The ability to hold information across short delays is important for everything from remembering a phone number to remembering why you went into the kitchen.

Functional MRI can reveal which parts of the brain are active when someone is doing different activities. It involves having someone in a magnetic resonance imaging (MRI) machine alternate between performing tasks and resting. An example of a task that is used in this work is the n-back test. Images of the brain are taken throughout the time the person is in the machine. The differences in the images produced are identified as being due to performing the task. Scientists and doctors can then work out from these images which parts of the brain were involved in the task. These kinds of studies can provide new information on how a diseased brain and a healthy brain work. They can also lead to a greater understanding of how the human brain works.

In this activity, students first practise and then design n-back tests.

**What you need**

* Access to the articles [Magnetic resonance imaging (MRI)](https://www.sciencelearn.org.nz/resources/997-magnetic-resonance-imaging-mri) and [Looking at the brain with MRI](https://www.sciencelearn.org.nz/resources/987-looking-at-the-brain-with-mri)
* Access to the video clips [What can we use an MRI for?](https://www.sciencelearn.org.nz/videos/542-what-can-we-use-an-mri-for), [Functional MRI – looking at the brain over time](https://www.sciencelearn.org.nz/videos/523-functional-mri-looking-at-the-brain-over-time) and [Looking at head injuries in the MRI](https://www.sciencelearn.org.nz/videos/522-looking-at-head-injuries-in-the-mri)

**What to do**

1. Introduce your students to MRI by showing them the video clip [What can we use an MRI for?](https://www.sciencelearn.org.nz/videos/542-what-can-we-use-an-mri-for) and getting them to read [Magnetic resonance imaging (MRI).](https://www.sciencelearn.org.nz/resources/997-magnetic-resonance-imaging-mri)
2. Introduce your students to the n-back test and its use in functional MRI by showing them the video clip [Functional MRI – looking at the brain over time](https://www.sciencelearn.org.nz/videos/523-functional-mri-looking-at-the-brain-over-time) and getting them to read the article [Looking at the brain with MRI](https://www.sciencelearn.org.nz/videos/523-functional-mri-looking-at-the-brain-over-time).
3. Discuss with your students the format of an n-back test and how it is used to test working memory.
4. Ask your students to get into pairs. Assign roles to the student pairs – one is the tester, one is the subject.
5. The tester tells the subject that they are going to do a 2-back test. The tester will read out a sequence of letters. They instruct the subject to tap on the desk when they hear a letter read out that was read out two letters ago.
6. For example, if the tester reads out the list of letters A **C** M **C** Q P C **X** R **X**, the subject will tap on the desk when they hear the second C, as it is the same as the letter two letters ago. They would then tap on the desk when they hear the second X. Inside the MRI, subjects are given a buzzer to push.
7. Instruct the tester to design their own sequence of 20 letters for a 2-back test. The tester then tries this out with the subject.
8. Reverse the roles so that the subject becomes the tester and the tester becomes the subject.
9. Discuss as a class how they found the 2-back test. Is it difficult or easy? How would you make a harder n-back test or an easier n-back test?
10. Watch the video clip [Looking at head injuries in the MRI](https://www.sciencelearn.org.nz/videos/522-looking-at-head-injuries-in-the-mri) and discuss with your class how an n-back test may be useful in this sort of study. You may also want to revisit the video clip [Functional MRI – looking at the brain over time](https://www.sciencelearn.org.nz/videos/523-functional-mri-looking-at-the-brain-over-time).

**Extension ideas**

n-back tests are also available as apps for your phone/tablet. These may be used as a substitute for reading out a sequence of letters or as an extension activity.