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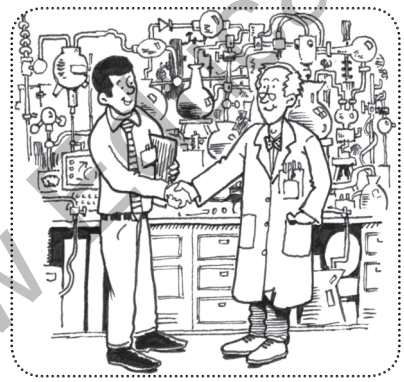
Chapter 1

Neuroscience in the classroom – principles and practice

Getting started



By the end of this chapter you will:

- understand what neuroscience is and how the brain processes information
- understand what kind of research neuroscientists conduct
- understand current relationships between educators and neuroscientists
- know how to build bridges between the two fields.

Why would you want to know about this?

Have you ever wondered what is happening in the brains of your learners when you teach them and whether this information would be useful to you in developing your practice? Presumably you have or you would not be reading this book. You might be pleased to know that you are not alone in your curiosity about the workings of the brain. The Wellcome Trust recently published a report, entitled *How Neuroscience Is Affecting Education* (Simmonds, 2014), which contains data from a series of surveys with teachers and parents. In one of the surveys, which involved over 1000 teachers, more than nine out of ten teachers said that their understanding of neuroscience influenced their practice (2014: 1). Furthermore, eight out of ten said they would collaborate with neuroscientists doing research in education (something that is now happening with increasing frequency – see Research Zone 1.1).

Despite this, only 25% of teachers report having a good or fair amount of knowledge about neuroscience, meaning that for many teachers their practice is being influenced by quite limited knowledge, some of which may be inaccurate (2014: 3). One of the reasons we wrote the book is to try to help in this area. Another reason is that our experience tells us that learning about the brain is one of the most exciting types of professional development you can have, and many teachers find it enthralling.

We think there are two specific areas of your teaching that you can enhance by increasing your knowledge of neuroscience. Firstly, neuroscience knowledge can be a powerful way to inform how you teach and understand what happens when your students – and, of course, you – learn information and skills. Moreover, neuroscience is not limited to helping you understand learning. For example, it can also provide us with information about **motivation**, mood and the reason why adolescents sometimes appear to belong to a different species.

Secondly, neuroscience knowledge can provide you with a theoretical basis for established or new classroom practice, and can help you to evaluate the so-called brain-based learning products that may be on the market. This is important because if you understand the neuroscience evidence, you can spot products that are making claims about being brain-based which are in fact just using neuroscience terminology to sound impressive. In addition, understanding how memory works can help teachers to plan the delivery of content in a way that does not overload the brain's capacity to deal with new information – an area we will spend much time on in Chapter 2. Research Zone 1.1 gives an example of the way in which neuroscience theories have been used to develop classroom interventions and how research programmes can be used to explore their effectiveness.

"Eight out of ten teachers said they would collaborate with neuroscientists doing research in education."

Research Zone 1.1. The Wellcome Trust Education and Neuroscience Initiative

In 2014, the Wellcome Trust launched an initiative with the EEF to explore six areas of neuroscience-informed practice that show the potential to be scalable and affordable for schools. As this book goes to press, the researchers have yet to report the outcome of the studies because the trials are still taking place. Despite this, the topics are worth mentioning as they illustrate the range of areas that neuroscience can contribute to in education. The projects are:

- Fit for study – which is looking at how exercise could improve academic attainment (report due early 2018).
- Spaced learning – an approach in which intense periods of study are alternated with shorter sections of activity containing "distractor" activities (like juggling); see Chapter 7 (pilot report available at EEF, 2017).
- Teensleep – this is testing the effect of sleep education on attainment (report due September 2017). The programme involves training teachers to deliver lessons to students about the importance of areas such as good sleep-related behaviours, routines and stress management techniques.

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- Learning counterintuitive conception – which is applying techniques that may help children to "inhibit" prior contrary knowledge when learning new ideas in maths and science (report due summer 2017).
- GraphoGame Rime – looking at a literacy improvement programme based on phonics which uses rhyme (report due spring 2018).
- Engaging the brain's reward system – exploring reward strategies in secondary school science classes (report due autumn 2017). This research compares three approaches: game-based questions with uncertain rewards, test-based questions with fixed rewards and conventional teaching (the teacher's usual practice).

The Wellcome Trust Education and Neuroscience Initiative is now being broadened and expanded to include the development of teacher training materials and a range of innovative teacher professional development opportunities. One of these projects involves a collaboration between us and the Wellcome Trust to carry out a series of neuroscience-informed teacher-led randomised controlled trials.[1]

What is neuroscience?

For you to understand how you can apply neuroscience evidence to your teaching, it is critical to understand first what neuroscience is exactly. This question is quite straightforward to answer because neuroscience literally means the science of the nervous system. Here, and from now on, we will use the word "science" to refer to any knowledge acquired using scientific method. We will discuss scientific method later in this chapter. For now, you just need to know that scientific method is the name given to a process of designing and conducting research that involves making observations and interpreting them in the context of very specific research questions. Importantly, if you have a science background or can just vaguely remember science from your school days, you will already have some knowledge of neuroscience because it makes use of the principles and many techniques from the main science disciplines of physics, chemistry and biology.

Now we have the science part covered, we will look at exactly what we mean by the nervous system. Figure 1.1 shows a simple diagram of the human nervous system. As you can see, there is a central part, comprising the brain and the spinal cord, and then many branches that extend throughout the body. The central part is the **central nervous system** (brain and spinal cord) and everything else is the **peripheral nervous system**.

1 Find out more about these projects and the activities that are taking place as part of this initiative on the Wellcome Trust website: www.wellcome.ac.uk.

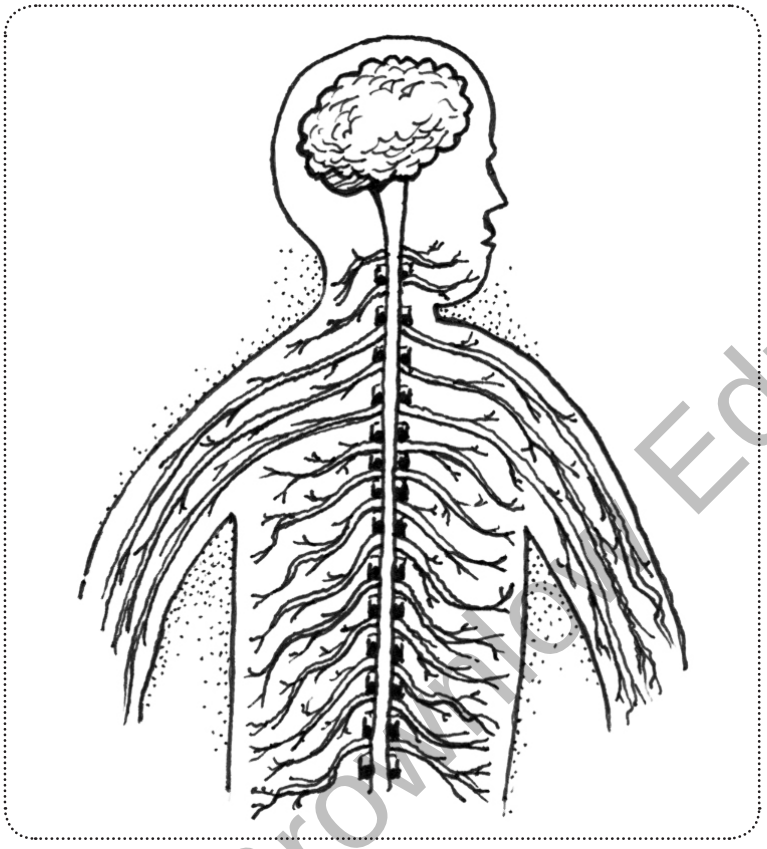

Figure 1.1. The human nervous system.

Although neuroscience is technically the study of the whole nervous system, much of the research neuroscientists carry out aims to investigate the brain. Because this type of research is of most relevance to education, the remainder of the book focuses on research about the brain rather than the whole nervous system.[2]

The appearance of the human brain is not unlike a walnut, with a wrinkly outer surface called the **cortex**. In vertebrates the whole brain can be divided into two cerebral hemispheres (illustrated in Figure 1.2). These cerebral hemispheres, sometimes referred to as the left and right brain, are separated by a fissure that runs from the front of the brain to the back. Beneath the cortex are hundreds of other structures, including the examples shown in the figure.

2 If you are interested in reading more about the entire nervous system there are some excellent neuroscience textbooks available (e.g. Breedlove et al., 2013), as well as brain books that are aimed at the general reader (e.g. Carter, 2009 – with many examples and illustrations; Greenfield, 2016).

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