The word “Electroencephalogram” is an intimidating one. But, when the word is broken down to its roots, it becomes easier to understand. As Rose Hendricks discussed in one of her lectures at the University of California San Diego, “electro” means electrical activity, “encephalo” is Latin for coming from the head, and “gram” means a written record. This breakdown serves as a good starting point in the process of learning about electroencephalograms, or EEGs, as they record changes in electrical activity at the scalp. It is likely that someone who has never heard of an EEG may find this idea challenging to comprehend, and they may ask how such a procedure works and why it is used.

In order to answer the question of how an EEG works, one must first understand the purpose of electrodes and how they serve as the foundation for EEGs. Electrodes are small metal pieces that attach to wires and are stuck to a person’s scalp. These record electrical changes at specific areas of the scalp at specific times. The electrical activity which is measured occurs in response to a stimulus, which the researcher manipulates. In addition, it is assumed that the recorded changes in electrical activity reflect cognitive activities.

In one of Rose Hendricks’ lectures, she presented this example of a study done by UCSD graduate students Joshua Davis, Piotr Winkielman and Seana Coulson, which demonstrates how changes in electrical activity indicate cognitive processes. The alternative hypothesis, which the
researchers wanted to prove, was that it is more difficult to read emotional faces when one is unable to mentally simulate them. The null hypothesis of this study, which the researchers sought to reject, was that there is no difference in difficulty when reading emotional faces. The control group for the study was able to move their face freely, while the other group held chopsticks in their mouths in order to lessen facial movements. Both groups were shown the same images of emotional faces while researchers monitored their electrical activity with EEGs. After collecting all of the data, the researchers examined the N400 component. The N400 size is known to be associated with the how difficult it is to recognize facial expressions. Thus, the larger N400 size indicates more difficulty. Upon investigating the results the null hypothesis was rejected. In this study, an EEG was a useful method of obtaining data than other experimental methods as it provided reliable, quantitative data.

Because they provide precise quantitative data, EEGs are often advantageous in the field of cognitive science. EEGs are also advantageous because they compose many data sets from the multiple electrodes placed around the scalp. In addition, they are safe and non-invasive. There are also disadvantages to EEGs, including that they are prone to be noisy because they require extremely controlled conditions. This article, “Electroencephalography (EEG) and Event-Related Potentials (ERP’s) with Human Participants” published in the US National Library of Medicine, details the requirements to correctly perform an EEG test as well as identifies potential causes for noisy results. For example, one thing that causes noisy results include actual noise. The author writes, “Proper insertion of foam ear plugs is important to ensure that only the experimentally delivered auditory stimuli are represented in the EEG trace”. This makes sense because if there is noise unrelated to the experiment, it is likely that the subject’s brain will pick
up on it and thus the data will be affected. Eye blinking and muscle tensions have also been known to cause noisy data, so it is important that the person administering the test is professionally trained and can recognize when confounding variables may affect results.

Event Related Potential (ERP) is used to eliminate noise from data. This process calls for multiple trials and then computing an average of the data. Another article from the US National Library of Medicine, “Event-Related Potential: An Overview,” explains how components of ERP are used to identify different cognitive functions. The beginning of the article clarifies that ERPs are made up of two components. First, “The early waves, or components peaking roughly within the first 100 milliseconds after stimulus, are termed ‘sensory’ or ‘exogenous’ as they depend largely on the physical parameters of the stimulus”. Second, “ERPs generated in later parts reflect the manner in which the subject evaluates the stimulus and are termed ‘cognitive’ or ‘endogenous’ ERPs as they examine information processing”. In short, ERPs are categorized by whether they occur within the first 100 milliseconds after the stimulus is presented, or after this mark. ERPs within the first 100 milliseconds are associated with sensory information, and the ones after 100 milliseconds show how the subject processes information about the stimulus. The remainder of the article describes different waves that can be studied. For example, the author writes about studying P300 and schizophrenia patients, “One of the most robust neurophysiological findings in schizophrenia is decrease in P300 amplitude. P300 is often smaller in amplitude and longer in latency in patients who have been ill longer”.

All things considered, EEGs are not perfect, but when done correctly they produce reliable data about electrical activity in relation to cognitive function. These tests have proved tremendously
useful in fields such as psychology and cognitive science because they capture information that would otherwise be unattainable.