

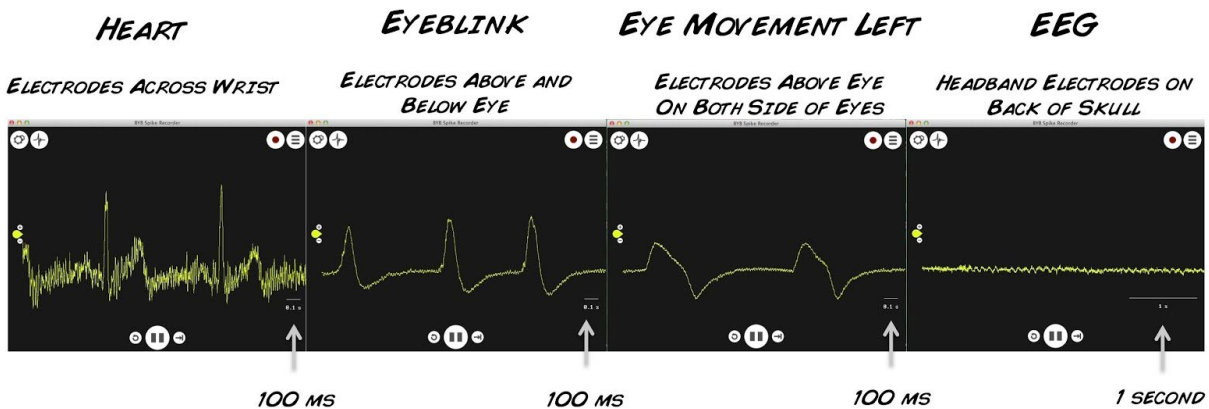
Backyard Brains EEG Troubleshooting Guide

Seeing your own brain activity can be exciting, and Backyard Brains is happy to offer a simple EEG (electroencephalogram) amplifier for teachers, students, and amateurs to begin investigating brain rhythms.

What are brain rhythms? They are synchronized slow (<100 Hz) oscillations or potentials that occur in various brain circuits. With scalp electrodes, it is possible to observe these oscillations, but there are fundamental physics problems that make recording EEGs a challenge.

- 1) Your brain is inside your skull, and the skull and the scalp reduce the signal strength of EEG.
- 2) The EEG signal on the scalp is small (in the 10s of microvolts), which is so small that muscle electrical signal will mask the signal, and even movement of the electrode cables can cause artifact.

As an analogy, imagine trying to view the stars with a telescope, but you live on the North Pole during the summer and the sun is always out. It'd be possible to detect stars but it would be a challenge and take focus and patience. Detecting the EEG across the scalp in an awake human is similar. For reference, see the figure below.

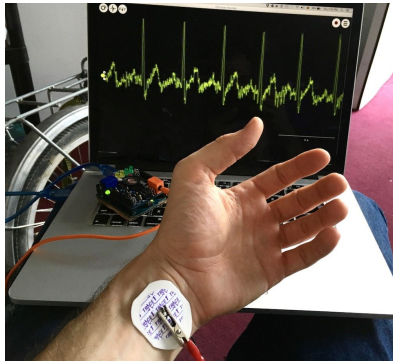


COMPARISON OF 4 BODY SIGNALS WITH HEART/BRAIN SPIKERSHIELD, SAME GAIN

Note that the heart signal (EKG) and the eye signal (EOG) are 10-20x larger than the EEG. These signals were all recorded in one recording session on the same human.

It's possible to record your EEG though, and we do it in our high school and college classes in live experiments on a monthly basis, and here are our troubleshooting steps you can use.

1) Do experiments on EKG first before trying to record the EEG



Verify that your equipment is working by recording your heart rhythm (EKG). Place the red alligator clips on electrodes on each wrists, and the black on the back of your hand. The full procedure is available at:

<https://backyardbrains.com/experiments/hearttrate>

You should see a robust heart rhythm, telling you your equipment is ready for an EEG experiment.

2) Battery Power Alone

Have your laptop computer running on battery power alone, and place your computer away from any electrical sources. Once you have success isolating EEG, such precaution may often not be necessary, but the first time you are doing experiments, try to you remove all electrical noise sources nearby your computer.

3) Sufficient Gel on Electrode Interface



Make sure there is sufficient gel between the electrodes on the headband and the scalp. The person with the headband on should “feel” the coolness of the gel. This tells you the interface is good, as *the metal electrode must have electrical contact with the scalp with the gel. Excessive hair between the electrode and the scalp will make the interface unreliable. This is the principle cause of noise in users.* Also make sure the ground electrode is on the bone (mastoid process) behind the ear



4) Electrodes over V1, not over cerebellum

To get the best alpha wave signal, have your headband over the visual cortex instead of the cerebellum. The Visual Cortex lies on the top back of the head, in a region going straight-back over the line caused by the top of the ears. The cerebellum lies under the the visual cortex, directly behind the ears.



5) Part the hair

To make sure the metal electrodes on the headband have electrical contact with the surface of the scalp, part the hair on the subject a little bit with your fingers. This is critical in people with long hair, and parting the hair was more effective than changing the electrode style in our experiments.

6) Turn on Filters (60 Hz) and bandpass filter from 1-100 Hz.

To reduce noise, you can filter the signal. Go to Config (the gears symbol) and Click the box for “60 Hz” (USA) or “50 Hz” (Europe and South America). Also set your bandpass from 1-100 Hz.

