

## II. EXPERIMENTAL OBJECTIVES

- 1) To record an EEG from an awake, resting subject with eyes open and eyes closed.
- 2) To identify and examine alpha, beta, delta, and theta components of the EEG complex.

## III. MATERIALS

- BIOPAC electrode lead set (SS2L)
- BIOPAC Disposable Electrodes (EL503,) 3 electrodes per subject
- BIOPAC Electrode Gel (GEL1) and Abrasive Pad (ELPAD)
- *Optional:* BIOPAC Skin Prep Gel (ELPREP) or alcohol prep
- Lycra® swim cap (such as Speedo® brand) *or* supportive wrap (such as 3M Coban<sup>®</sup> Self-adhering Support Wrap) to press electrodes against head for improved contact
- Biopac Student Lab System: BSL 4 software, MP36, MP35 or MP45 hardware
- Computer system (Windows or Mac)

## IV. EXPERIMENTAL METHODS

### A. SETUP

#### FAST TRACK Setup

1. Turn the computer **ON**.
  - If using an MP36/35 unit, turn it **OFF**.
  - If using an MP45, make sure USB cable is connected and Ready light is **ON**.
2. **Plug the equipment in** as follows:
  - Electrode Lead Set (SS2L) Electrode Check (MP3x only. For MP45, plug into CH 1.)
3. Turn **ON** the BIOPAC MP36/35 unit.

Setup continues...

#### Detailed Explanation of Setup Steps



Fig. 3.2 MP3X (top) and MP45 (bottom) hardware connections

4. Position electrodes on the scalp.  
Fig. 3.3 shows a sample configuration.

**IMPORTANT**

Good electrode contact with scalp is crucial for obtaining a meaningful EEG recording.

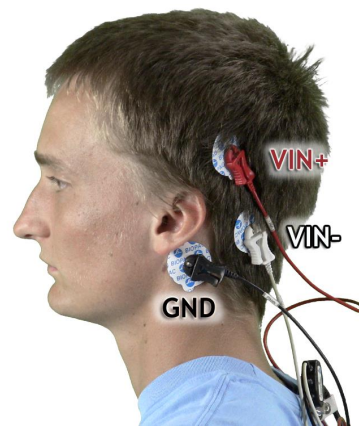


Fig. 3.3

**Guidelines for electrode placement:**

- The placement of the scalp electrodes can vary (within limits) depending on your instructor's or **Subject's** preference.
- Keep the electrodes on one side (right or left) of the head.
- The third electrode is the ground electrode and is placed over the Mastoid region (behind the ear).

**Hints for obtaining optimal data:**

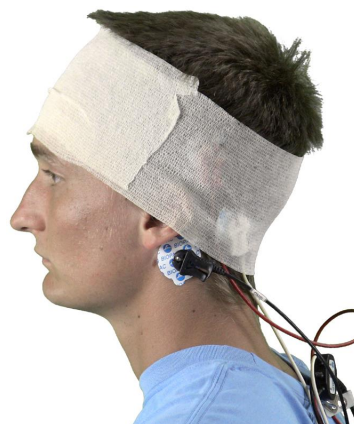
- As much as possible, move (part) the hair away from the electrode area to ensure the electrode makes contact with the scalp.
- Clean electrode sites with ELPREP Skin Prep Gel or alcohol before abrading.
- Gently abrade skin at the electrode sites.
- Apply some gel to the electrode. (*A fair amount of gel must be used to obtain a good electrode to scalp connection.*)
- Apply pressure to the electrodes for about 1 minute after the initial placement.
- **Subject** must remain still. Blinking and other movement will affect the recording of all four rhythms.
- Despite your best efforts, electrode adhesion may not be strong enough to record data; try another **Subject** or different electrode placement.

5. Clip the Electrode Lead Set following the color code in Fig. 3.3.
6. Place cap/wrap on **Subject's** head to press electrodes into scalp (Fig. 3.4).

The pinch connectors work like a small clothespin, but only latch onto the nipple of the electrode from one side of the connector.

Drape the electrode cables over the head so that they are not pulling on the electrodes.

The cap or wrap should be snug but not uncomfortably tight.



Place a Lycra<sup>®</sup> swim cap or supportive wrap on **Subject's** head to press the VIN+ and VIN- electrodes against the scalp with a constant pressure. **Subject** should not press electrodes against scalp.

Setup continues...

7. Get **Subject** in proper seating position (Fig. 3.5).
8. Wait five minutes to allow **Subject** to relax, and for electrodes to establish proper contact.

9. **Start** the Biopac Student Lab Program.
10. Choose “L03 – Electroencephalography (EEG) I” and click **OK**.
11. Type in a unique **filename** and click **OK**.

12. **Optional:** Set Preferences.
  - Choose File > **Lesson Preferences**.
  - Select an option.
  - Select the desired setting and click **OK**.

**END OF SETUP**

**Fig. 3.4**

**Subject** should be seated and relaxed. Ideally, the room should be *reasonably quiet* to help **Subject** mentally relax.



**Fig. 3.5 Positioning**

Start Biopac Student Lab by double-clicking the Desktop shortcut.



No two people can have the same filename, so use a unique identifier, such as **Subject's** nickname or student ID#.

A folder will be created using the filename. This same filename can be used in other lessons to place the **Subject's** data in a common folder.

This lesson has optional Preferences for data and display while recording. Per your Lab Instructor's guidelines, you may set:

**Grids:** Show or hide gridlines

**Lesson Recordings:** Specific recordings may be omitted based on instructor preferences.

## B. CALIBRATION

The Calibration procedure establishes the hardware's internal parameters (such as gain, offset, and scaling) and is critical for optimal performance. **Pay close attention to Calibration.**

### FAST TRACK Calibration

1. **Subject** remains relaxed with eyes closed during Calibration.
2. Check Electrode Impedance. (Optional\*)

**\*Only functional if your MP hardware is compatible with the Electrode Check feature.** If your MP hardware is not compatible, this feature will not be available. Please contact BIOPAC Technical Support for more information on how to enable Electrode Check functionality.

### IMPORTANT

Certain subjects may not fall below the 10 K ohm reading. This reading is subject to individual variations in skin conductivity and electrode placement.

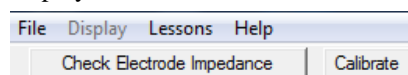
3. Click **Calibrate**.
4. During Calibration **Subject** must:
  - Remain seated, relaxed and still, with eyes closed.
  - Wait for Calibration to stop.
5. Verify recording resembles the example data.
  - If similar, click **Continue** and proceed to Data Recording.
  - If necessary, click **Redo Calibration**.

**END OF CALIBRATION**

### Detailed Explanation of Calibration Steps

*This step is optional and not applicable to MP45 hardware.*

Use **Check Electrode Impedance** to check the **Subject's** skin conductivity. This opens the Electrode Checker panel and displays skin resistance in k ohm.



To use:

- Make sure the SS2L is plugged into the MP unit's Electrode Check input.
- Click Check Electrode Impedance button.
- Ideally, both readings should be similar and below 10 k ohm. (See Fig. 3.6.)
- When finished, be sure to remove the SS2L from the Electrode Check input and plug into the CH 1 input before continuing (right).

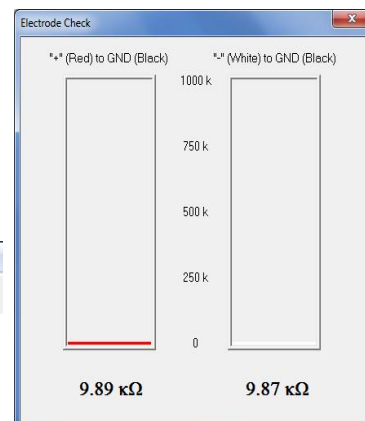


Fig. 3.6



Calibration lasts eight seconds.

The baseline should be relatively stable around 0 uV.

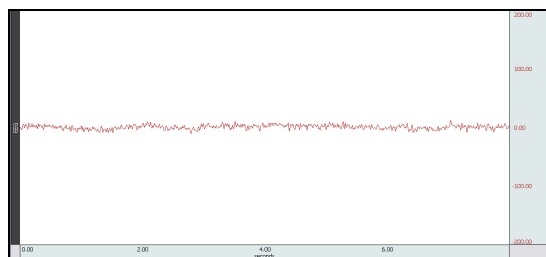


Fig. 3.7 Example Calibration data

If the data shows excessive baseline drift or large spikes, make sure the electrodes are making good contact with the scalp and that the cables are not pulling on the electrodes.

Click **Redo Calibration** and repeat Steps 3 & 5 if necessary.

## C. DATA RECORDING

### FAST TRACK Recording

1. Prepare for the recording.
  - **Subject** remains seated, relaxed and still, with eyes closed.
  - **Review** recording steps.

2. Click **Record**.

- **Subject** remains seated, relaxed and still, with eyes closed.
- Record for 20 seconds.
- **Director** presses F4 and cues **Subject** to open eyes.
- Record for an additional 20 seconds.
- **Director** presses F5 and cues **Subject** to close eyes.
- Record for an additional 20 seconds.

3. Click **Suspend**.
4. Verify recording resembles the example data.
  - If similar, click **Continue** and proceed to the optional recording section, or click **Done** to finish.
  - If necessary, click **Redo**.

Recording continues...

### Detailed Explanation of Recording Steps

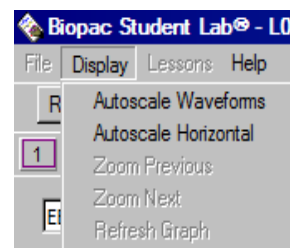
This lesson will record the **raw** (full bandwidth) EEG while the **Subject** is relaxed with eyes closed, eyes opened, and eyes closed again. The alpha, beta, delta and theta channels are simultaneously recorded, but are hidden by default. Hidden channels may be displayed during the recording by holding down the **Alt** (PC) or **Option** (Mac) key when clicking on the channel button.

To work efficiently, read this entire section before recording, or review onscreen **Tasks** to preview recording steps in advance.

#### Hints for obtaining optimal data:

- **Subject** should be seated and relaxed to keep muscles still, especially facial muscles. (Do not talk.)
- **Subject** must try not to blink during **Eyes Open** portion of recording.
- **Subject** should try to relax mentally; i.e. think of a relaxing place.

**Note:** **Display > Autoscale Waveforms** and **Autoscale Horizontal** are available DURING recordings to allow scale changes if necessary.



The **Director** instructs **Subject** to change the eye condition for 20-second intervals, and inserts an event marker at each change.

*First 20 seconds (secs. 0 to 20)*

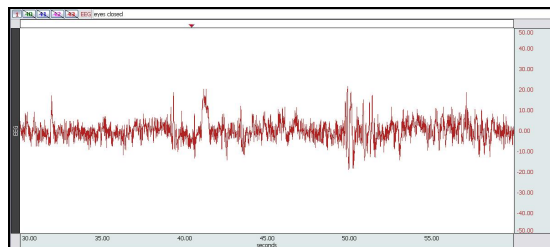
**Subject** is relaxed, with eyes closed for the first 20 seconds.

*Next 20 seconds (secs. 21 to 40)*

**Director** presses **F4** to insert a marker labeled **Eyes Open** and cues **Subject** to open eyes and try not to blink for the next 20 seconds.

*After another 20 seconds (secs. 41 to 60)*

**Director** presses **F5** to insert a marker labeled **Eyes Closed** and cues **Subject** to close eyes for the next 20 seconds.



→ CH 1 EEG  
CH 40 alpha  
CH 41 beta  
CH 42 delta  
CH 43 theta

**Fig. 3.8 Example data**

Verify recording shows variation between the **Eyes Open** and **Eyes Closed** recordings.

**Note:** To check the data, it may be necessary to show one or more of the hidden frequency bands. To activate, hold down the **Alt** (PC) or **Option** (Mac) key when clicking on the channel button.



**OPTIONAL ACTIVE LEARNING PORTION**

5. After clicking **Done**, choose an option and click **OK**.
6. Remove electrodes.

**END OF RECORDING**If recording does not resemble the Example Data

- If the data is noisy or flatline, check all connections to the MP unit.
- If there is excessive baseline drift or large spikes:
- Check that electrodes are making good contact with the scalp, cap or wrap is snug and that the cables are not pulling on the electrodes.
- Subject must remain as still as possible.
- Try relaxation techniques, such as slow breathing or relaxing muscles.

Click **Redo** and repeat Steps 2 to 4 if necessary. Note that once **Redo** is clicked, the most recent recording will be erased.

With this lesson you may record additional data by clicking **Continue** following the last recording. Design an experiment to test or verify a scientific principle(s) related to topics covered in this lesson. Although you are limited to this lesson's channel assignments, the electrodes may be moved to different locations on the **Subject**.

**Design Your Experiment**

Use a separate sheet to detail your experiment design, and be sure to address these main points:

**A. Hypothesis**

Describe the scientific principle to be tested or verified.

**B. Materials**

List the materials you will use to complete your investigation.

**C. Method**

Describe the experimental procedure; be sure to number each step to make it easy to follow during recording.

**Run Your Experiment****D. Set Up**

Set up the equipment and prepare the subject for your experiment.

**E. Record**

Use the **Continue**, **Record** and **Suspend** buttons to acquire as many recordings as necessary for your experiment.

Click **Done** when you have completed all of the recordings required for your experiment.

**Analyze Your Experiment**

- F.** Set measurements relevant to your experiment and record the results in a Data Report.

If choosing the **Record from another Subject** option:

- Continue the entire lesson from Setup Step 4.

Remove cap or wrap, the electrode cable pinch connectors, and peel off all electrodes. Discard the electrodes. (BIOPAC electrodes are not reusable.) Wash the electrode gel residue from the skin, using soap and water. The area around the electrode sites may remain red for a few hours, which is quite normal.