

**Knowledge Domain: Electrical Simple**  
**Unit: Fabrication**  
**Skill: ECG Electrodes**

**Tools and Parts Required:**

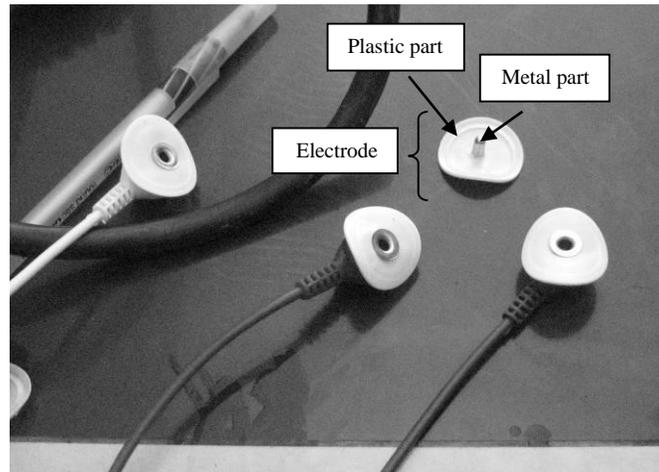
- 1) **Bottle Caps**
- 2) **Sewing Snaps**
- 3) **Flathead Screwdriver**
- 4) **Exacto Knife**
- 5) **Two Containers**
- 6) **Water**
- 7) **Salt**
- 8) **Flour**
- 9) **Bleach Disinfectant**
- 10) **Rubbing Alcohol**
- 11) **Medical Adhesive Tape**
- 12) **Scissors**
- 13) **Tape measure**
- 14) **Spoon**
- 15) **Dropper**
- 16) **Stove or hot plate**
- 17) **Cooking pot or Sauce Pan**

**Introduction**

An electrocardiograph (ECG) is a device that monitors the electrical activity of the heart. An electrode transfers electrical signals from the skin to the ECG device. Electrodes used on multiple patients may become dirty or worn. Dirty or worn electrodes cannot transmit signals. Dirty or worn electrodes can prevent the ECG from detecting the patient's heartbeat. Electrodes eventually need to be replaced. Replacement ECG electrodes can be fabricated from simple materials.

## Example

Below is a picture of an ECG electrode.



ECG electrodes consist of two parts. The metal part conducts the signal from the body to the ECG device. The plastic part provides mechanical support. The plastic part increases the contact the electrode has with the body.

## Identification and Diagnosis

An electrocardiograph cannot be used without functioning electrodes. New electrodes must be fabricated when the old electrodes are too dirty or too worn to transmit a signal. Worn electrodes may be ripped or torn.

## Procedure

### 1. Inspect existing electrodes

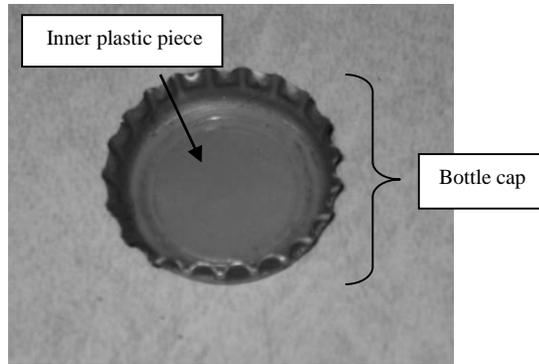
Functioning ECG electrodes transmit electrical signals from the patient's skin to the electrocardiograph. Non-functioning electrodes cannot detect a signal from the patient.

Visually inspect existing ECG electrodes. Look for rips or tears. Electrodes with rips or tears are non-functional. Discard electrodes with rips or tears. Look for dirt. Excessively dirty electrodes are non-functional. Discard excessively dirty electrodes.

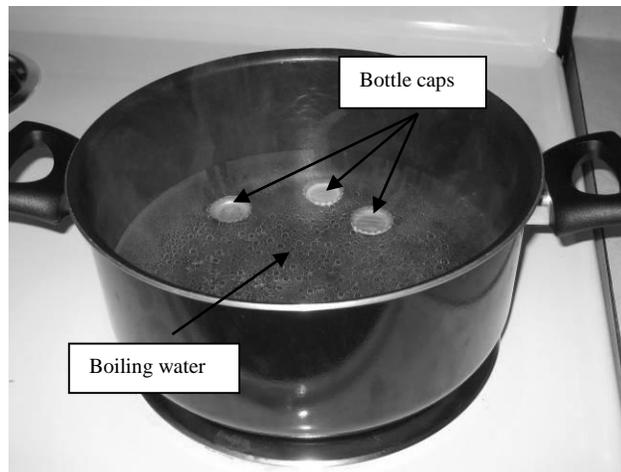
### 2. Make new electrodes.

New electrodes must be fabricated if there are no existing electrodes. New electrodes must be fabricated if the existing electrodes are dirty or worn.

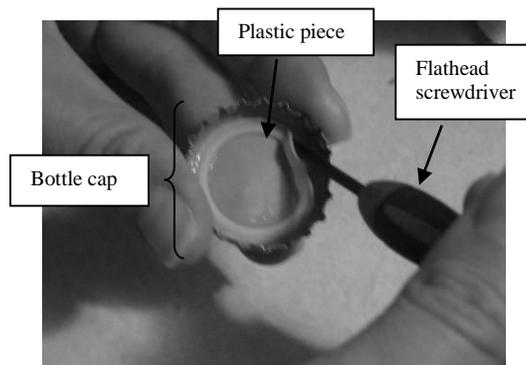
- Metal bottle caps on glass bottles contain a thin piece of plastic. This piece of plastic can be used to make an electrode. The plastic piece must be detached from the bottle cap.



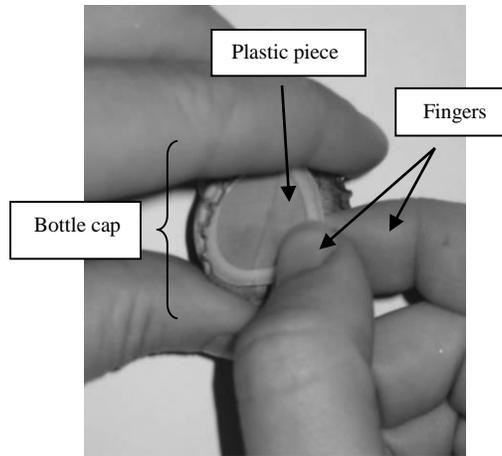
Boil approximately 1.5 L of water. Add several bottle caps. Cover the pot. Leave the bottle caps in the boiling water for 30 minutes.



Use a spoon to carefully remove one bottle cap. Dry the bottle cap. Use a glove or towel to protect your hands from burns. Use a flathead screwdriver to pry up the edge of the plastic.

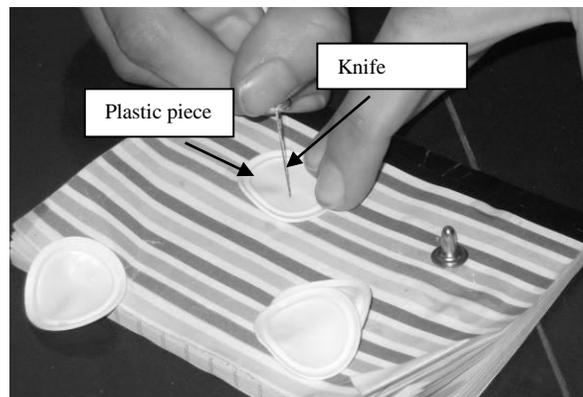


Use your fingers to gently remove the plastic. Set the plastic aside to dry.

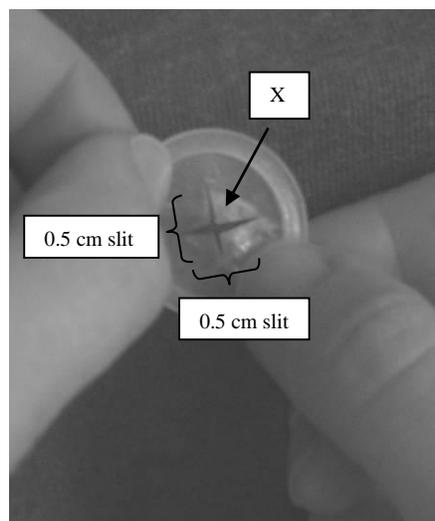


Repeat these steps. Remove the plastic layer of every bottle cap. Discard plastic pieces with tears in the middle.

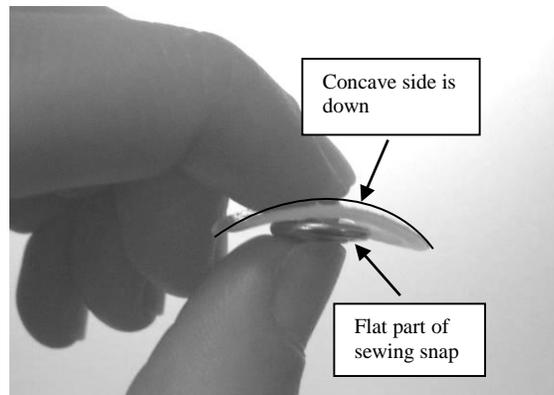
Use a knife to cut an approximately 0.5 cm slit in each plastic piece.



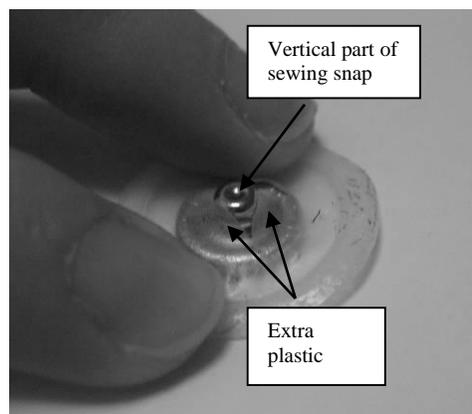
Cut a second 0.5 cm slit in each plastic piece to make an "X".



Insert a sewing snap into the “X”. Insure that the flat part of the snap is on the concave part of the plastic.



Use a knife to remove the extra plastic on the vertical part of the sewing snap.



### 3. Make electrode gel.

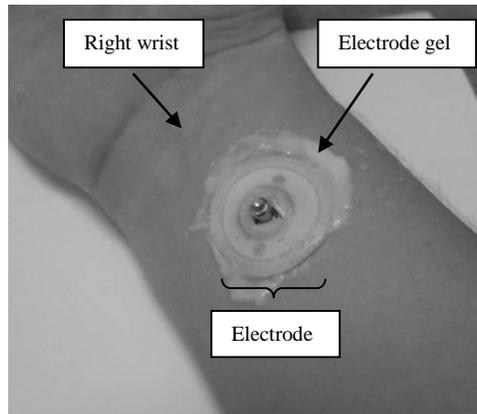
Electrode gel must be made if there is no electrode gel already available. Here is a recipe for a flour, salt and water gel.

- Choose an available container to be a standard. The standard should hold approximately 250 mL. Fill the standard container with water. Pour the water into a larger container. This container should hold approximately 500 mL. Add approximately 40 g of salt to the water. Use a spoon to mix the solution.
- Fill the standard container with flour. Slowly add the flour to the salt water solution. Mix the solution with the spoon. Stop mixing when the gel is a uniform consistency. The gel should be thick and sticky.
- Use a dropper to add 1 drop of bleach disinfectant to the gel. Use the spoon to stir the disinfectant into the gel.

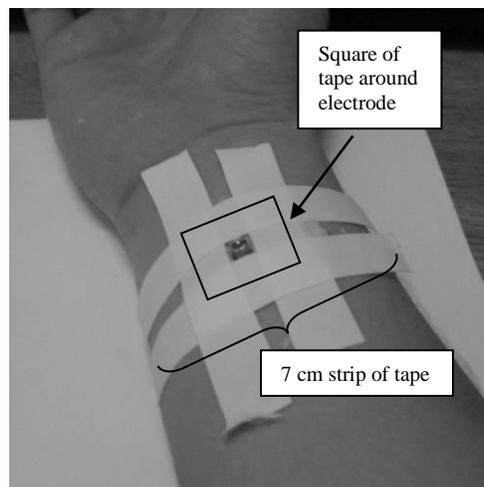
### 4. Verify your work.

Test the new ECG electrodes. Insure that the new electrodes transmit electrical signals from a human body to the ECG. This will be easiest with a partner.

- Clean the skin of your partner's ankles and right wrist with an alcohol solution. Apply electrode gel to his ankles and right wrist. Apply slightly more electrode gel than it would take to cover the electrode. Place one electrode over each area of electrode gel. Insure that each of the three electrodes is entirely surrounded by electrode gel.

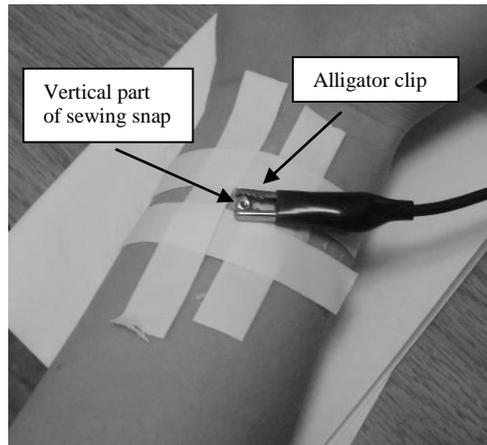


- Secure the electrodes
  - Cut twelve 7 cm strips of medical adhesive tape. Use four strips of tape to make a square around each electrode. Put the tape as close to the center of the electrode as possible. Do not cover up any of the metal sewing snap.



- Determine how the electrodes will be connected to the ECG machine.
  - For lead wires with snaps:*
    - Snap the lead wire snaps into the electrode sewing snaps. Insure that the lead wire does not touch the adhesive tape on the wrist and ankle.
  - For alligator clips:*
    - Clip the alligator clip onto the vertical part of the electrode sewing snaps.

- Use adhesive tape to hold the alligator clips in place on the ankles and the wrist.



- Turn on the ECG machine. Verify that an ECG waveform is displayed.
5. Wash and disinfect the electrodes.
- Disconnect the ECG leads from the electrodes on the wrist and ankles. Remove the tape from the skin.
  - Prepare a dilute disinfectant solution.
  - Add approximately 50 mL of water to a container. Add approximately 5 mL of disinfectant to the water. Use a spoon to stir the solution.
  - Disassemble the electrodes. Remove the metal sewing snaps from the plastic pieces. Place the snaps and the plastic pieces into the disinfectant solution for 30 seconds. Use a spoon to remove the snaps and the plastic pieces from the solution. Wear plastic gloves to protect your hands from the disinfectant. Individually dry each snap and each plastic piece. Insure that all of the gel and other contaminants are removed from the snaps and plastic pieces.
  - Reassemble the ECG electrodes. Insert the metal sewing snaps into the plastic pieces. Insure that the flat part of the metal sewing snap is on the inside of the concave part of the plastic pieces.

### **Exercise**

Make one ECG electrode. Then use the recipe to make ECG gel. Your instructor will provide you with the necessary materials.

*If an ECG is available:*

Form a group of three with your classmates. Choose one person to be the patient. Test your three electrodes and your electrode gel on the patient. Wash and disinfect the electrodes.

Your instructor must verify your work before you continue.

## **Preventative Maintenance and Calibration**

Visually inspect ECG electrodes regularly for signs of dirt and wear. Insure that electrodes are washed and disinfected after use on each patient.

Always calibrate every medical device before returning it to use.