

Lecture 14: Electrical Safety

(Quiz)

0. Review

1. Physiological Effects of Electricity

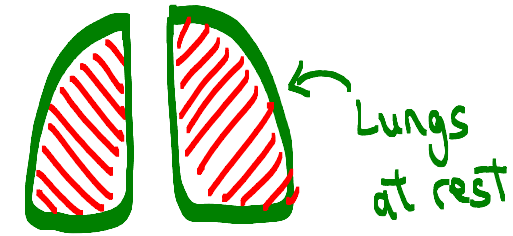
2. Macroshock Hazards

3. Microshock Hazards

- PreLab 6 due in lab session
- Thu: HWG due
- Fri: Lab 5 report due
- Exam #2 next Thu (Mar 5)
 - Lectures 9-14 material
 - Labs 4-6 material
 - see course website for 2019 exam.
- ★ Presentations: Mar 10 + 12
- ★ Ellis Tour (Mar 10)

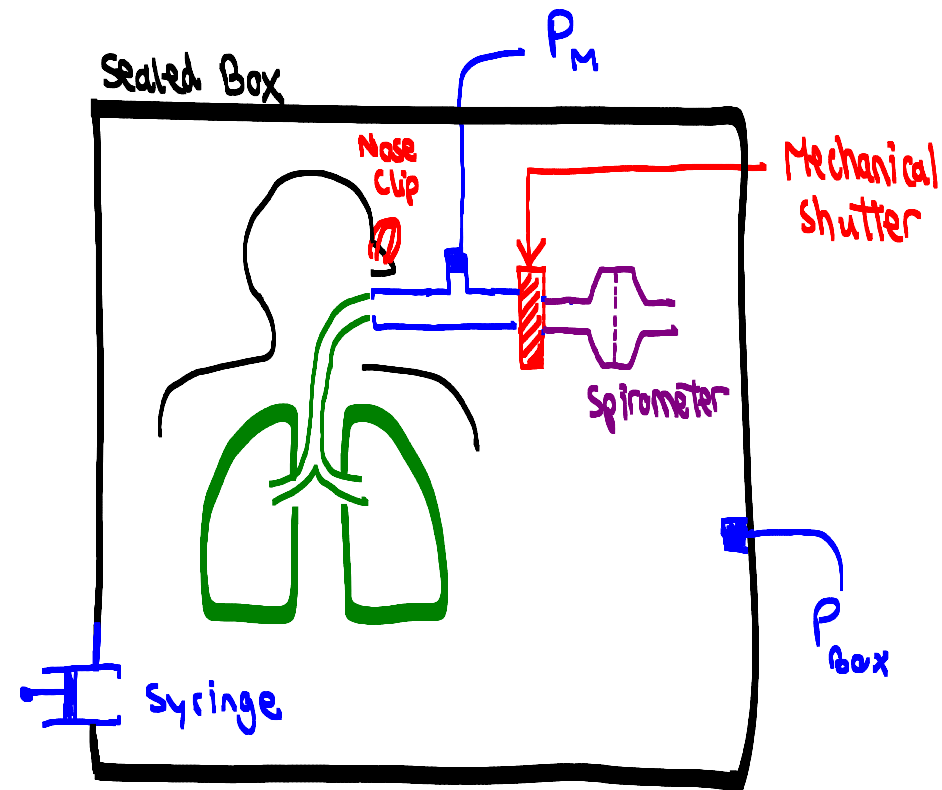
0. Review

- Absolute Lung Volume: FRC is lung volume at rest
 $\uparrow$ Functional Residual Capacity



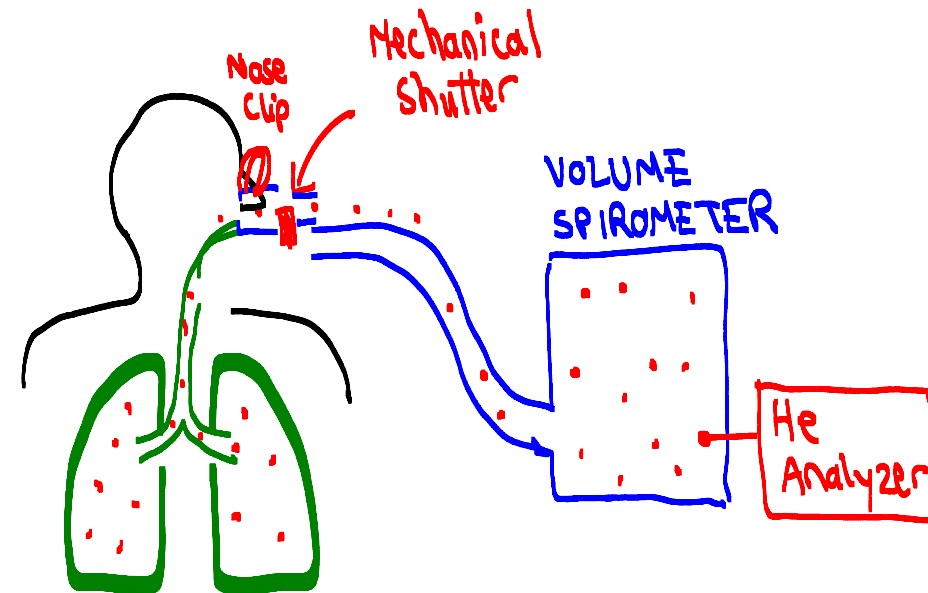
① Whole Body Plethysmography

$$FRC = \frac{P_M - \Delta P_M}{\Delta P_M} \cdot (\Delta V_{Box})$$



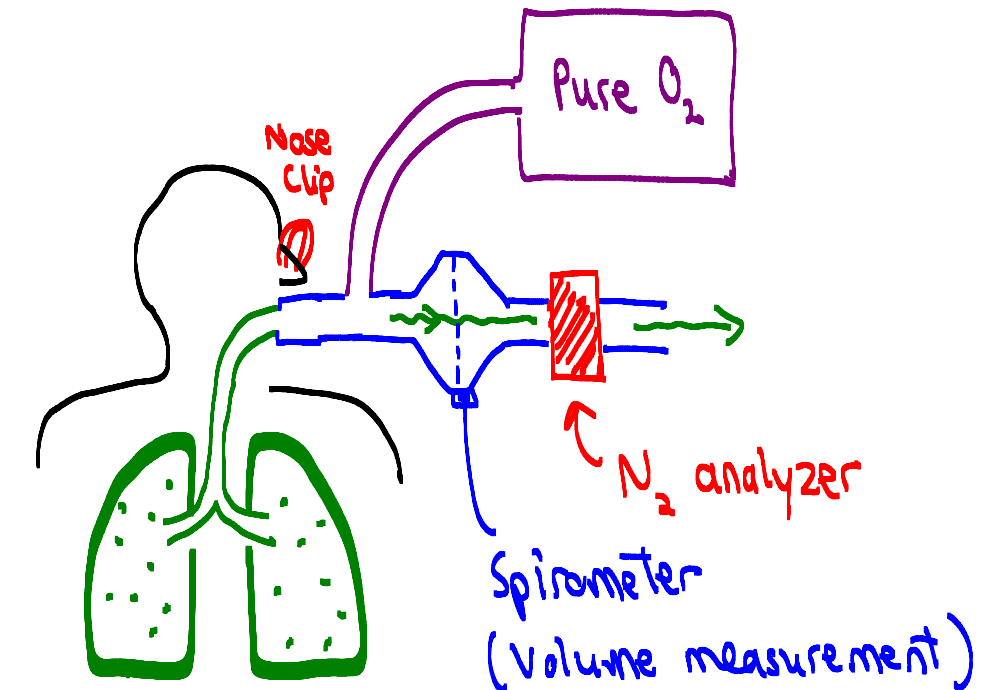
② Helium Dilution ← "closed circuit"

$$FRC = V_L = \frac{(C_s - C_{Ls}) \cdot V_s}{C_{Ls}}$$

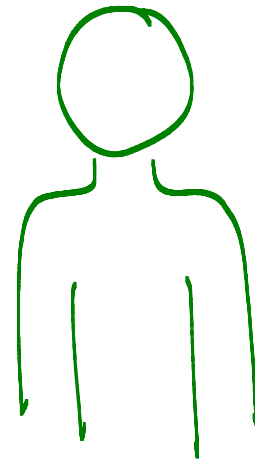


③ Nitrogen Wash-out ← "open circuit"

$$FRC = V_L = \frac{\sum_b C_b \Delta V_b}{C_L}$$



1. Physiological Effects of Electricity



• Intro

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}}$$

• Biological Phenomena

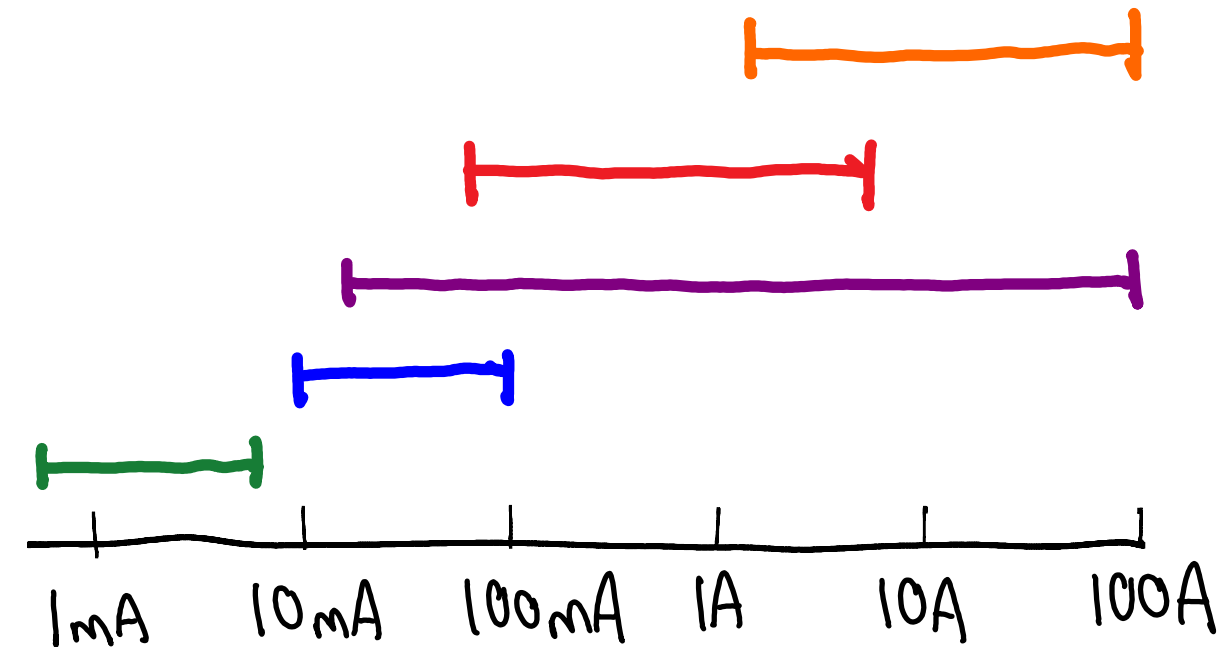
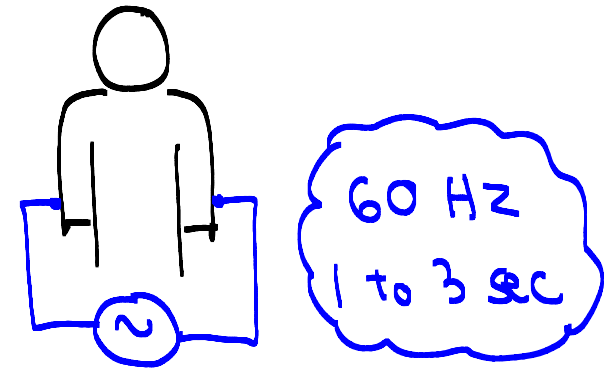
①

②

③

• Current Thresholds

(14.1)

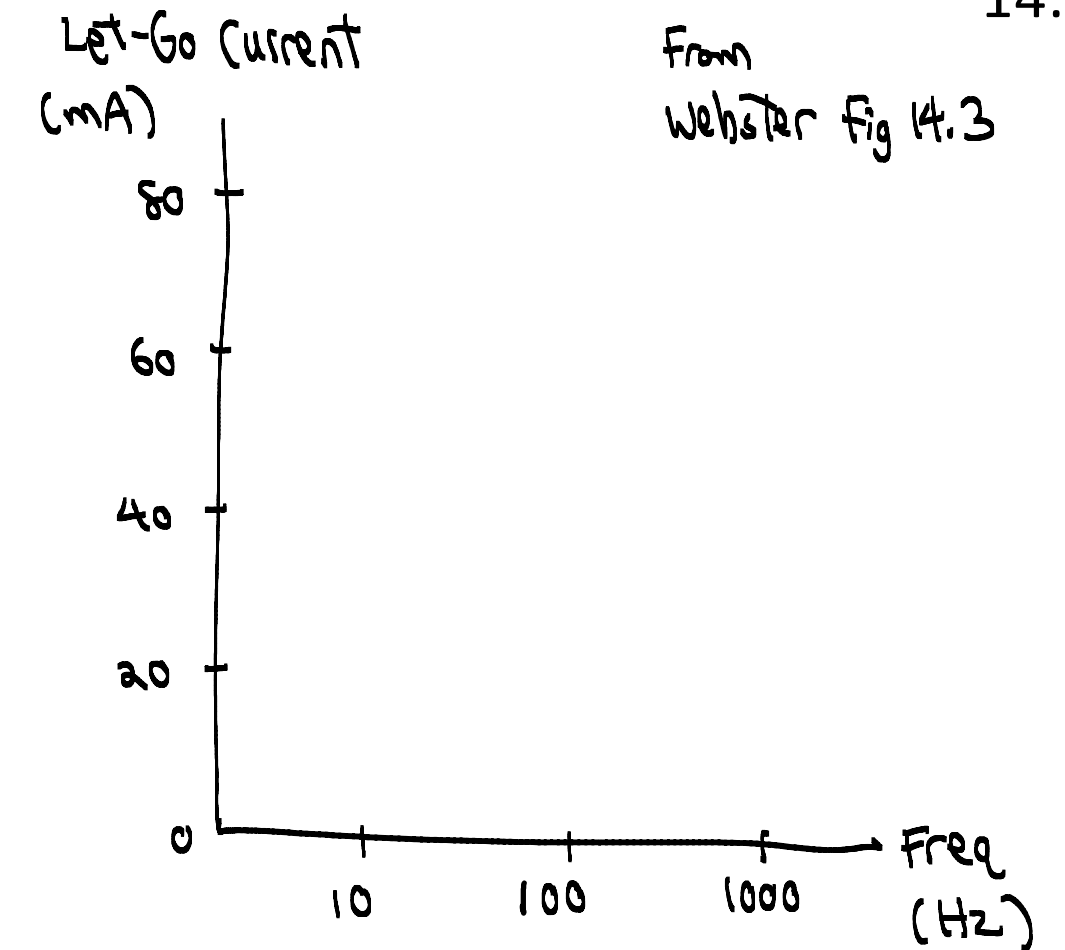


Adapted from Webster Fig 14.1

- Threshold of perception

- Let-Go current

- Respiratory Paralysis, Pain, and Fatigue



- Ventricular Fibrillation (V-Fib)

Electrical shock can disrupt
the normal cardiac cycle



webster Fig 4.20(b)

(14.3)

★ V-Fib

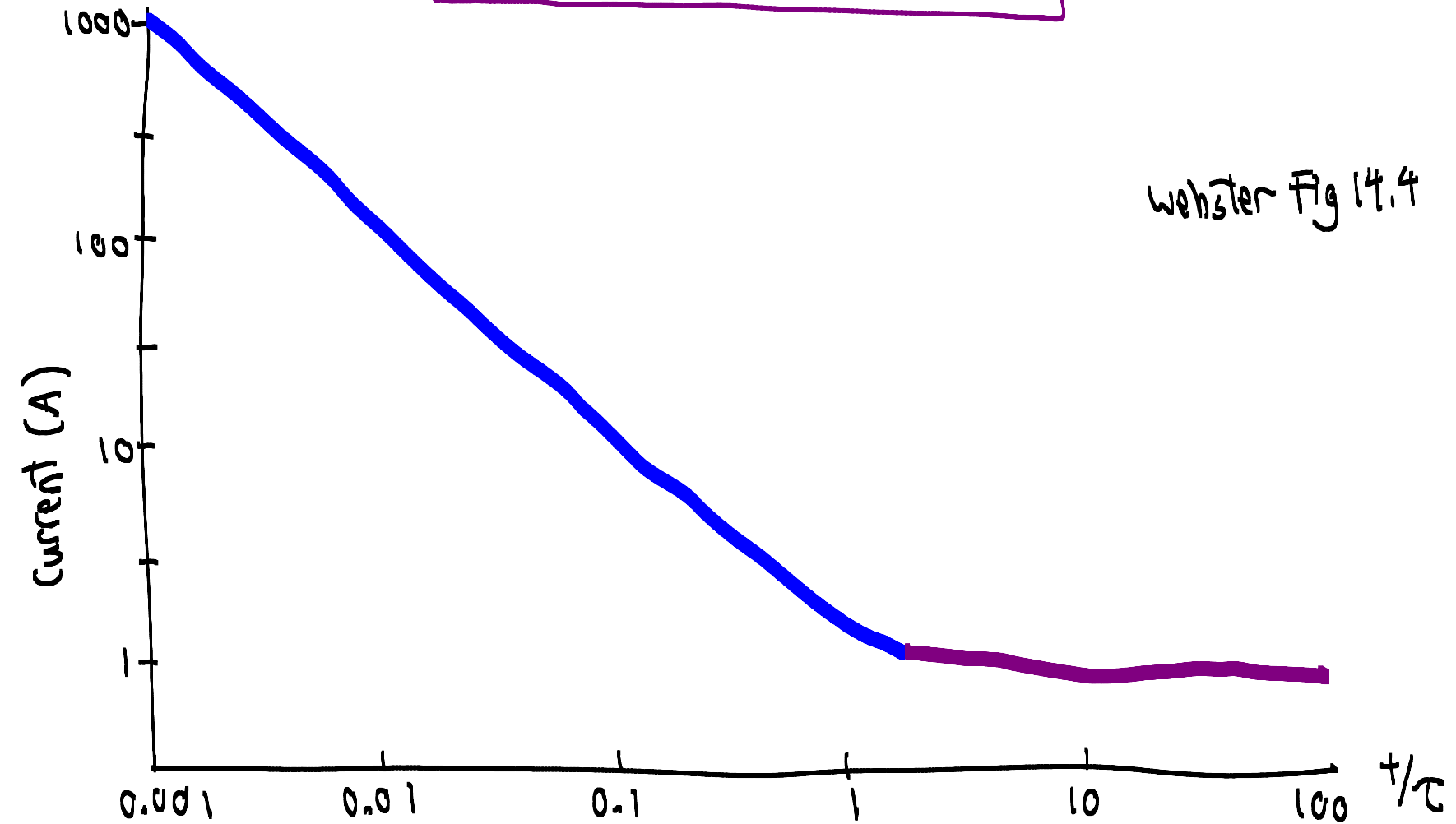
Defibrillator :

- Shock Duration

★ Shocks must last

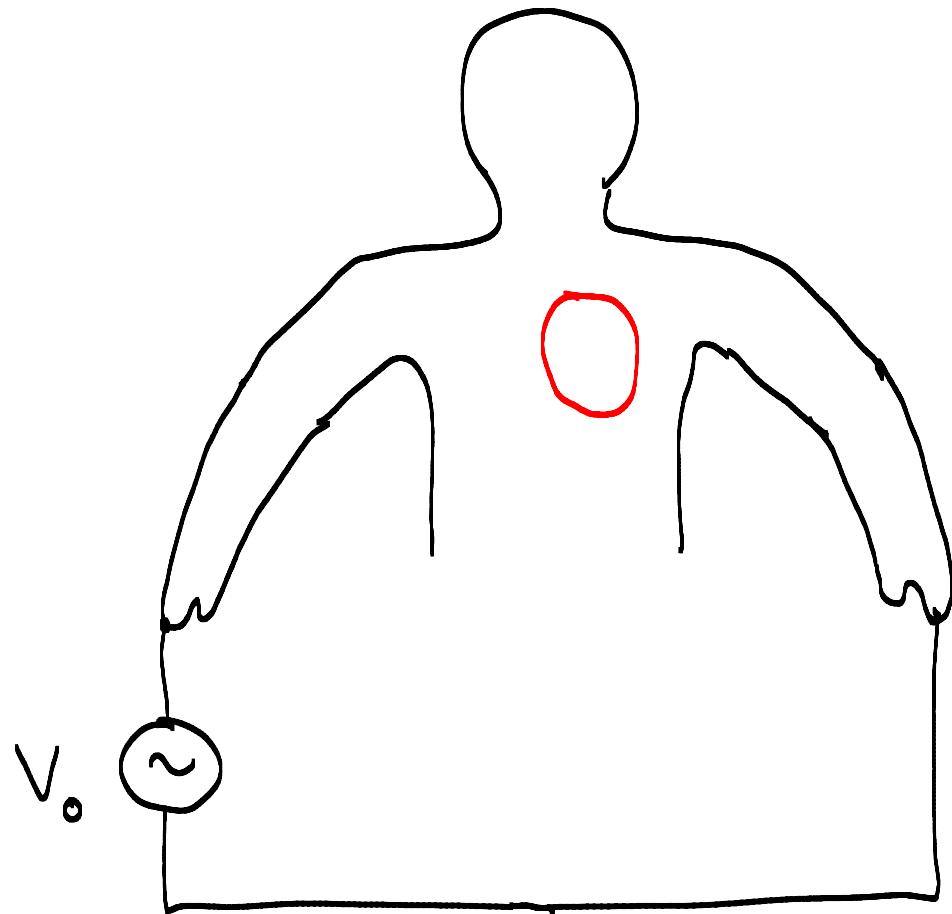
★ Heart is most vulnerable

Stimulation Current Threshold

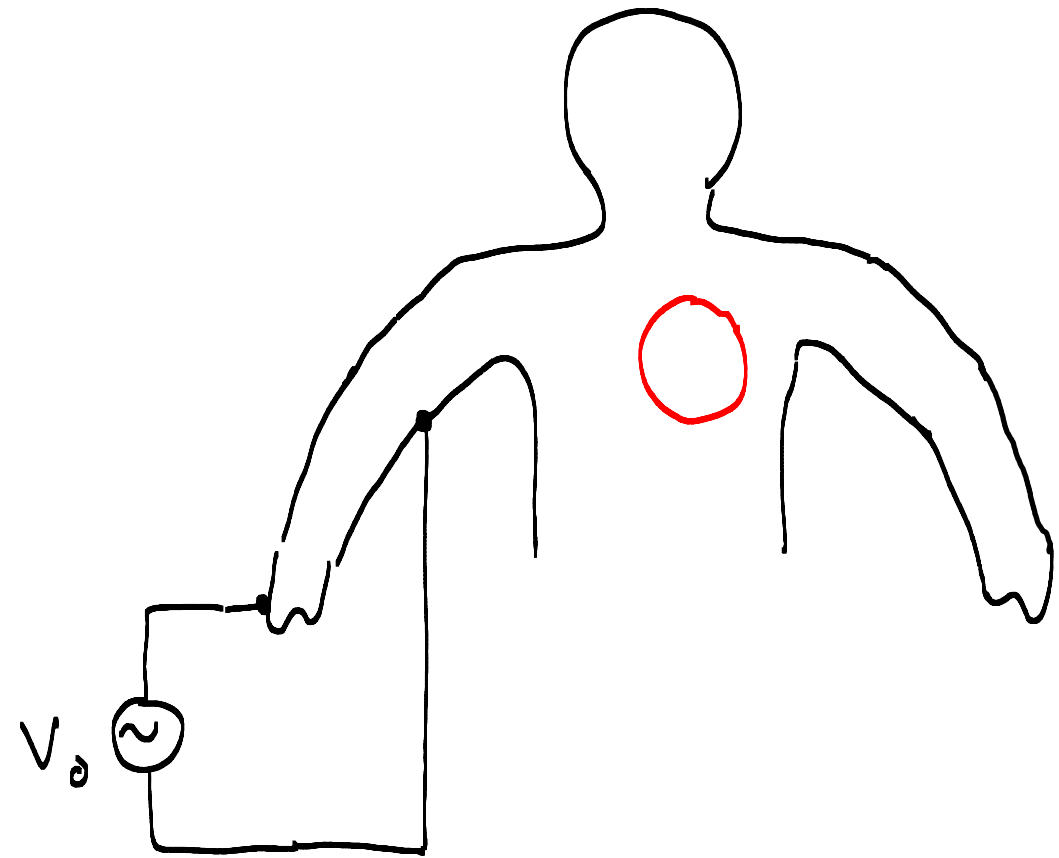


- Points of Entry : Where current enters/exits the body matters !

Ⓐ Points on

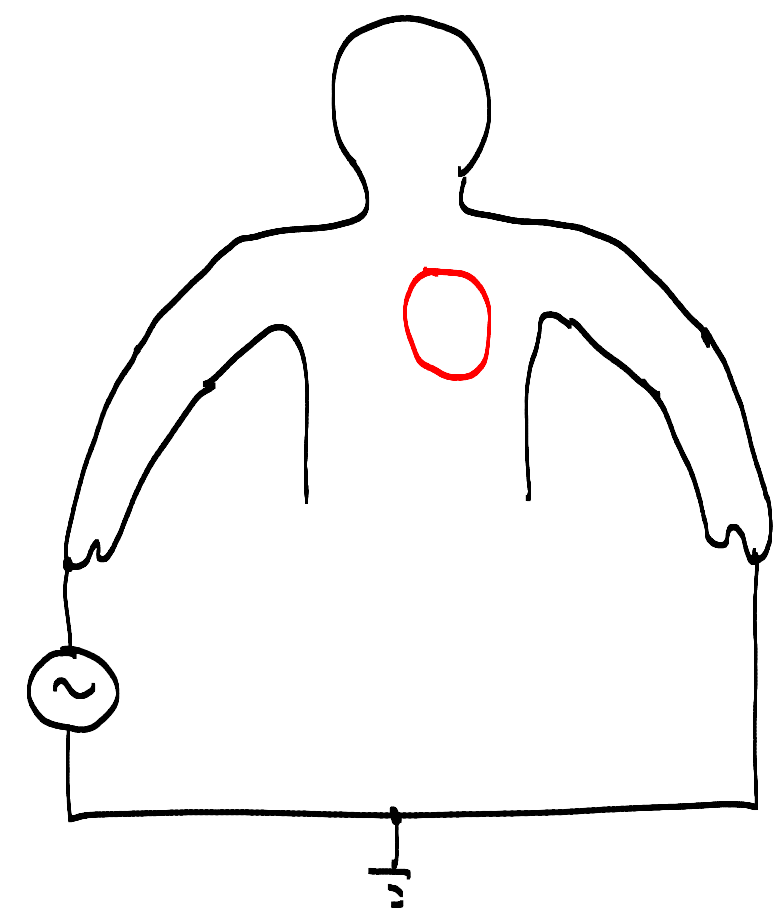


Ⓑ Points on



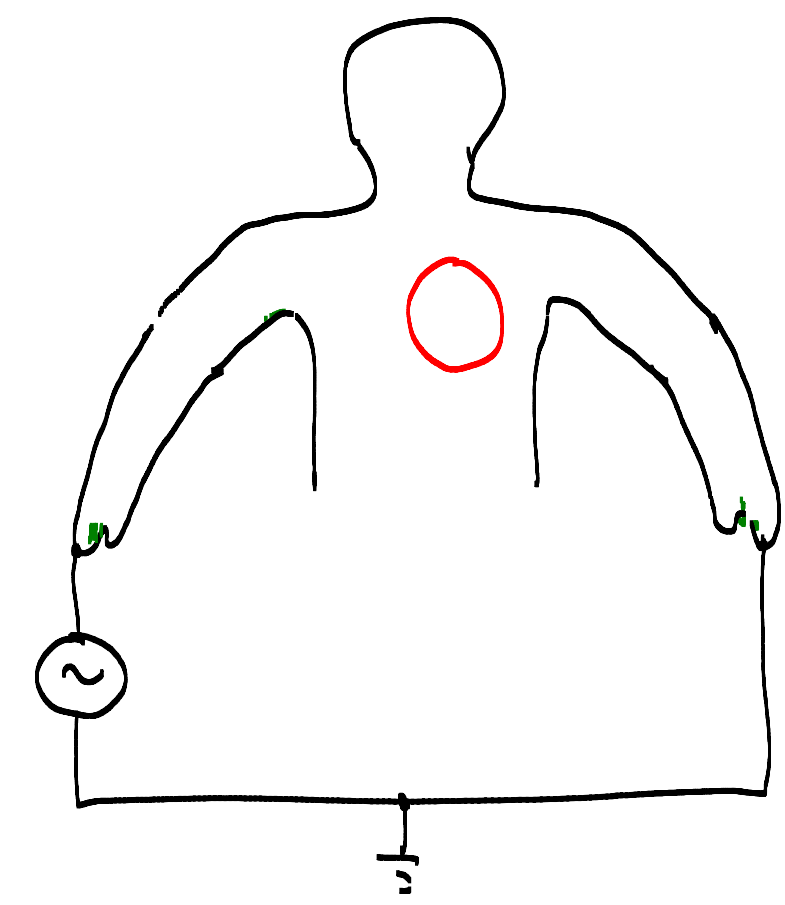
● Macroshock
vs.
Microshock

MACRO SHOCK



microshock

-
-

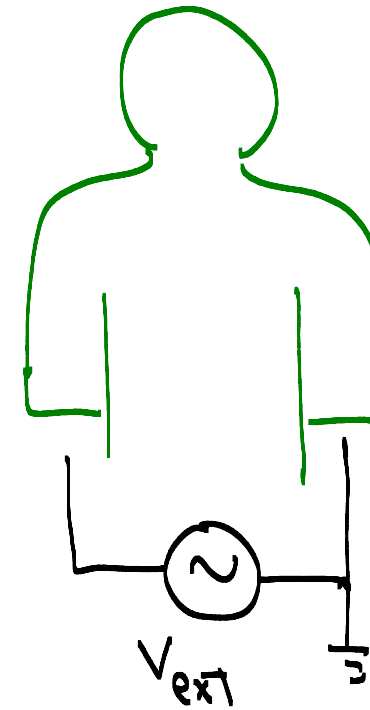


webster Pg 14.6

2. Macroshock Hazards

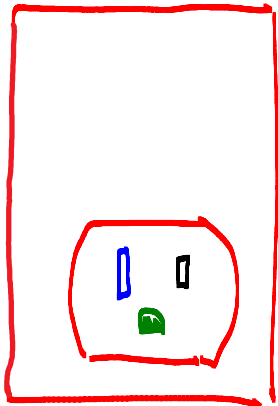
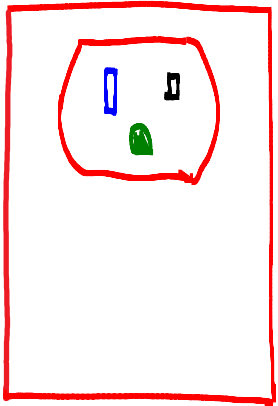
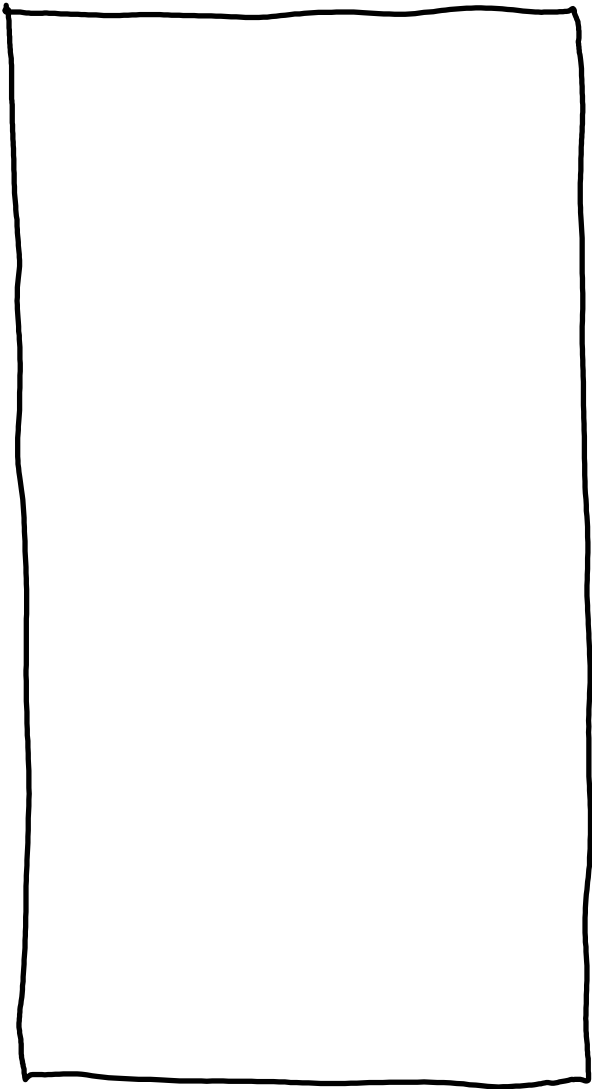
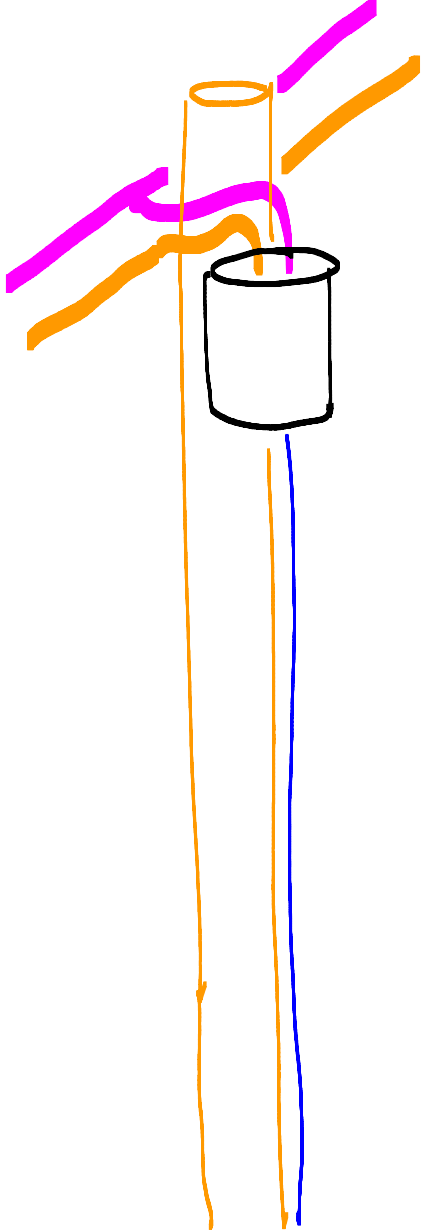
A. Reduced Skin Resistance

$$\text{Current} = \frac{\text{Applied Voltage}}{\text{Resistance}}$$

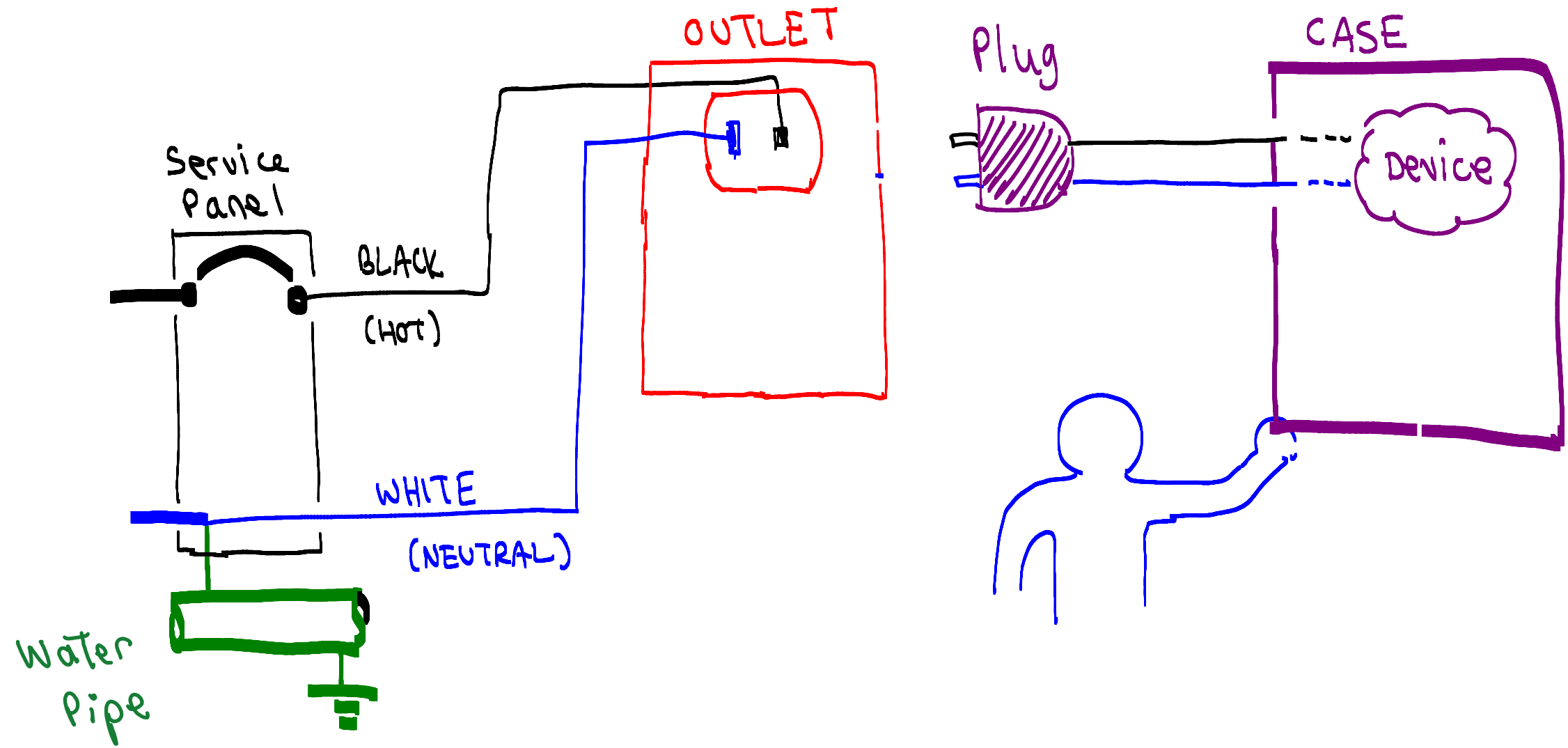


B. Typical Power Line Wiring

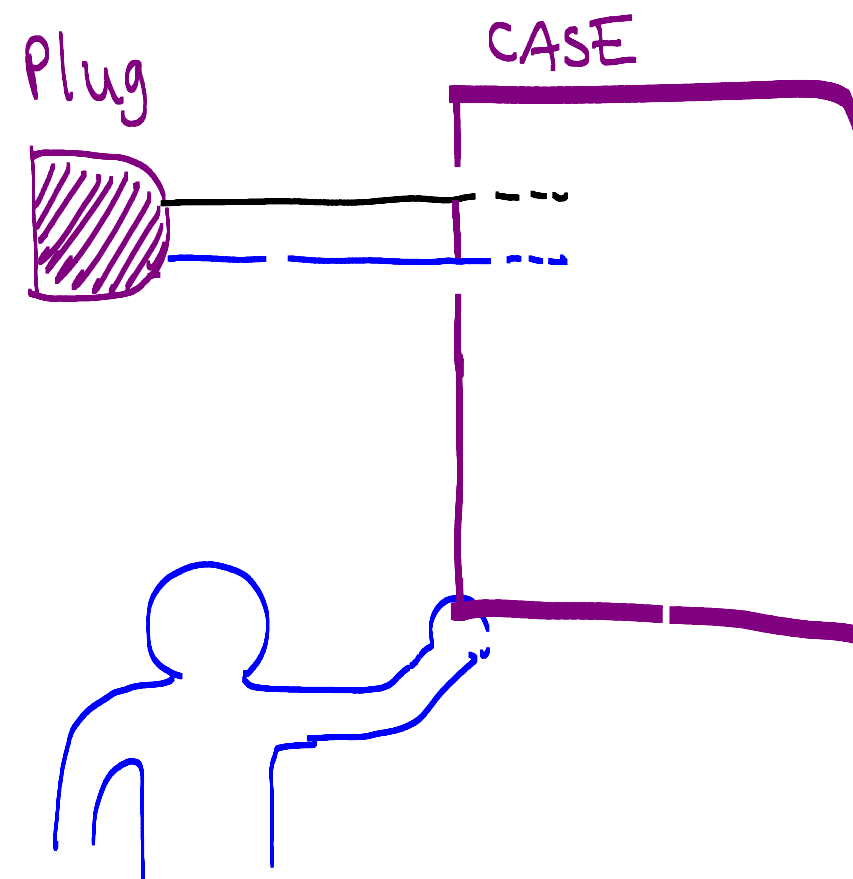
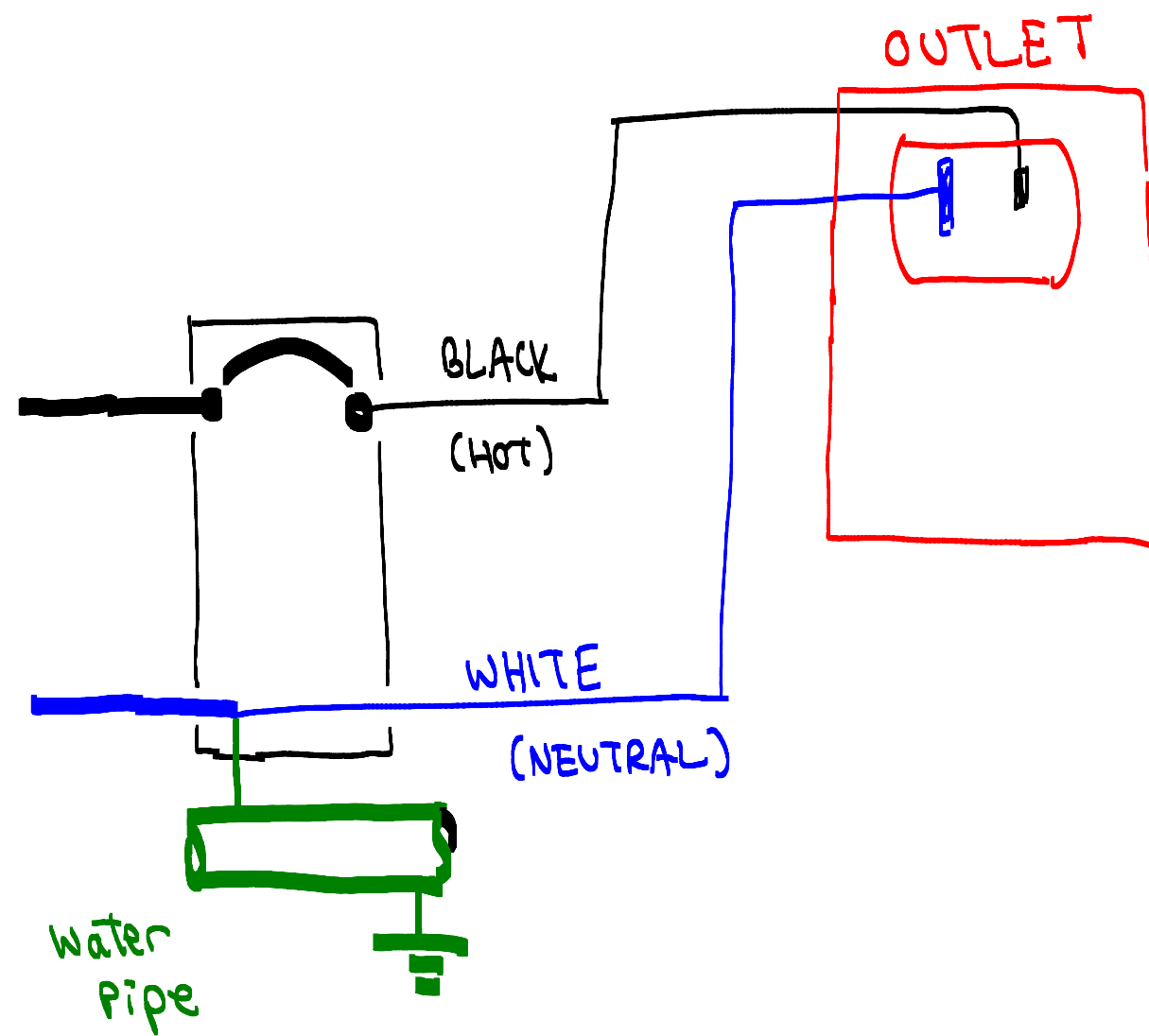
(14.8)



- 2-wire : under normal conditions,

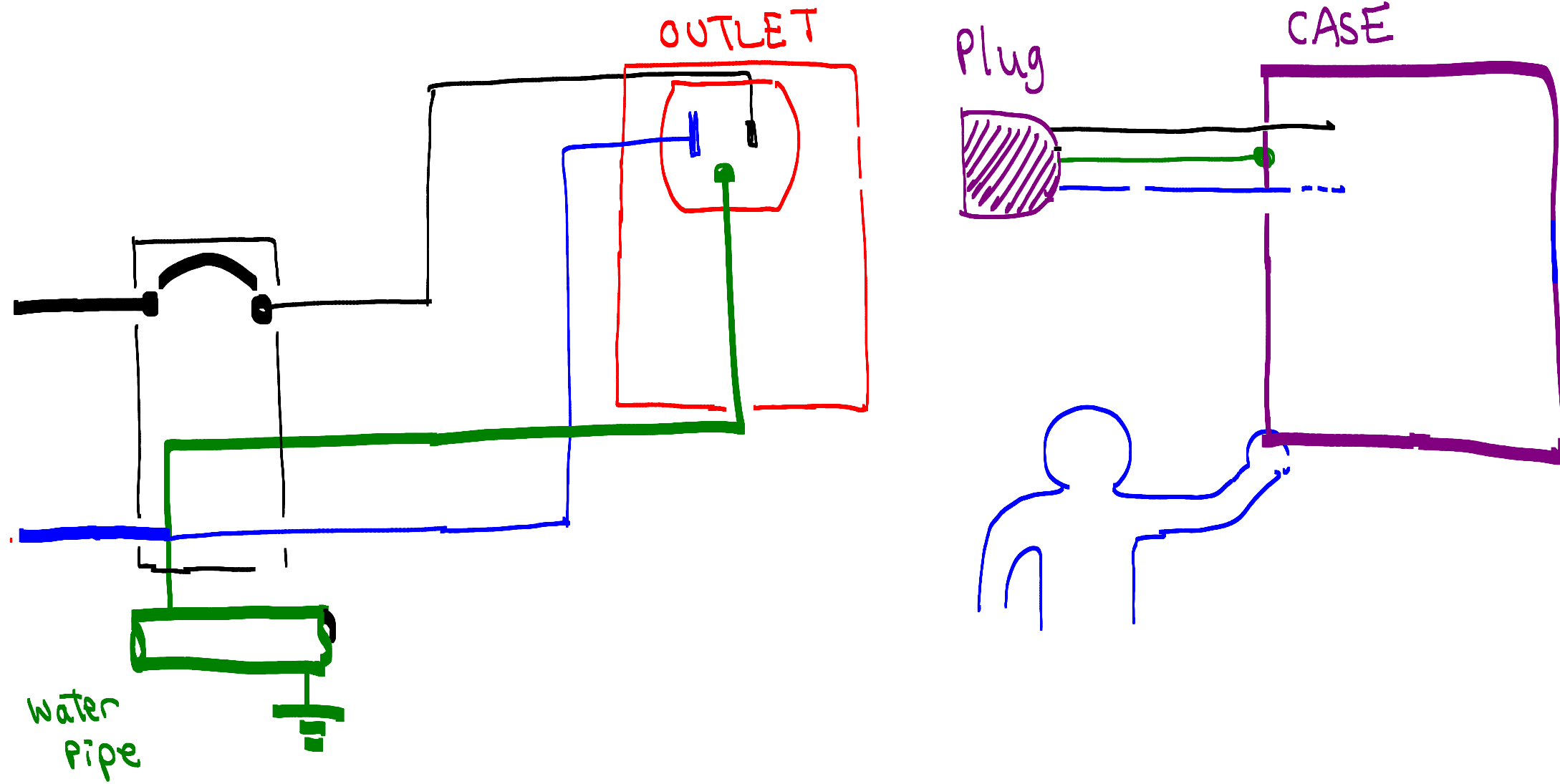


Ground Fault



- 3-wire:

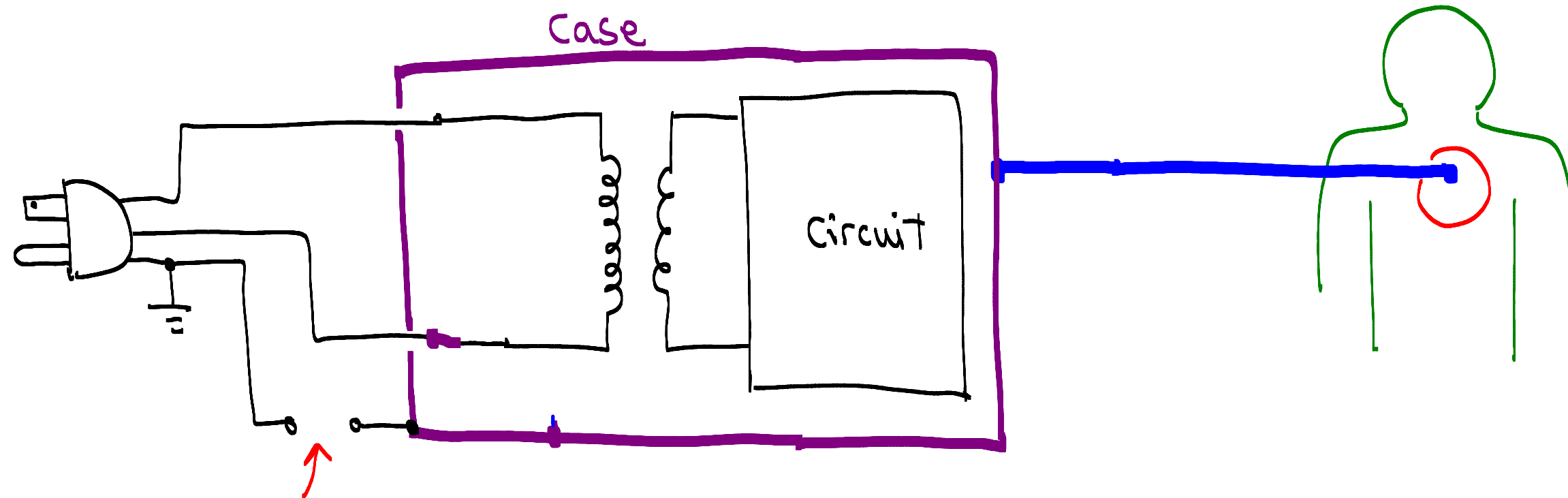
14.11



3. Microshock Hazards

Due to a device that is directly connected to the heart !

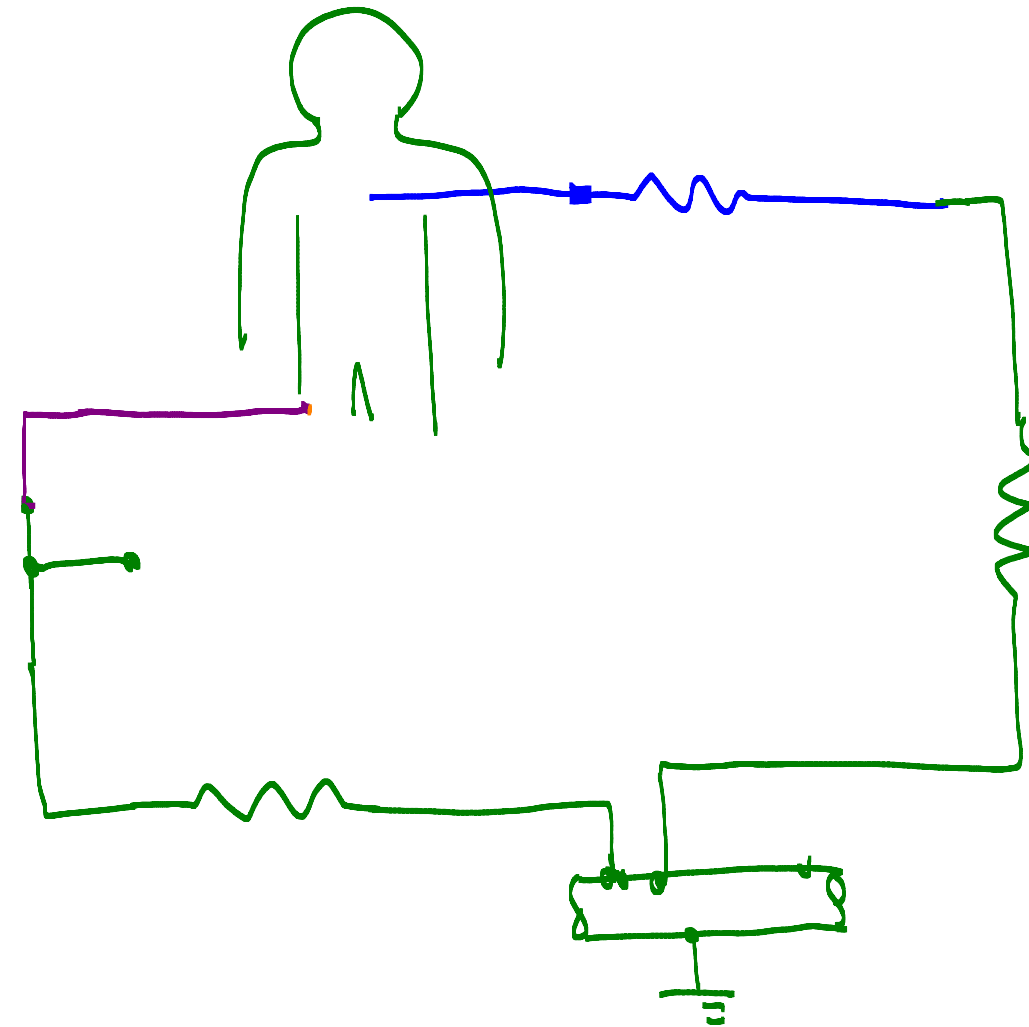
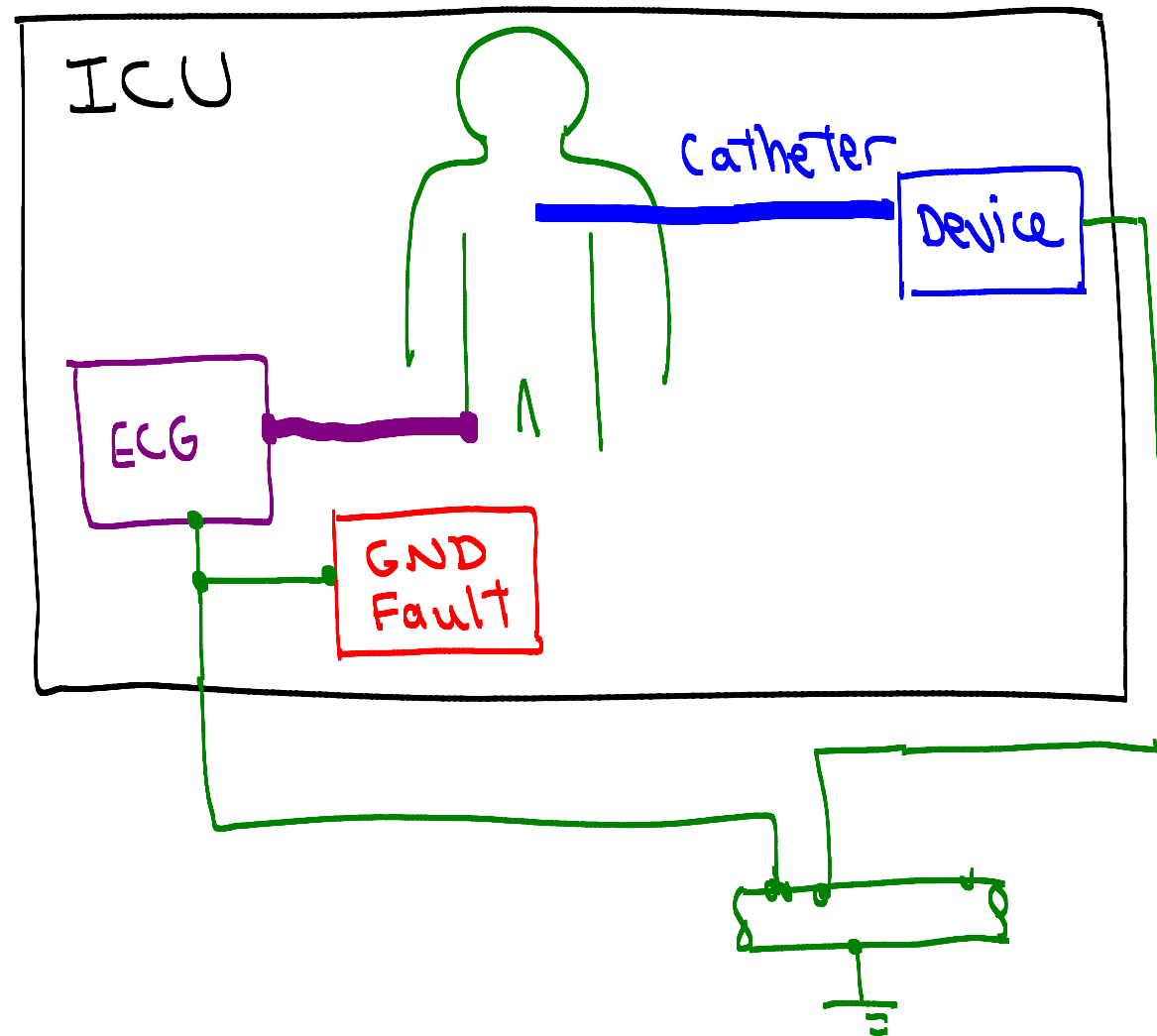
Leakage Currents: Tiny currents



B. Ground Potential Differences

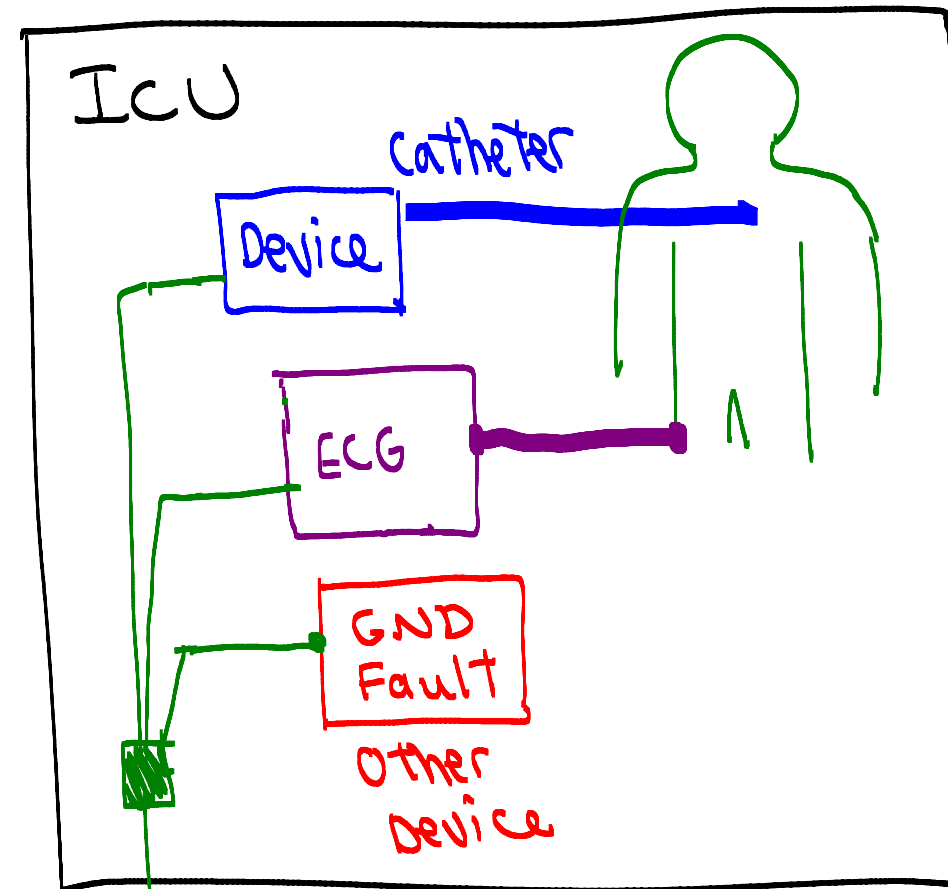
14.13

- Critical care areas (e.g. ICU) need a why?



☆ _____ Can minimize microshocks!

(14.14)



Hospital
Ground
(far away
from ICU)

