Chapter 8

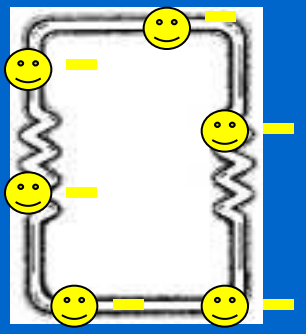
Electrofishing

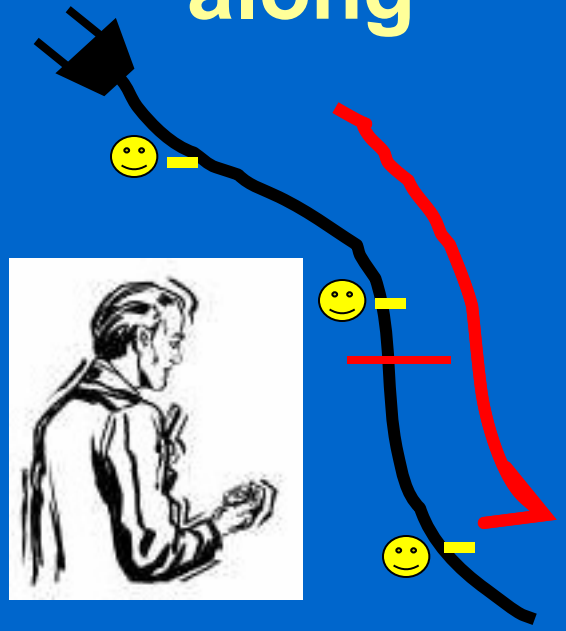
8.1 Introduction

- **Electrofishing - use of electricity to:**
  - **capture fish**
  - **guide fish**
  - **block the movement of fish**

8.2 Principles of Electricity

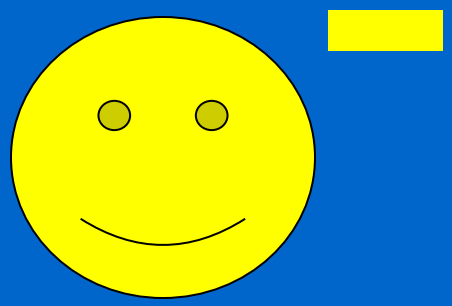
- circuit - closed path that charged particles move along





- current - how many charged particles pass a point in the circuit per unit time [units=Amperes (A)]

Principles of Electricity (cont.)



= V?

- voltage - how much energy per charged particle [units=Volts (V)]

- resistance - voltage:current ratio in a circuit [units=ohms (Ω)]

$V/A = \Omega$

Principles of Electricity (cont.)

- conductance - 1/resistance [units=mhos or siemens (S)]
- electrical power - energy per unit time or current x voltage [units=watts (W)]

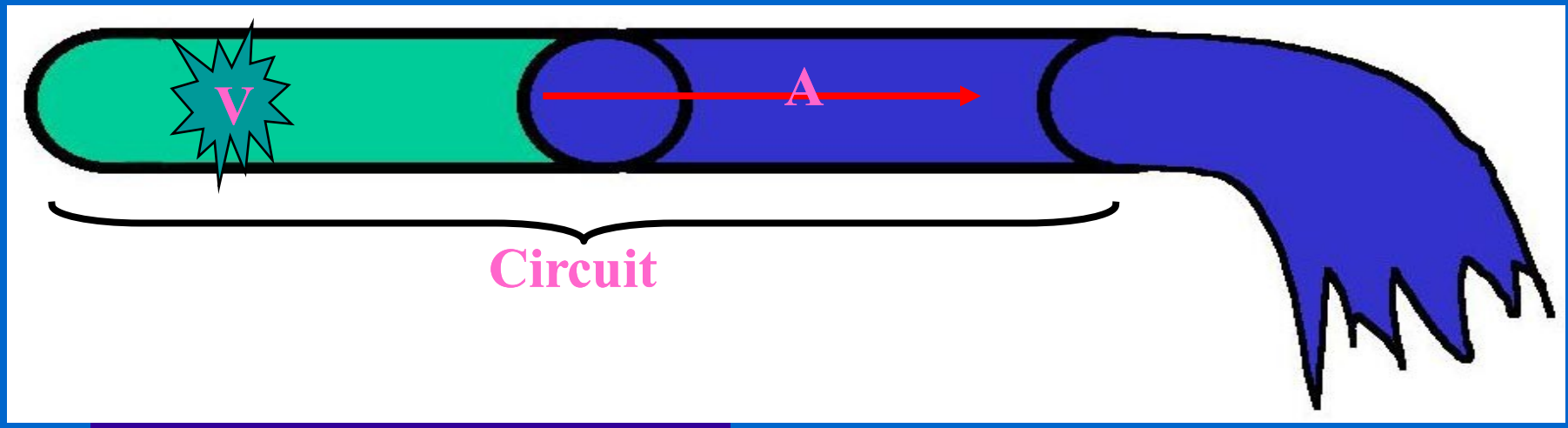
$1/\Omega = S$

$A*V=W$

- 1 watt = 1 A x 1 V when resistance is 1 Ω

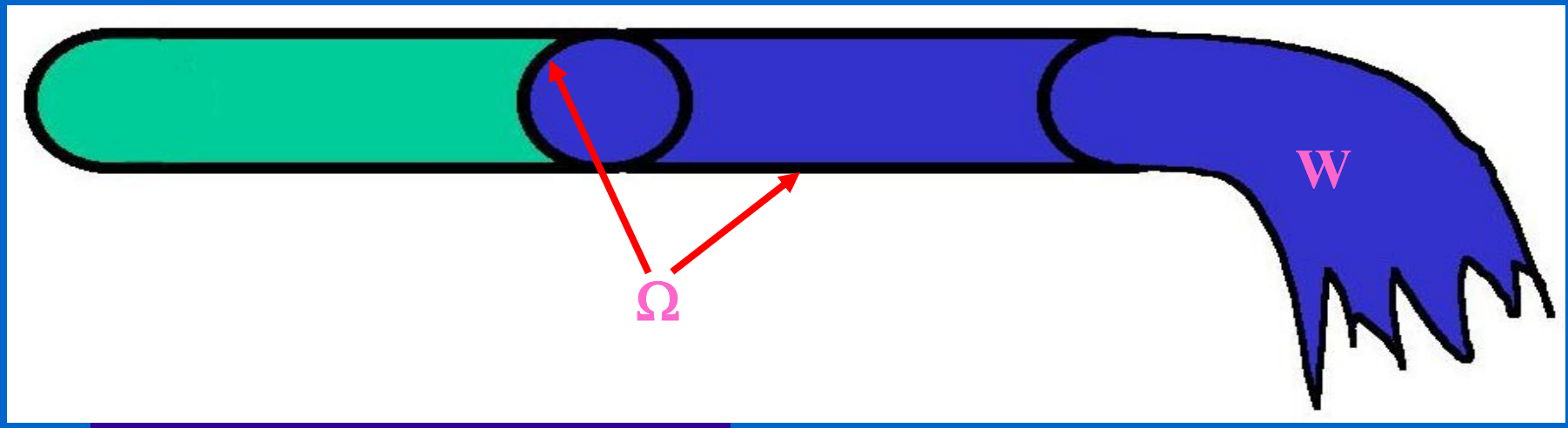
Principles of Electricity (cont.)

- Imagine water flowing in a pipe... (analogy)
  - Voltage = water pressure
  - Current = flow of water
  - Circuit = the pipe itself



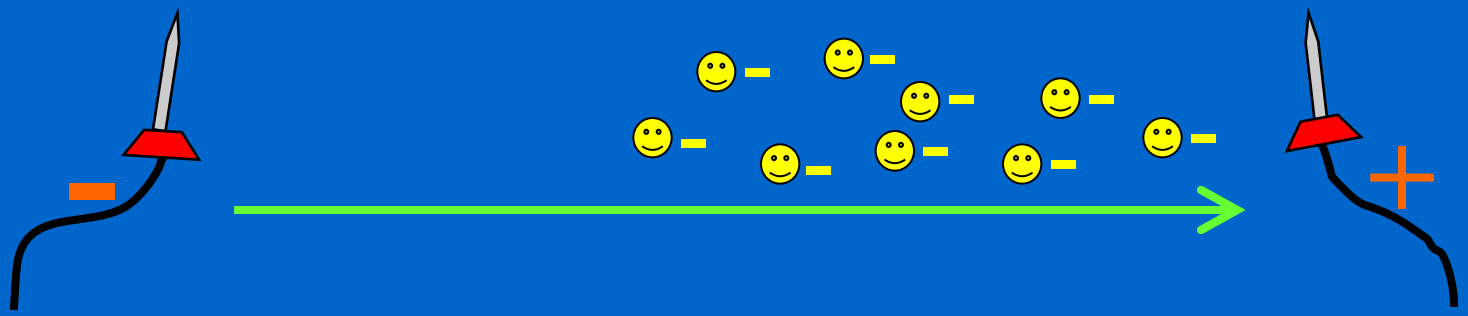
Principles of Electricity (analogy cont.)

- Resistance = factors affecting flow (pipe diameter, friction on pipe wall)
- Power = work water could do shooting out of pipe



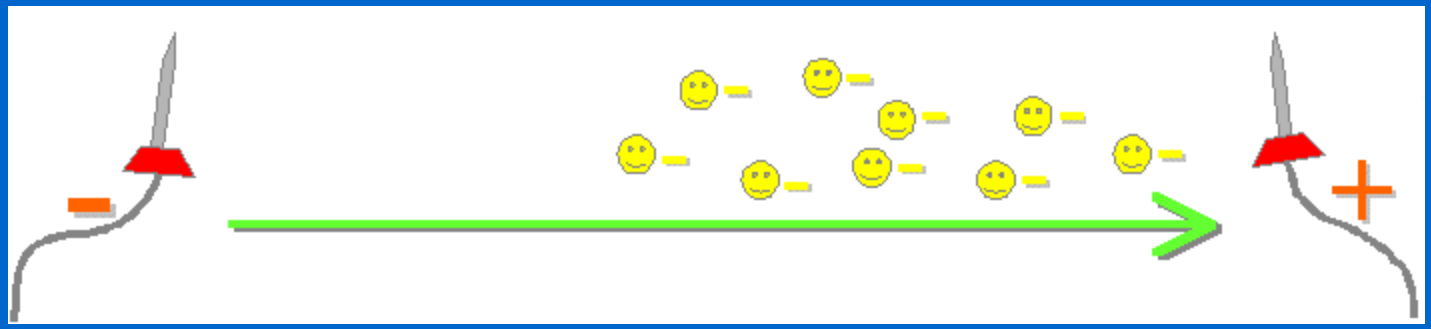
Direct Current (DC)

- Charged particles all flow same way
- Negative particles (electrons)
- Repelled from negative electrode (cathode)
- Flow toward the positive electrode (anode)



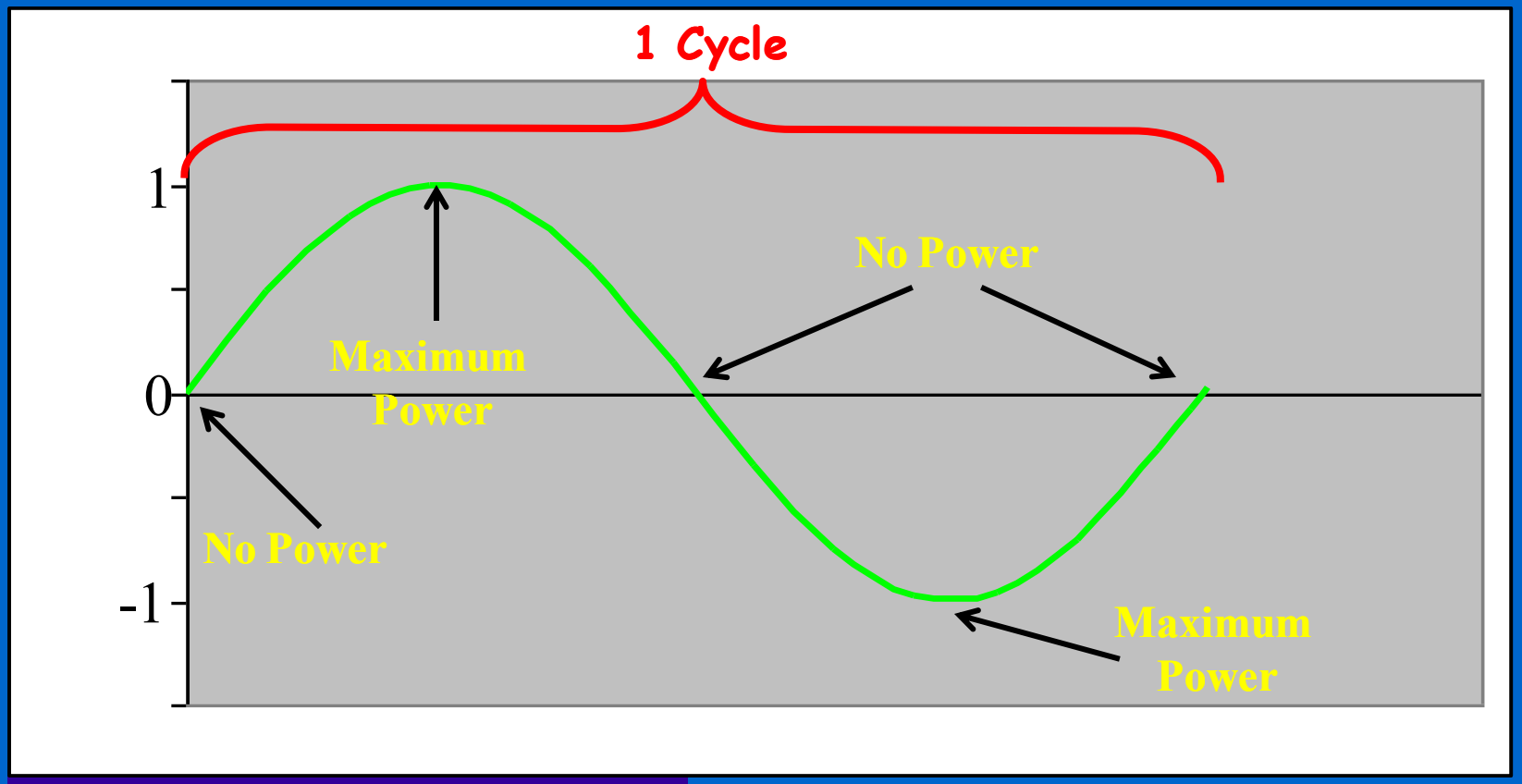
Alternating Current (AC)

- Charged particles flow in both directions
- Polarity of electrodes constantly reverses
  - (click mouse or Enter for animation)



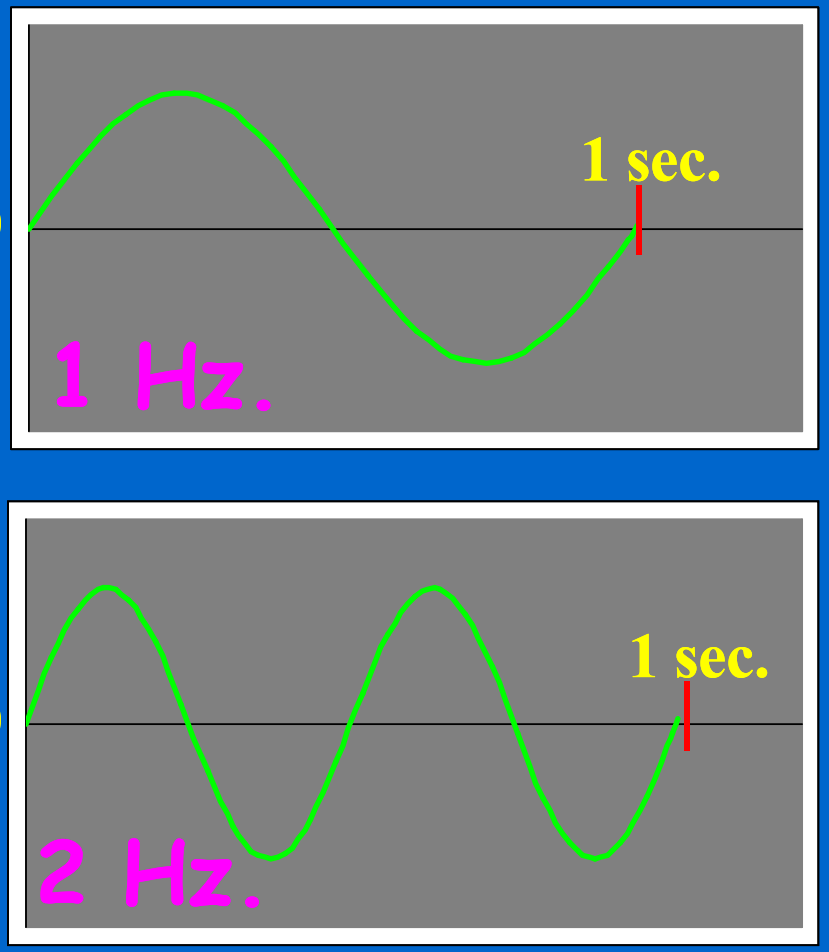
Alternating Current (AC) (cont.)

- Cyclic (like a sine wave)



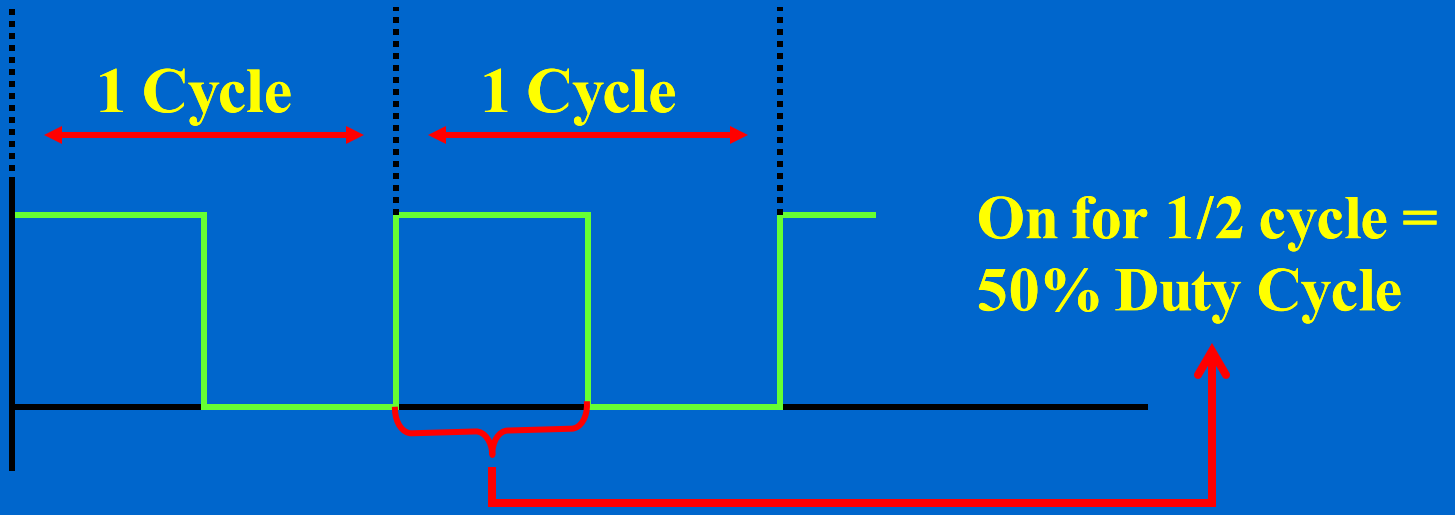
Alternating Current (AC) (cont.)

- Frequency - cycles per second [units=hertz (Hz)]
  - 1 Hz = 1 cycle/sec
  - Note: frequency of AC to your house is ~60 Hz



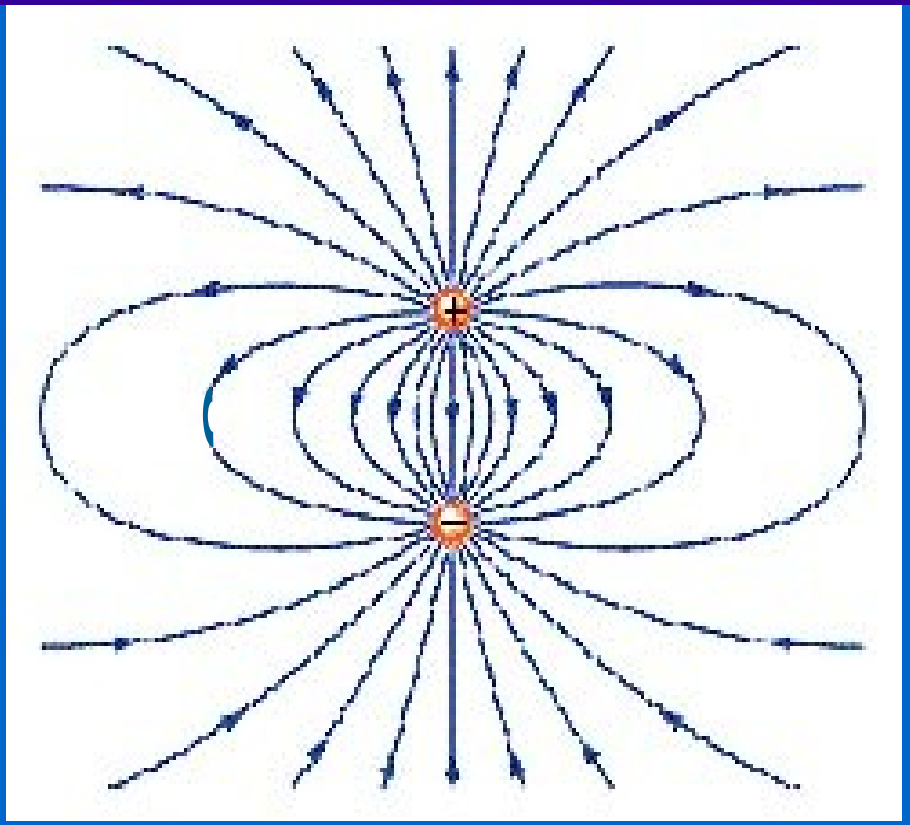
Transformations

- AC or DC can be transformed to pulsed DC
- Current all one direction or zero (square wave)
- Duty cycle - % of time current is on during a cycle



Electrical Fields

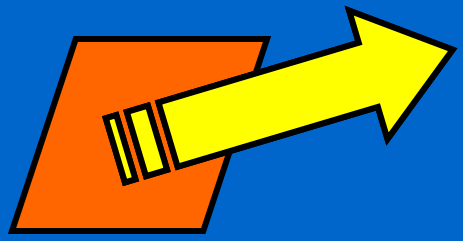
- The space between anode and cathode
  - (imagine north/south poles on a globe)
- Equipotential lines - same voltage along line (like longitude lines)



- Flux lines - strength of field across lines (like latitude lines) varies

Electrical Fields (cont.)

- Current density - amount of current flowing through 1 cm^2



- Voltage gradient - amount of voltage change over 1 cm

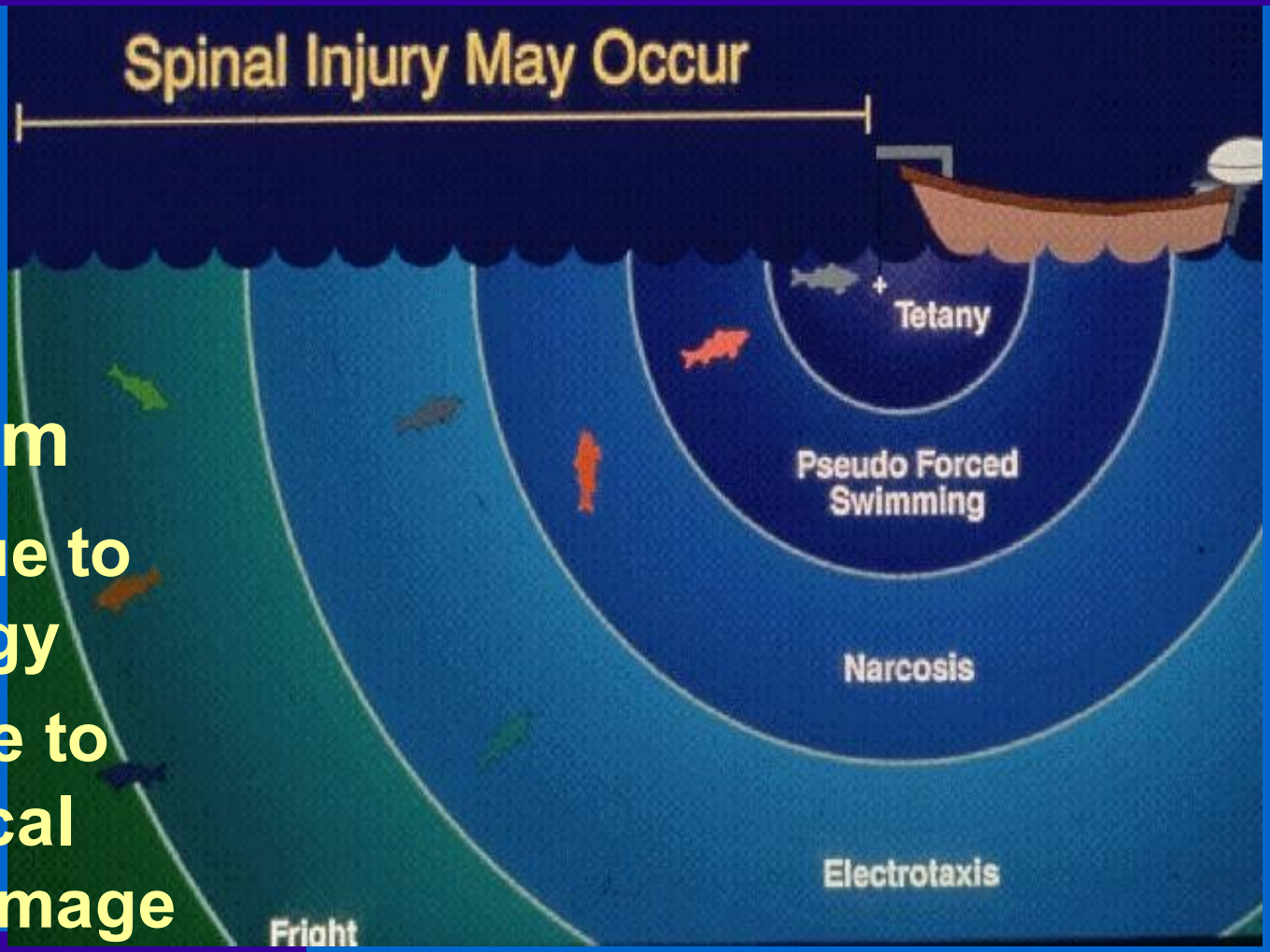
- Ohms law: resistivity (Ω-cm) = voltage gradient (V/cm) / current density (A/cm^2)

Electrical Fields (cont.)

- Conductivity - how well does water conduct electricity (=1/resistivity)
- Freshwater conductivity ~50-1500 μS/cm
- Voltage gradient 0.1 to 1.0 V/cm

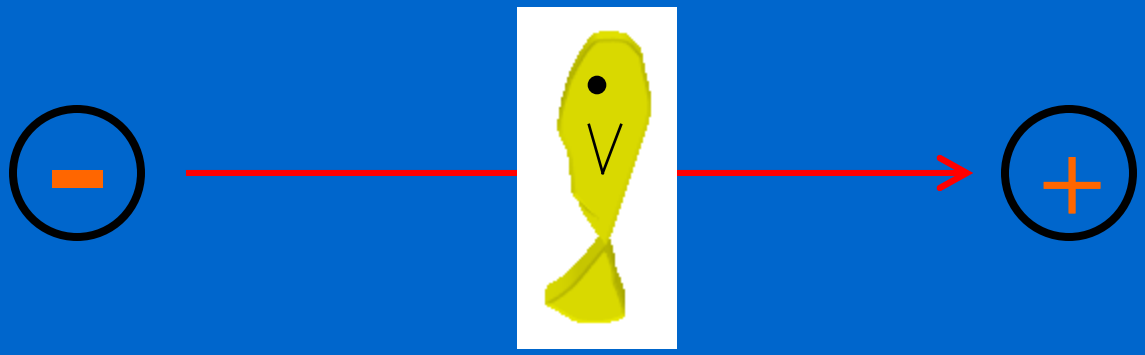
Fish in an Electrical Field

- Behavior change or reactive movement
- Trauma from
  - Stress due to physiology
  - Injury due to mechanical tissue damage



Fish in an Electric Field (cont.)

- Low AC - fish lines up perpendicular to flux line



- High AC - muscle contraction and tetany

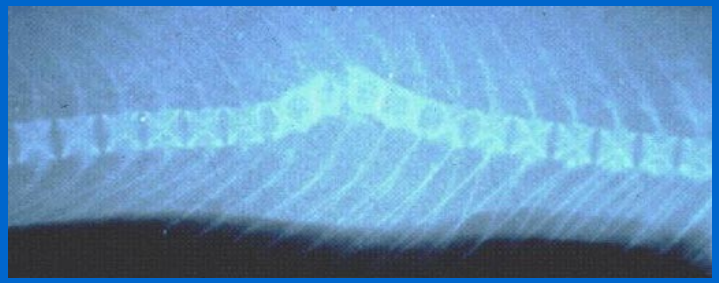
Fish in an Electric Field (cont.)

- Low DC - fish moves toward anode (like an electron)

- High DC - narcosis (muscle relaxation & loss of equilibrium)

Injuries to Fish

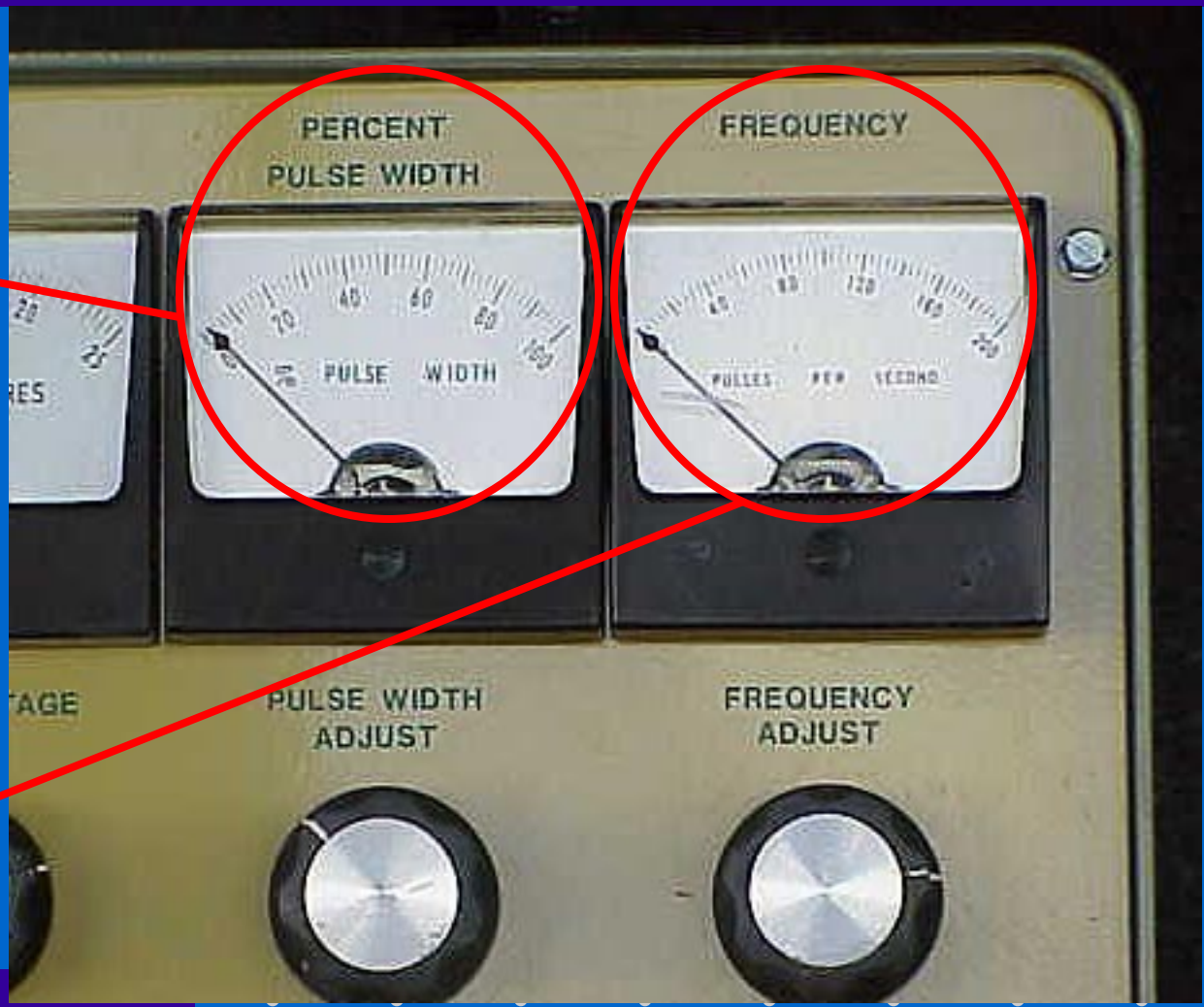
- Hemorrhages or bruising of soft tissue
- Fractures of vertebrae



- NOTE: AC is more likely to injure fish than pulsed DC
- Pulsed DC is more likely to injure fish than continuous DC

Most popular form is pulsed DC

- 25-50% duty cycle
- 50-60 Hz



8.3 Electrofishing system

- power source and power control unit
- meters
- wires & electrodes
- other equipment (lights, nets, pumps, livewells)
- boat
- shocking system
- backpack shockers

Boats

- 12-14 ft long x 5-7 ft wide
- Aluminum hull means boat serves as cathode.
- Motor
- 25-40 hp
- idle without dying
- Platform with rails on the bow
- Weight rated properly (>300kg)

Shocking system

- Booms for electrodes (fiberglass, wood)

- Booms retractable or removable for hauling boat

Equipotential Surfaces

- You don't get shocked standing on a boat (like a bird on a wire)

=

= NO SHOCK

- All metal must be attached to hull
  - Even generator should be wired to hull

General circuit - Boat

- AC Generator (grounded)
- Variable voltage/power box (VVP)
- Safety switch/dead-man foot pedals

General circuit - Boat (cont.)

- Anodes (out front of boat)
- Cathode (metal boat hull)
- Optional
  - Battery
  - Charger

VVP Box - control unit

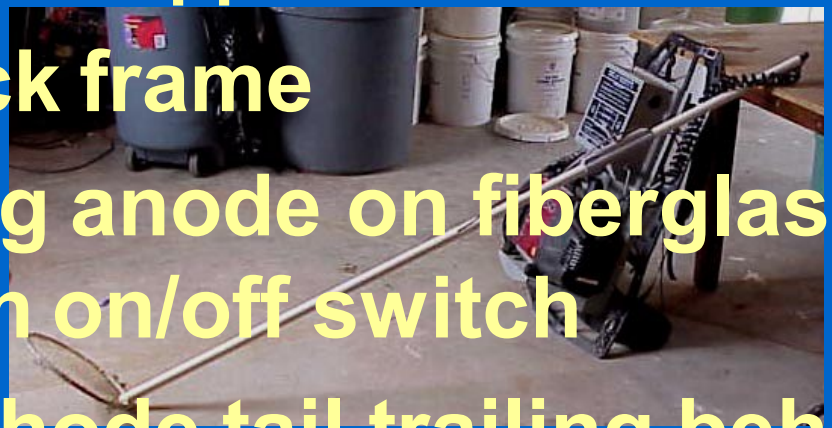
- Change power output
- Change AC to DC
- Change duty cycle
- Change wave form
- Pulsed DC or not

Electrode designs

- Round (size of basketball) split into two hemispheres so it sinks
- Cylinder
- Wisconsin ring (1 m diameter) with multiple 45cm-dropper electrodes

Backpack shocking units

- Weatherproof VVP and power source
- 12 V deep cycle battery
- 110 V AC generator
  - tilt activated circuit breaker
  - off if tipped over
- Pack frame
- Ring anode on fiberglass pole with on/off switch
- Cathode tail trailing behind

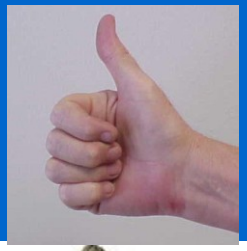


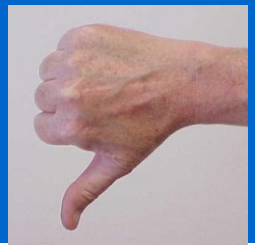
8.4 Efficiency - catch rate, what determines it?

- Biological (example: fish species)
- Environmental (example: day vs night)
- Technical (example: AC vs DC)

Biological Factors

- Species - shad susceptible...catfish not as much





- Fish size - big fish feel more due to voltage drop from head to tail

Environmental Factors

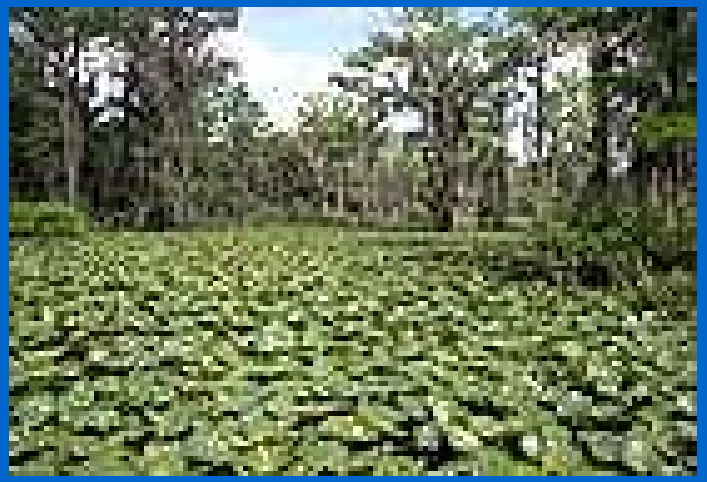
- Water conductivity - too low or too high = poor catch
- Temperature - warm water...active fish... escape
- Turbidity - too turbid...dipnetters miss fish

vs.

- Low bottom DO = fish higher in water... better catches

Environment Factors (cont.)

- Good fish habitat accessible by boat… better catches
- High vegetation... dipnetters miss fish



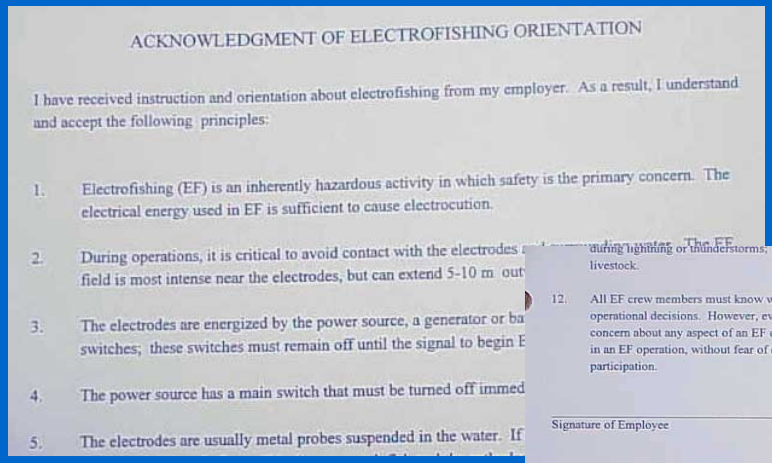
- Rain and wind... distracted dipnetters miss fish
- Night shocking...good catches of nocturnal predators (ex. LMB)

Technical Factors

- Experienced personnel...better catches
- Correct power form (AC/DC)...better catches

8.5 Procedures

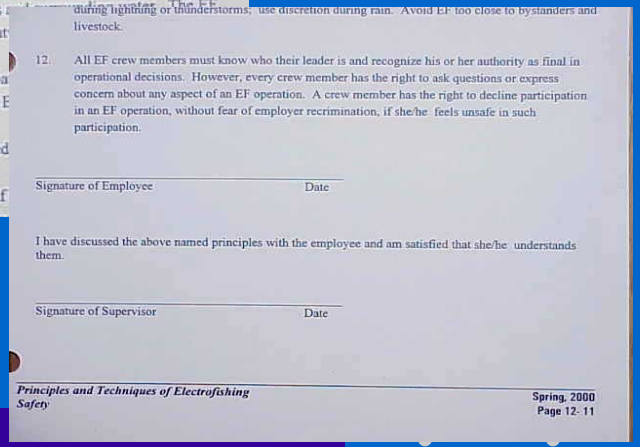
- **Safety Program - guidelines in writing (see Box 8.3, pg 245)**
- **CPR training**



ACKNOWLEDGMENT OF ELECTROFISHING ORIENTATION

I have received instruction and orientation about electrofishing from my employer. As a result, I understand and accept the following principles:

1. Electrofishing (EF) is an inherently hazardous activity in which safety is the primary concern. The electrical energy used in EF is sufficient to cause electrocution.
2. During operations, it is critical to avoid contact with the electrodes
3. The electrodes are energized by the power source, a generator or ba
4. The power source has a main switch that must be turned off immed
5. The electrodes are usually metal probes suspended in the water. If



during lightning or thunderstorms; use discretion during rain. Avoid EF too close to bystanders and livestock.

12. All EF crew members must know who their leader is and recognize his or her authority as final in operational decisions. However, every crew member has the right to ask questions or express concern about any aspect of an EF operation. A crew member has the right to decline participation in an EF operation, without fear of employer recrimination, if she/he feels unsafe in such participation.

Signature of Employee Date

I have discussed the above named principles with the employee and am satisfied that she/he understands them.

Signature of Supervisor Date

Principles and Techniques of Electrofishing Safety

Spring, 2000
Page 12- 11

Procedures (cont.)

- Rubber gloves, knee-boots, life vests for boat

- Rubber gloves, chest waders, life vest for backpack

- Ear-plugs or radio headphones

Safety Rules

- NEVER ELECTROFISH ALONE
- Don't fish around spectators or livestock
- Don't fish in the rain or during thunderstorms
- Don't chase fish or lean out too far

Technical safety issues

- Dipnets with non-conductive handles (like PVC)
- Holding tank with adequate aeration
- Adequate lighting for night shocking

Standardized sampling guidelines

- Collect all fish possible to avoid bias
- Standardize voltage output
  - Pulse rate = 5-40 Hz
  - Duty cycle = 25%
- Standardize season - spring or fall
- Standardize the water stage in flowing water (not too high or low)

Data analysis

- Species composition
- Species abundance
- Population structure - PSD, RSD
- Population dynamics - catch curve/mark-recapture