Built your own Electronic Piano

…a K-12 Workshop on Engineering and Electronics

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What is Engineering?

Making a Difference…

Solve all types of problems:

- New kinds of sport equipment to give players extra edge while keeping safe from injury.
- Develop sophisticated security equipment to keep nation safe
- Creating new medical sensors for health
- Creating new methods of communication
- Creating more family time w/ smart appliances

Engineers...

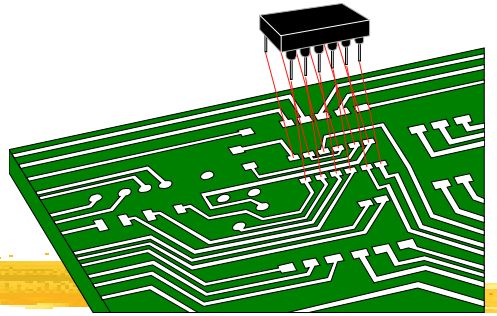
Use science & math to come up with solutions that are

- Safe
- Effective
- Energy efficient
- Economical
- Easy to use

Some types of engineers

- Chemical Eng. – improved food, cosmetics, synthetic clothes
- Environmental Eng. – recycling methods, ways to purify air, water, soil
- Biomedical Eng. – design artificial limbs, medical machines
- Mechanical Eng. – design cars, robotics, amusement rides.

Electrical Engineering



- Power - electricity distribution systems, electronics for control circuits for generation, transmission and usage of electric power.

- Electronics - Digital systems, computer architecture

- Control Systems - robotics, automation for manufacturing process

Electrical Engineering *(cont..*

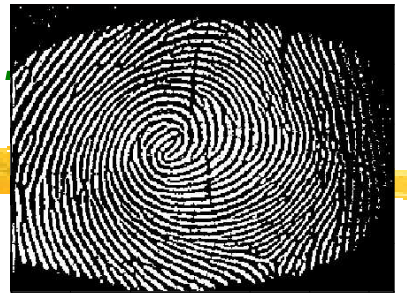


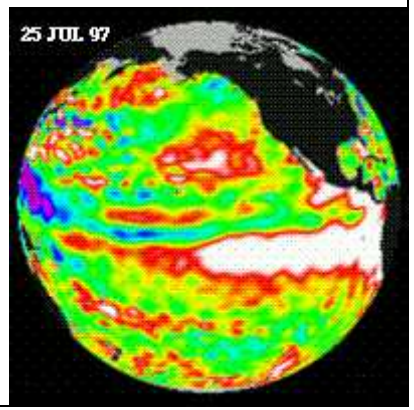
Image Processing

- Communications

  Digital Signal Processing, pattern recognition, image processing

- Electromagnetics

  Microwaves, optics, antennas,wireless. radars



Electromagnetics

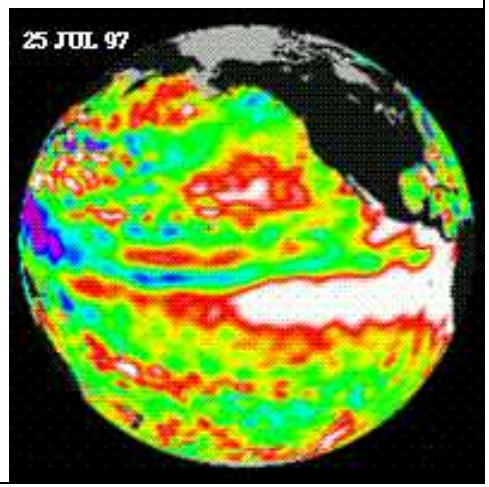
Applications:

- Communications

  Design of microwave circuits and antennas

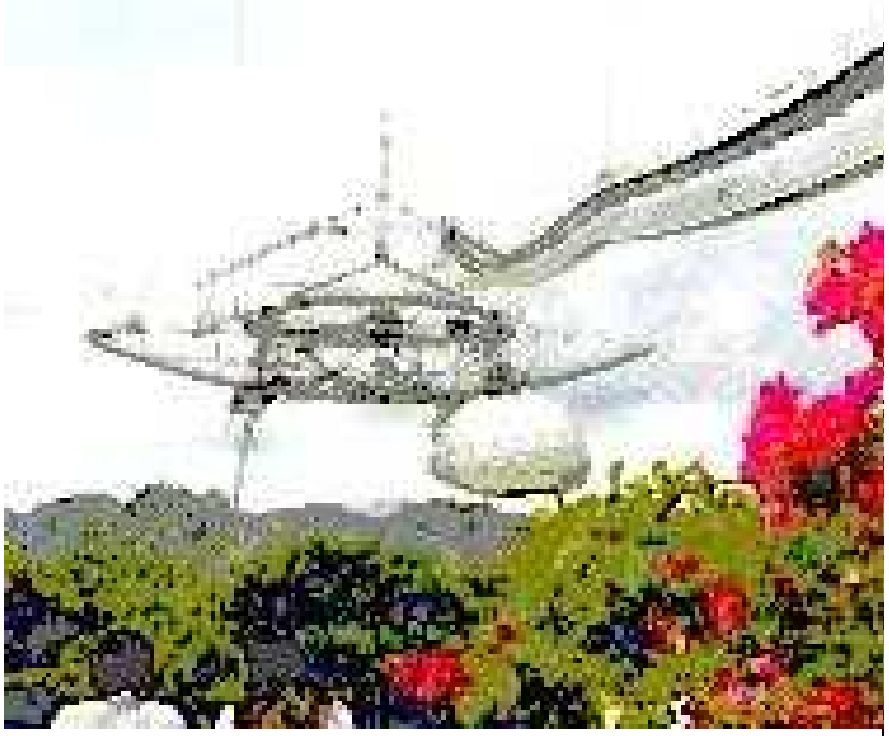
- Remote Sensing

  Radars and radiometers used to study nature and other objects



More Applications

- Propagation
  - E.g. Ionosphere, short band
- Frequency Spectrum
  - γ–Rays, X-rays, UV, IR,
- Medicine
  - Treat cancer microwaves Hyperthermia
  - Laser (eyes)
- Communication
  - Radio, TV, Telephony



Different Clouds types

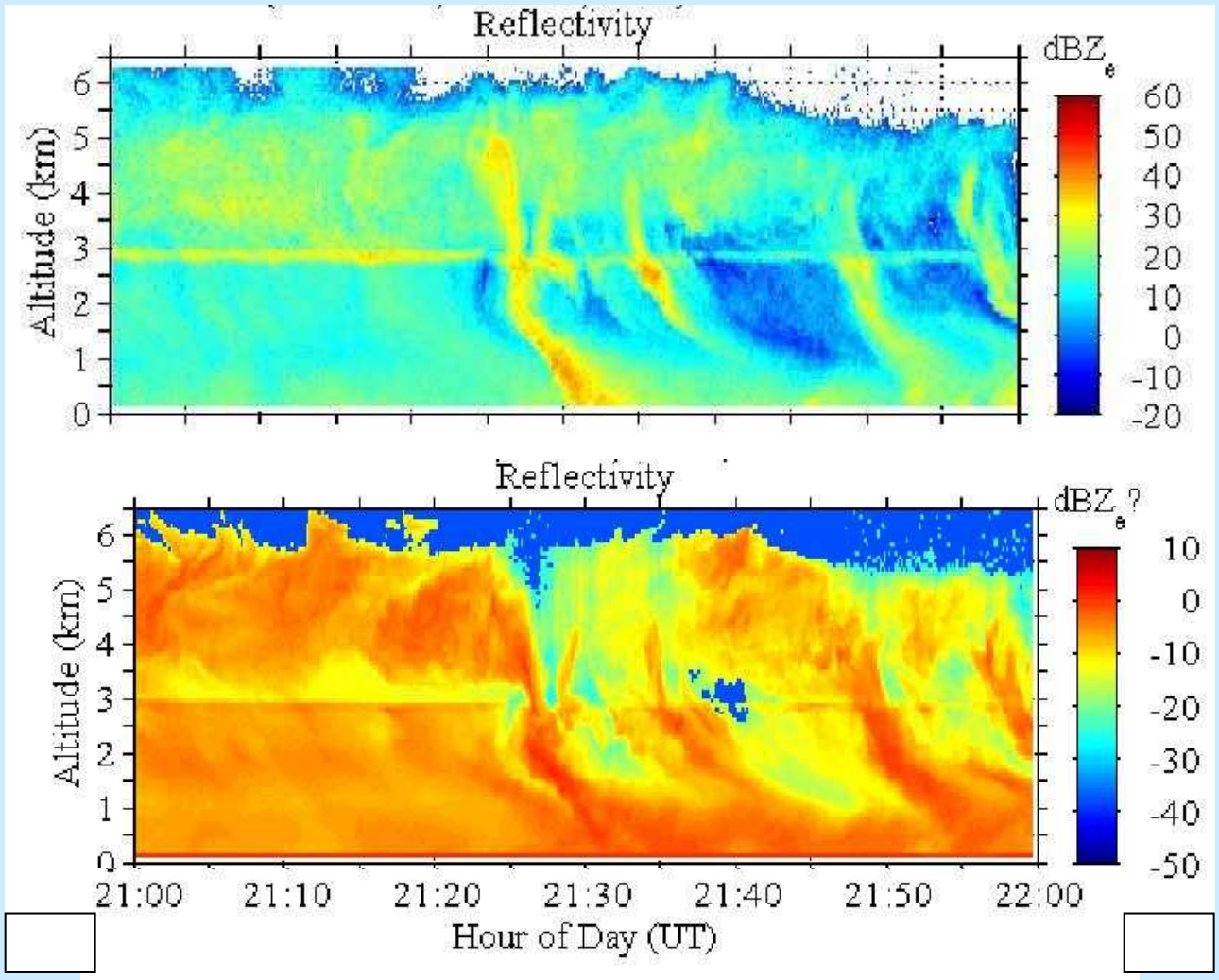
Field Measurements

Study of Rain at OK, 2001

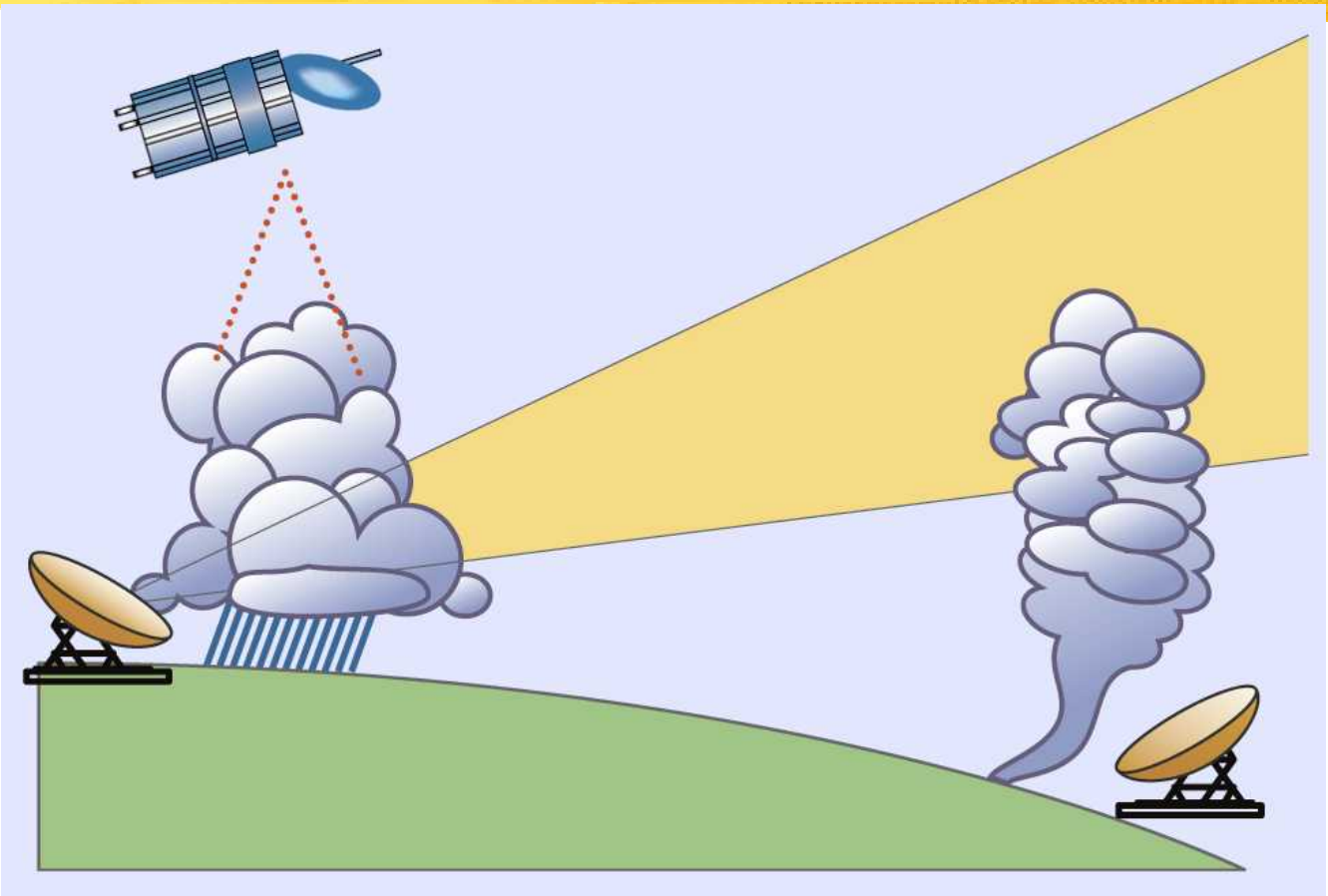
Collected Data Hour 21:00 UTC

@2.8GHz

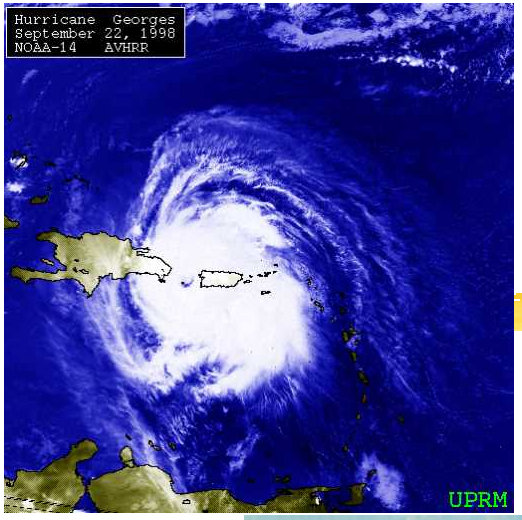
@95GHz



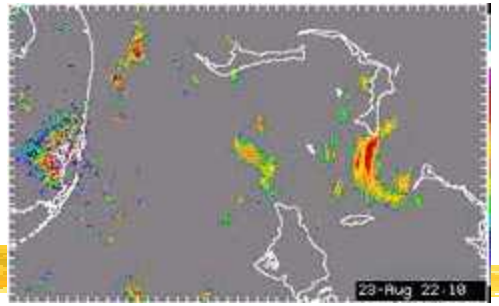
Collaborative Adaptive Sensing of the Atmosphere (CASA)



Earth curvature effects prevent 72% of the troposphere below 1 km from being observed



Climmate Lab



www.uprm.edu/climmate

Myths about electricity and electromagnetic properties

- Ocean is blue because of the reflection of sky.
  WRONG! Pure water is blue, a very faint blue color. In large quantities it's seen blue, such as swimming pool on cloudy day. Algae, sediments, also affect the ocean color.
- Edison invented of currently used AC electrical systems WRONG! : Nikola Tesla invented the AC poly-phase system, the radio, made first fluorescent lamps, neon lamps, X-rays photographs, wireless communications, remote controlled vehicles, Niagara Falls generator, largest man-made lighting-bolt, artificial earthquake, hyperthermia treatment and many inventions he didn't patented (only patented ~800).

Electronic Workshop

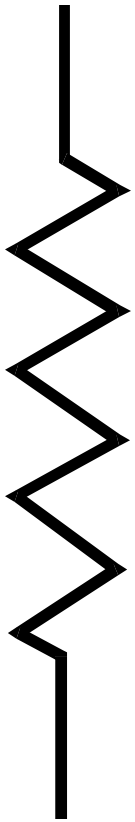
Electrical Circuits Components

Meet the Resistor

Resistors reduce or resist the pass of electrons

Carbon Composition

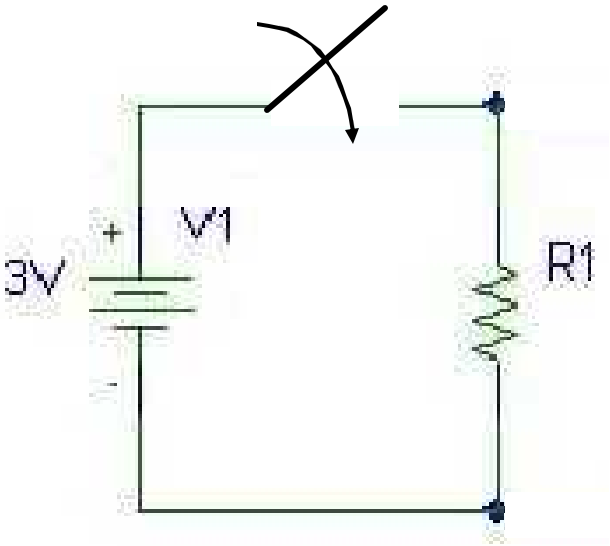
First Band = First Digit
Second Band = Second Digit
Third Band = Multiplier
Fourth Band = Tolerance



0	Black
1	Black
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White

Electrical Circuit

It most have a closed loop

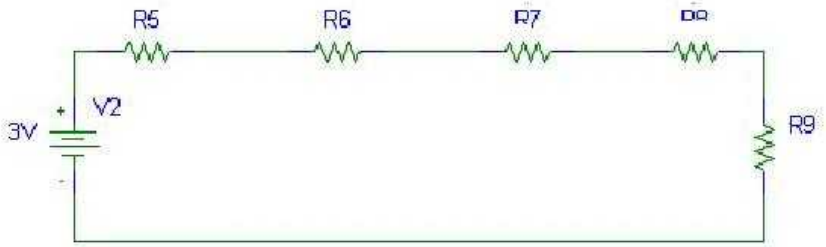


Circuit Connection

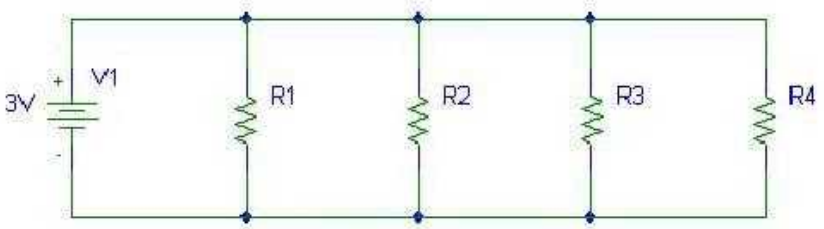
Connect the circuits below using the color light bulbs provided

Which connection makes the lightbulbs shine brighter? Why?

Series



Parallel

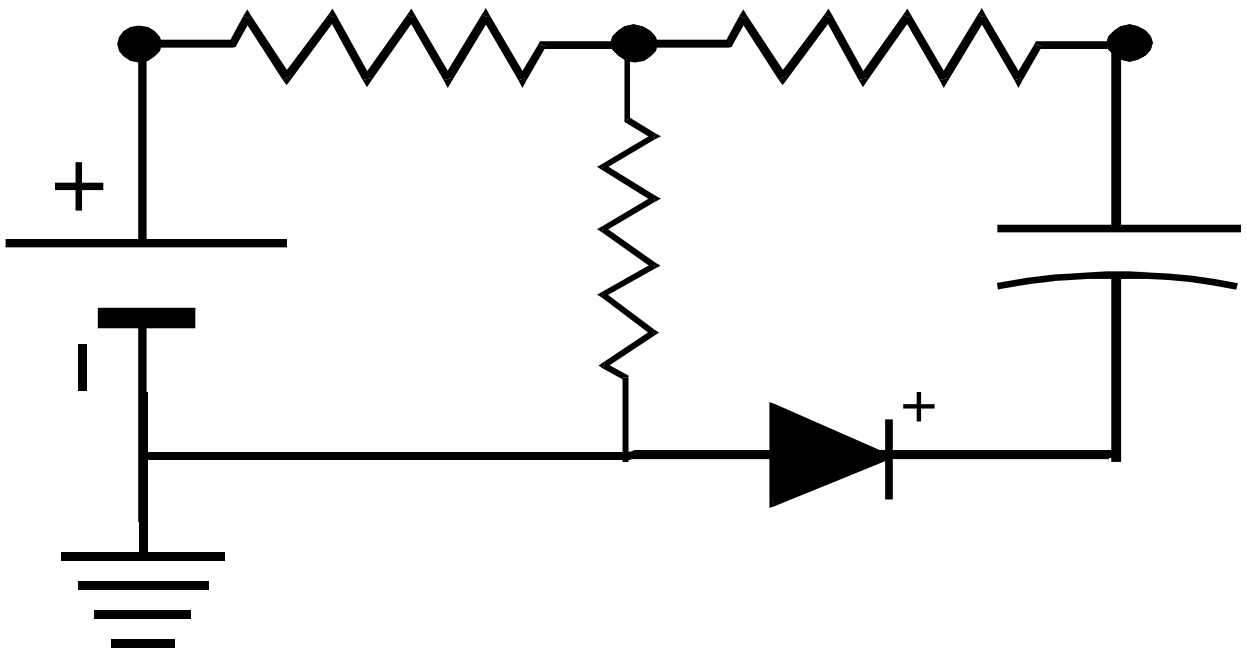


Ohm's Law:

$V = I R$

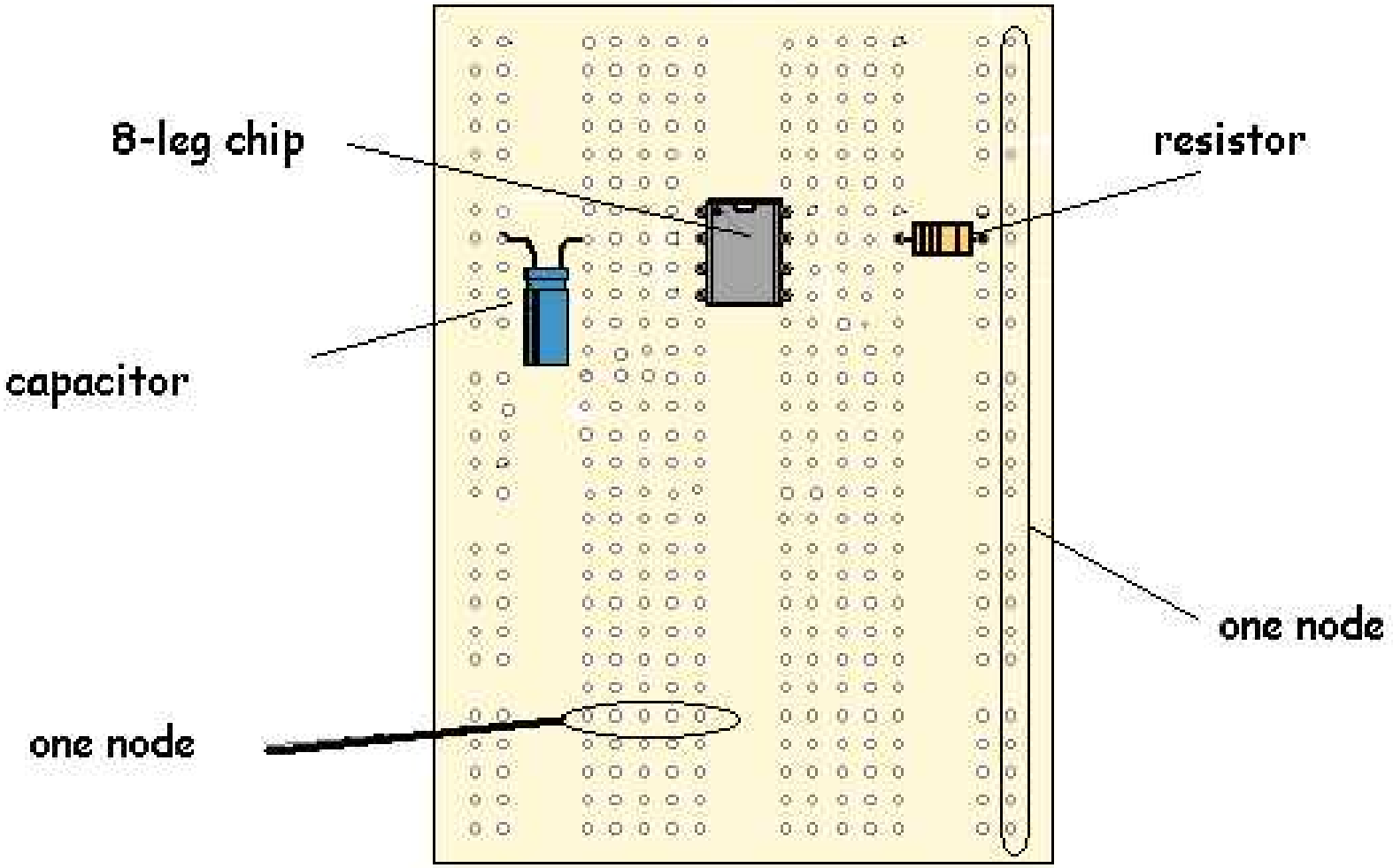
$I = V / R$

What is a Node?



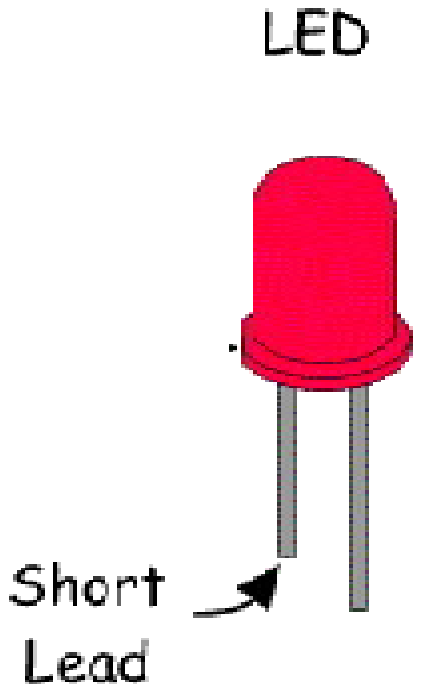
How many nodes are in this circuit?

What is a circuit Board? Nodes?

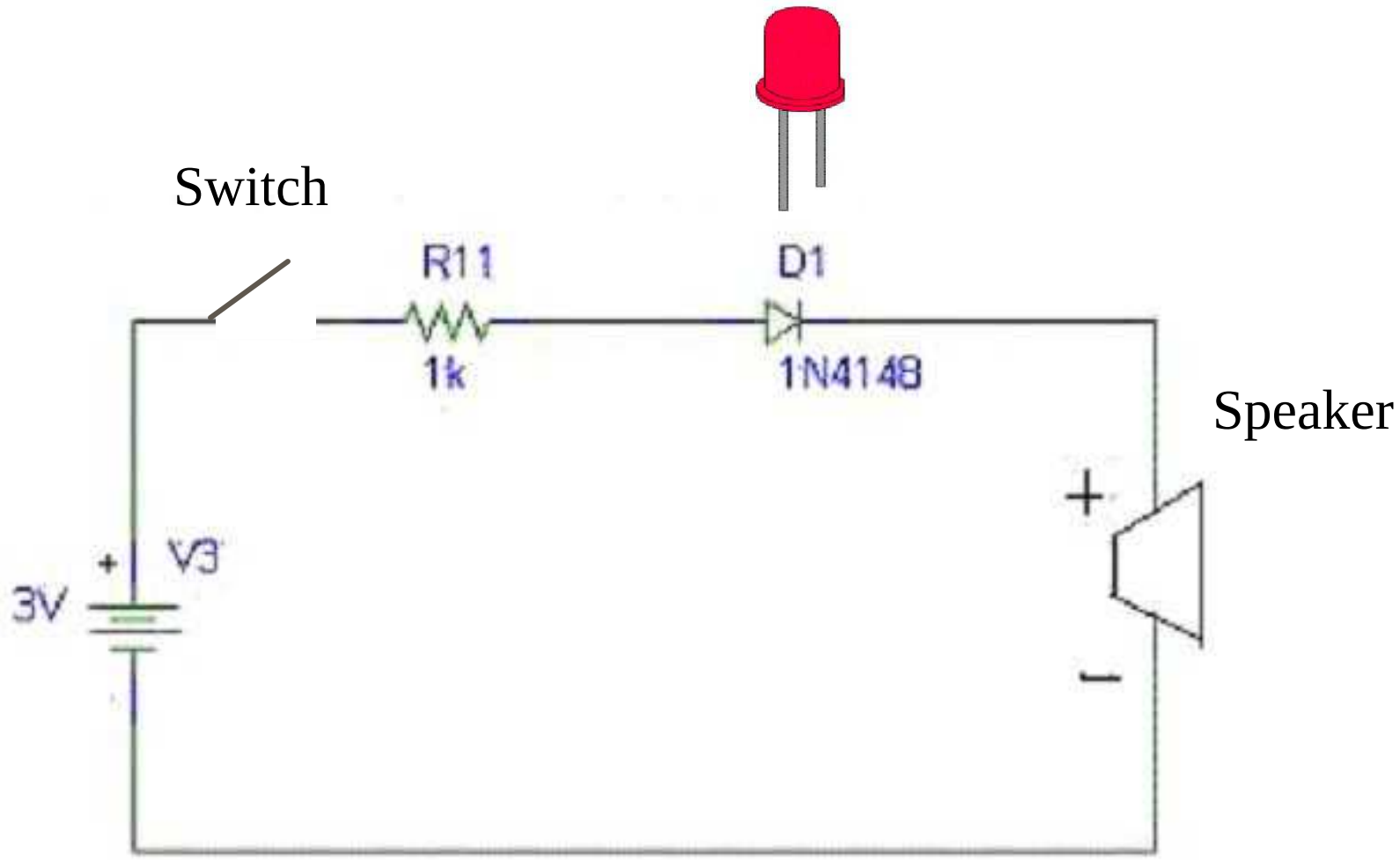


Meet the LED

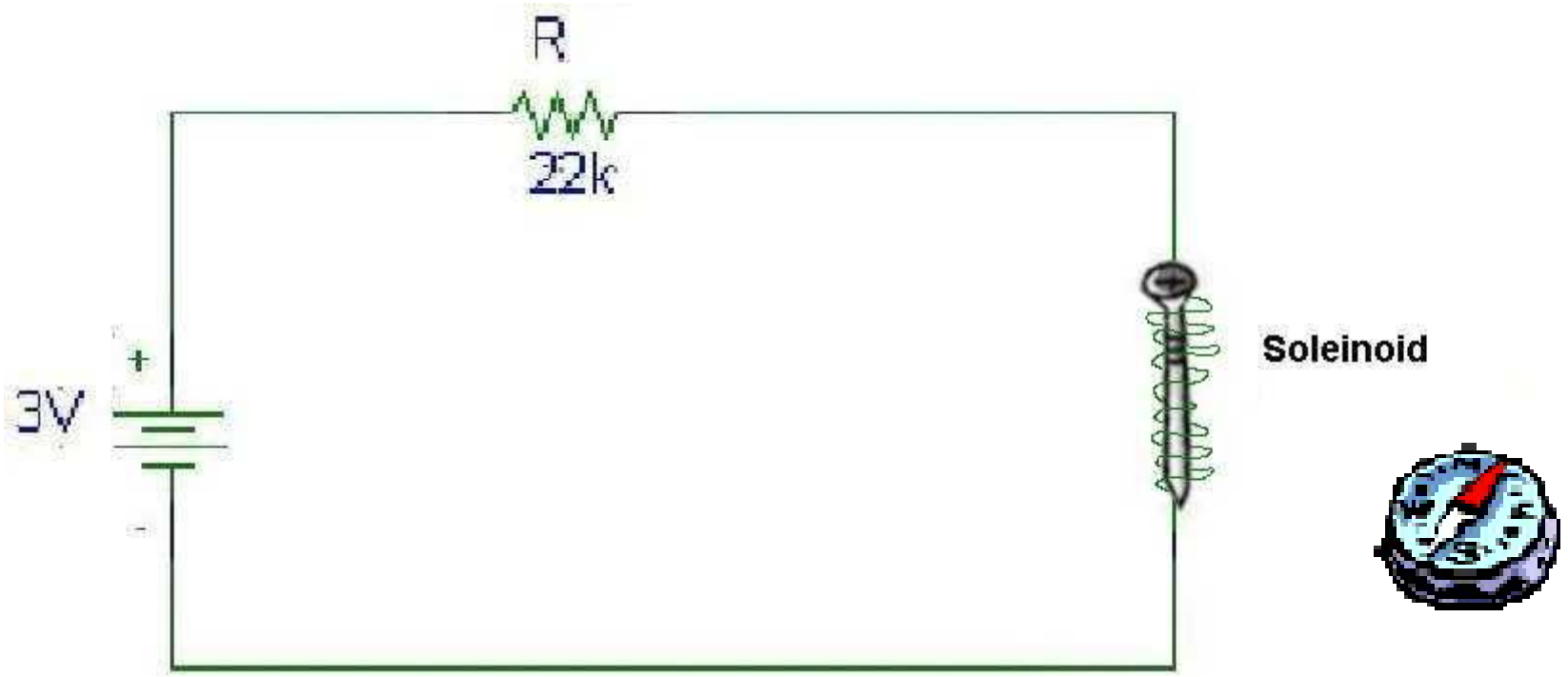
- Light emitting diodes (LED) like regular light bulbs but that are actually semiconductors that shine when an electrical current passes through them in a specific direction.



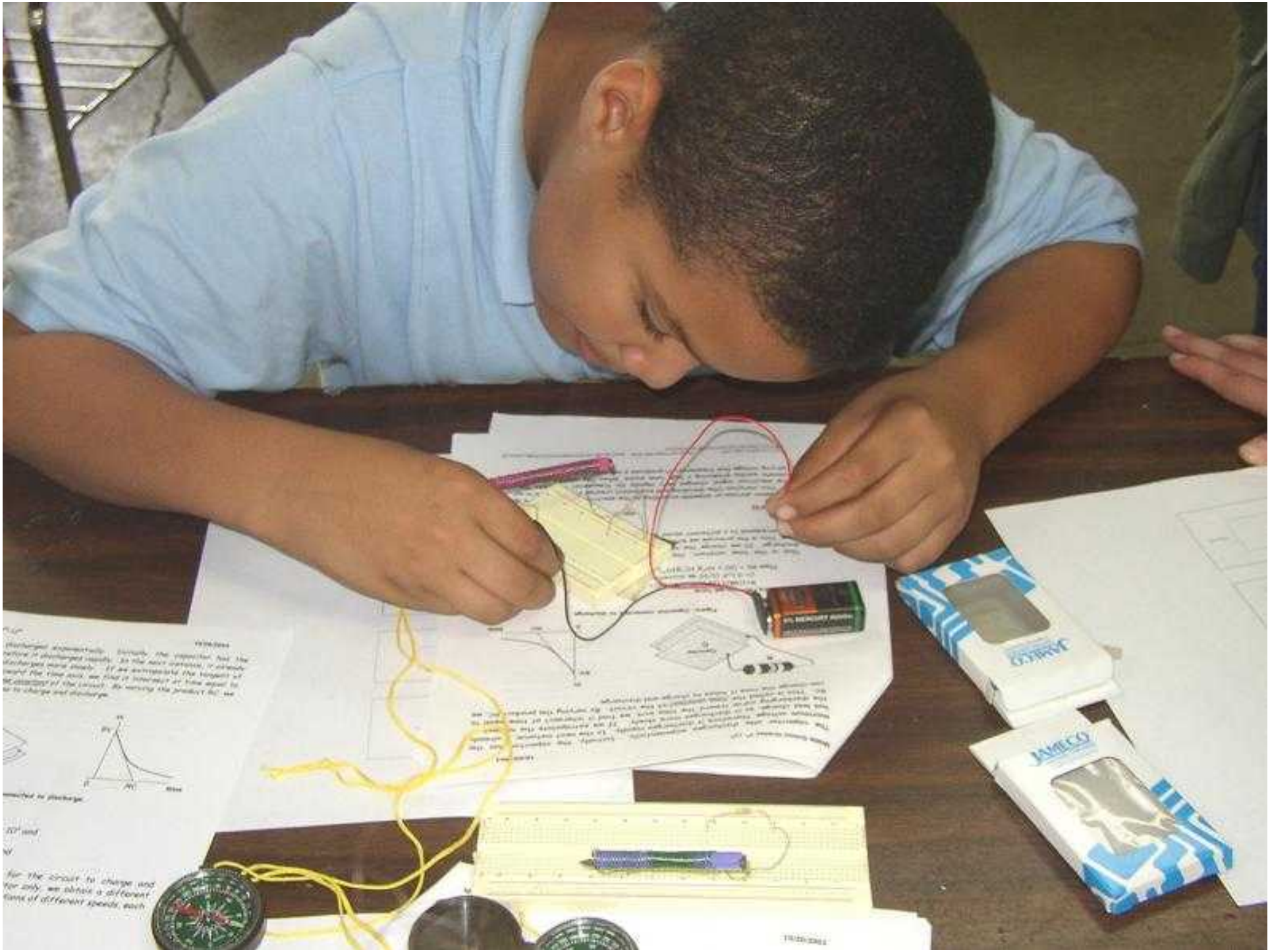
Electronic Doorbell



Electro-magnet

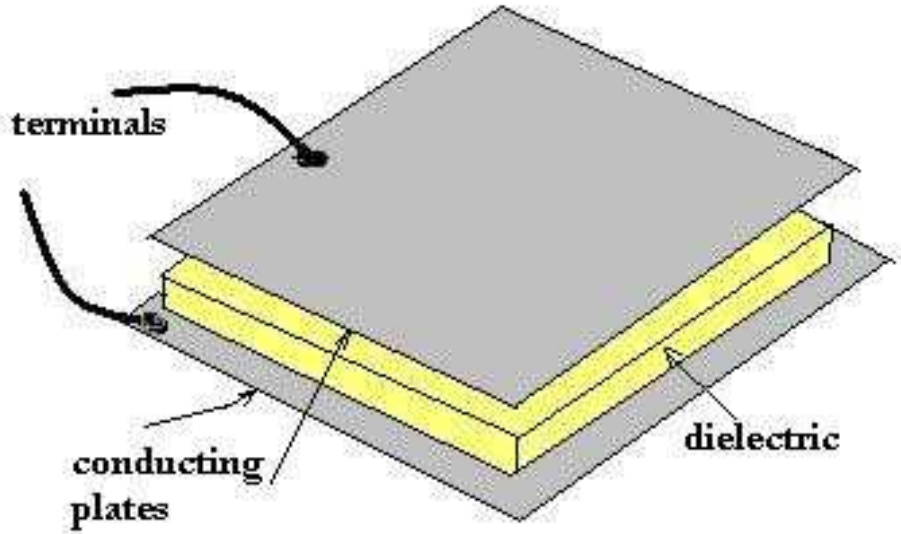


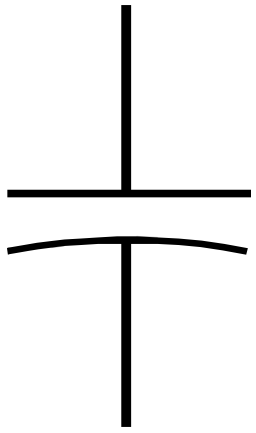
*****Warning!! It can get HOT.**

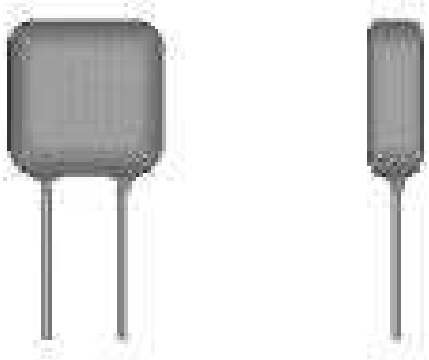


Meet the Capacitor

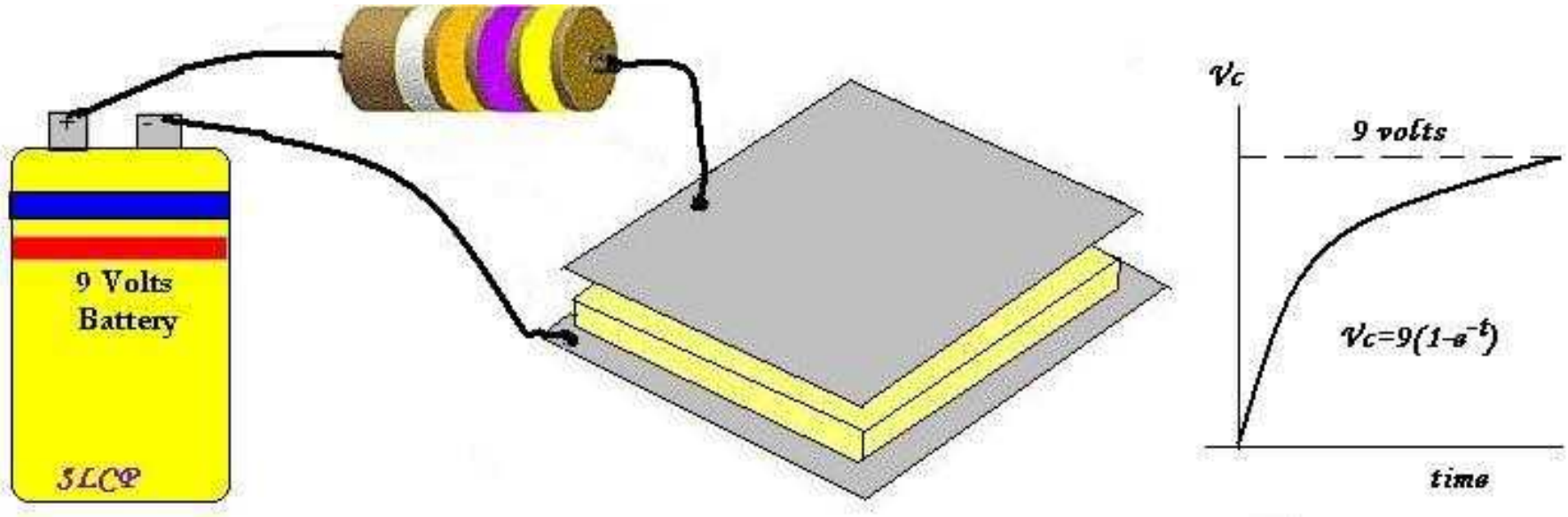
Capacitors store electrons



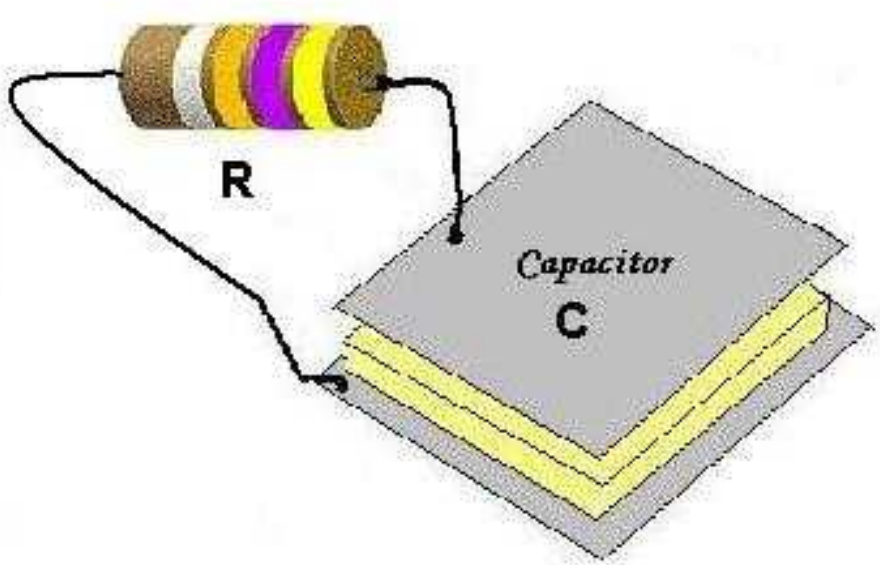


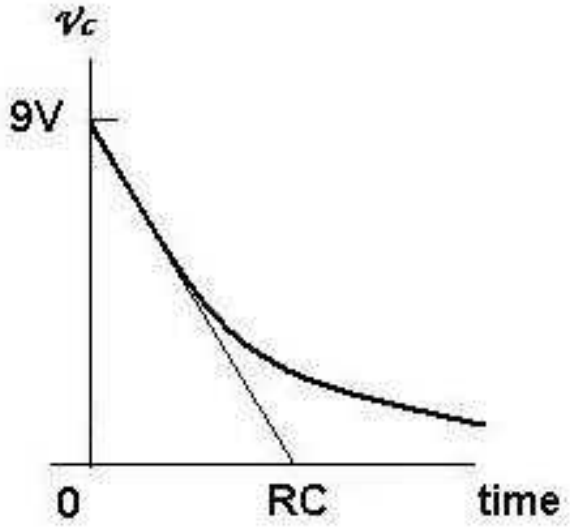


Charging a capacitor

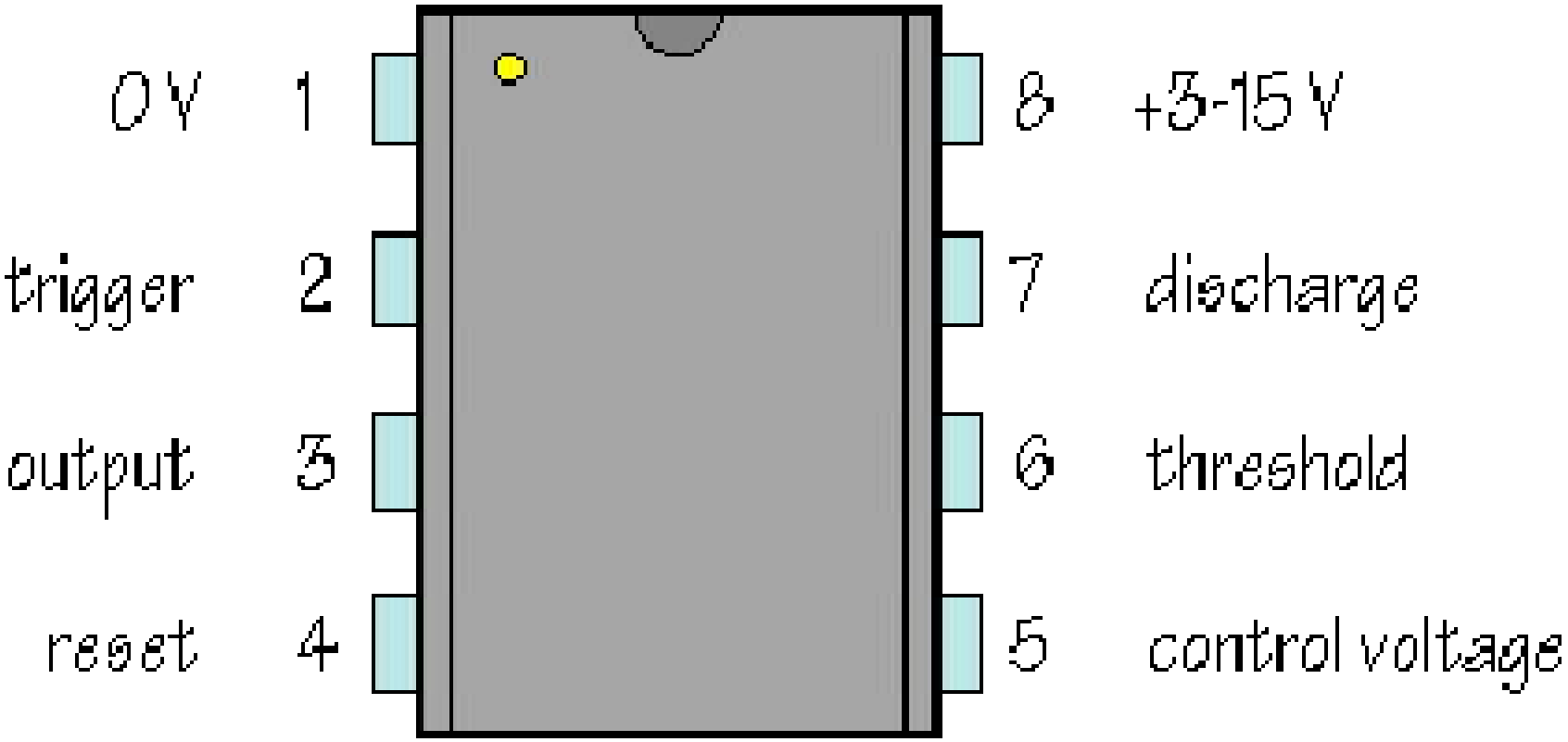


Discharging a capacitor



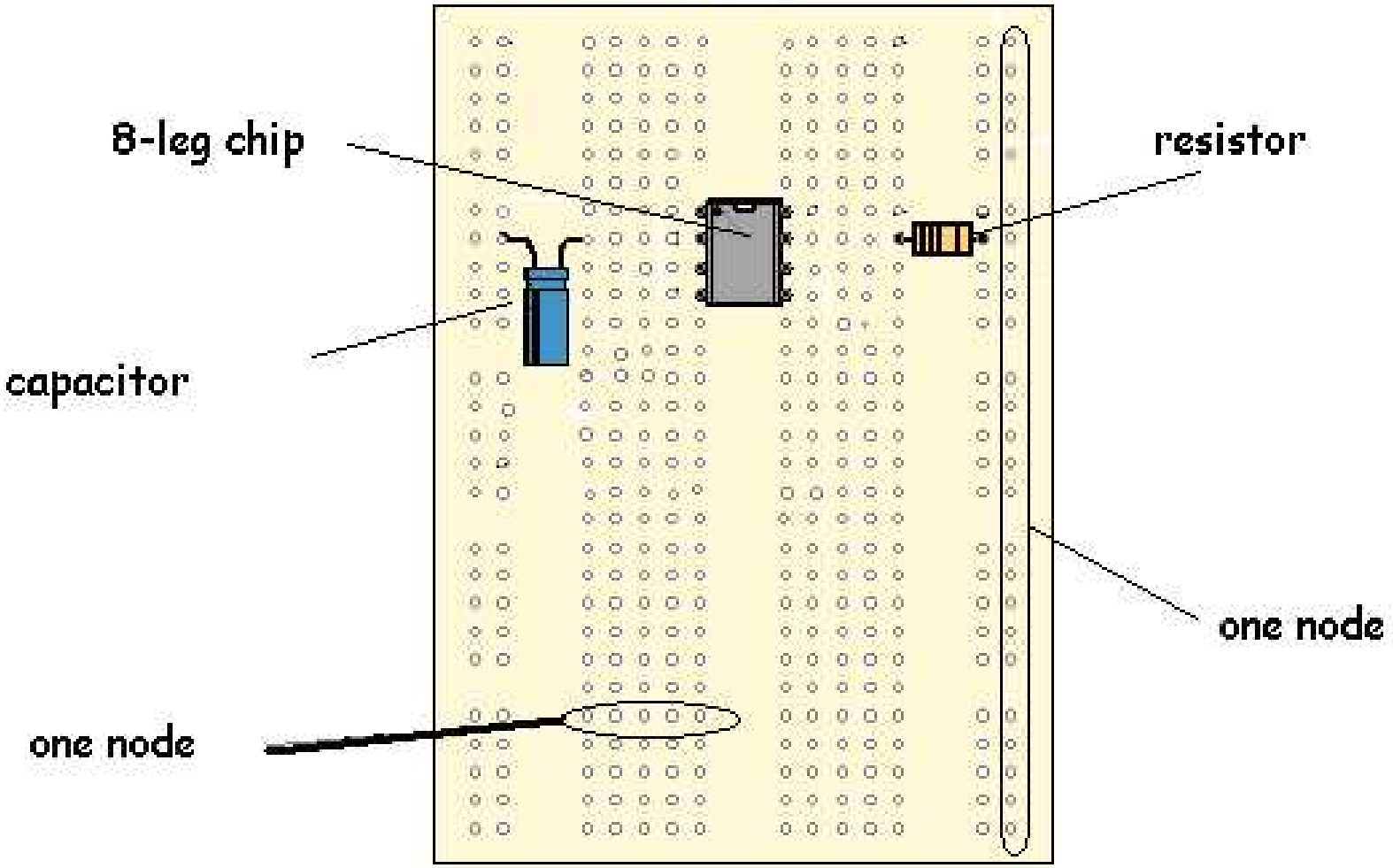


Chip

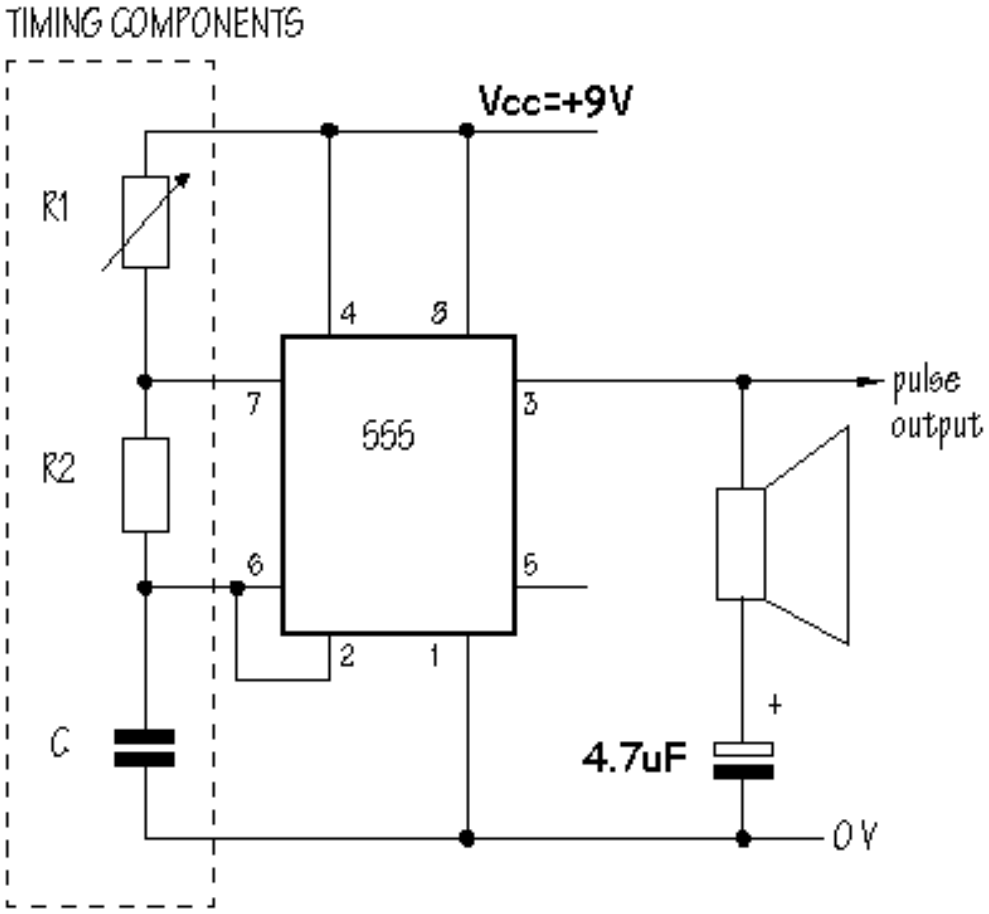


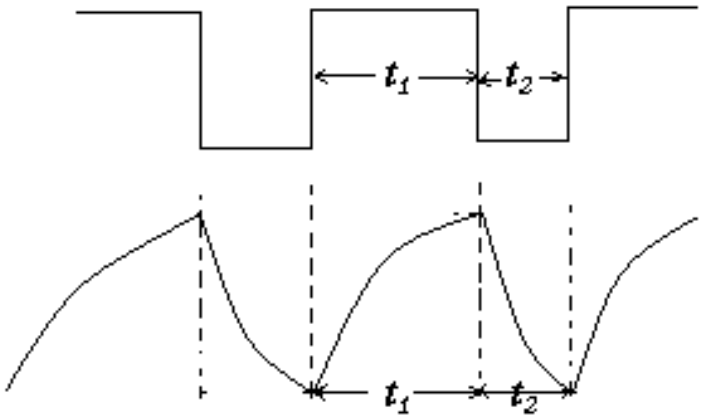
Timer-Regulator Chip 555

What is a circuit Board? Nodes?



Charge/discharge Capacitor

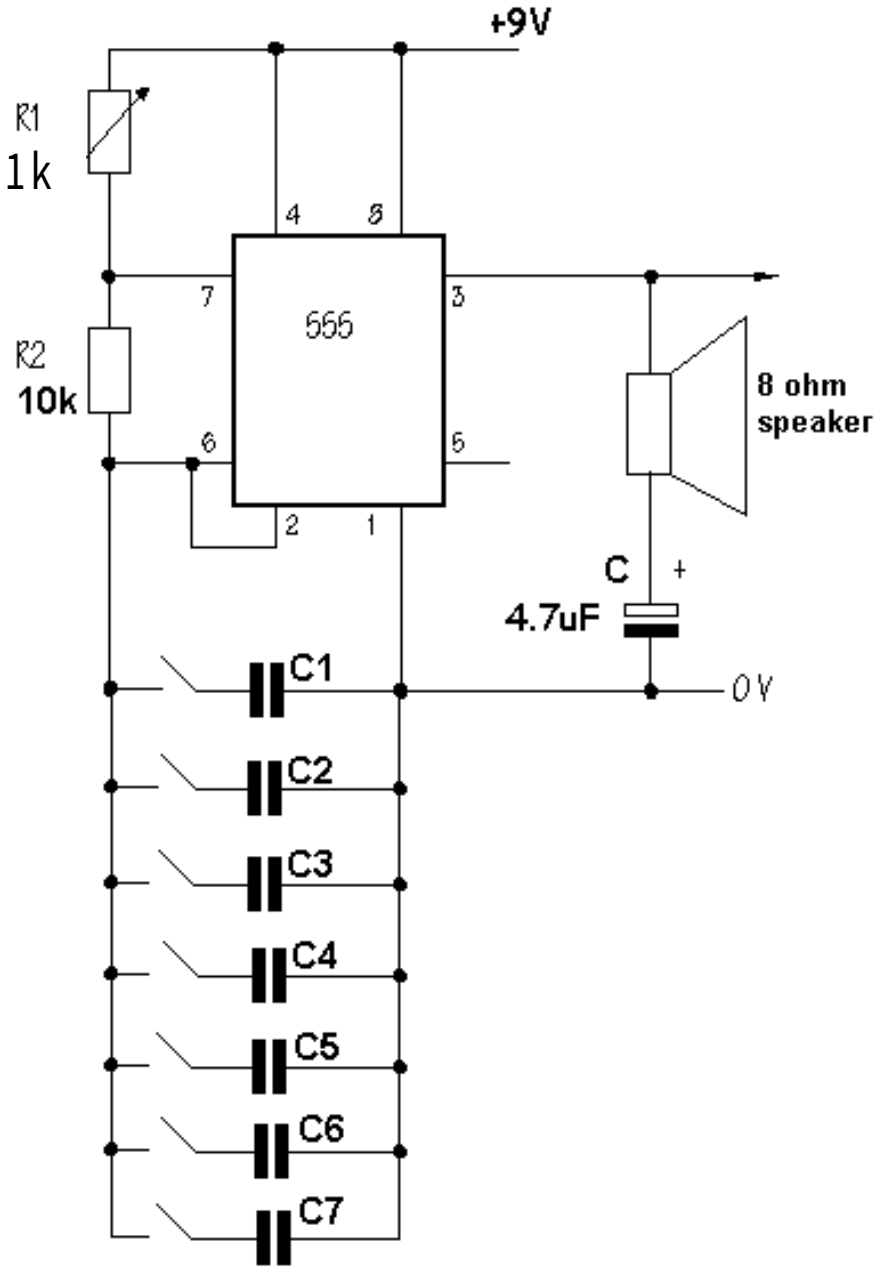




$$t_1 = .693(R_1 + R_2)C_1$$

$$t_1 = .693(R_2)C_1$$

$$frequency = \frac{1.44}{(R_1 + 2R_2)C_1}$$



	C(μF)	Frequency (Hz)
C1	.100	111
C2	.068	170
C3	.047	230
C4	.033	348
C5	.022	490
C6	.015	718
C7	.010	1,173


Surprise Everyone.
world...
conquer it.

Teacher Training

The author with some of the 38 teachers participating at the 2004 CASA Summer Content Institute at Amherst, MA