If you connect an LED directly to a pair of batteries you will smoke it! We need visitors. PFFT! More on that soon!
Figure 2

- High pressure
- Low pressure
- Low flow
- High flow

$I = \frac{V}{R}$

Example: Let $V = 10$ Volts
$R = 2$ Ohms
Then
$I = \frac{10}{2} = 5$ Amps.

(This resistor will be very hot!)
What happens if we change \( R \), keeping \( V \) the same?

**Figure 3**

\[
\begin{align*}
\text{10V} & \quad 2 \text{ Ohms} \\
\frac{10}{2} &= 5
\end{align*}
\]

\[
\begin{align*}
10V & \quad 1 \text{ Ohm} \\
\frac{10}{1} &= 10
\end{align*}
\]

\[
\begin{align*}
5 \text{ Amps} & \quad 10 \text{ Amps} \\
\text{Higher} \quad \text{Lower}
\end{align*}
\]

\[
\begin{align*}
\text{Higher} & \quad \text{Lower}
\end{align*}
\]

\[
\begin{align*}
\text{similar} & \quad \text{same}
\end{align*}
\]
Figure 4

Old Battery

New Battery

Low Current

Internal Resistance is high

High Current

Internal Resistance is low
FIGURE 5

LED Resistance Calculator

An LED takes away part of the Voltage.

\[ \text{LED} \quad \text{Lamps} \quad \text{Blue} \quad \text{Tapes} \]

Red / Green take away 2 V

Blue take away 3.5 V

The safe current is 15 mA.

Red LED (Removes 2 V)

\[ V_{\text{Voltage}} = 9 - 2 = 7 \text{ V} \]

\[ I_{\text{Current}} = 15 \text{ mA} = 0.015 A \]

\[ R = \frac{7}{0.015} = \frac{7000}{15} = 466.66 \Omega \]

\( \LARGE \text{means} \)

0 ohms
**Figure 6**

**Using a multimeter**

- **Voltages:**
  - Put in voltage range that best accommodates expected voltage
- **Current:** Put meter in series
- **Resistance:**
  - Short the leads after putting meter in expected range
  - Zero adjust using knob
  - Now you can measure the desired resistance.
Figure 7: Breadboarding

So, we can make two power and two ground "busses".

To realize the circuit connect as follows.
PC parallel port to operate an LED:

Figure 8: 16 15 13 11 14 12 10 9

Notch
Circular mark
PIN1 2 3 4 5 6 7 8

Resistor

LED

+ 9V

Causes a strong current here!

PC parallel port signal

A feeble current here...
Figure 9:

The music-maker program uses the following circuit.

Irrally, we must connect the speaker via a capacitor across the "load resistor" as shown.
Figure 10: Producing Binary Codes

About 150 Ω

Four LEDs.

DS 2003

PC parallel port pins

2
3
4
5

Ground
Figure 11:
The stepper motor connections

- Connect red, white, orange, blue in any fashion to 16, 15, 14, 13.
- Play with the values for C1, C2, C3, C4 in nVenture BAs.
  (Try 1428 in all possible ways...)

It is necessary to connect pin 9 to power when dealing with motors.
Figure 12:

Solar boat

- Hard spun motor
glow LED

Solar panel

- Cooling fan
- Styrofoam raft

Surface tension boat

- Edge of styrofoam
  Coated with thin layer of dishwashing soap