playing with protons

Welcome!

One of the reasons we are here is that we want to share with teachers, these “civilization transmitters”, our know-how of what stands between our world and chaos ; measurement .

This is the very old and very exciting human intellectual property and we try to make it more accessible and attractive to children giving ideas from the work in the lab we love, CERN.

Only you can turn these ideas into learning and the happiness that comes with it.

Apart from the teaching lectures and hands on demonstrations by Tina, involved in your course you have a group of CERN people that range from very famous and at the top of their field to the aspiring talent of the new generation;
people that started recently in this lab bringing their talent and enthusiasm and people that have been here for ever and are still as enthusiastic.
You are going to visit “famous” and less known parts of this lab – after the visits we would like to talk to you to see how you would explain these places to your students. You are going to follow lectures on everything in high energy physics today-we are also fascinated to see how you will transmit all this to the classroom.

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From my side and coming back to the measurement issue I would like to share with you some ideas, applications and hardware platforms that might enhance your students interest in measurement while teaching them programming which is nothing more or less than logical thinking, the natural “companion” to measuring.
The hardware platform will be Arduino;
The language of programming Scratch;
The examples will always have to do with measurement, but, of course , you can use the programming tools for anything else.

CERN is a 60 year old lab that has been following and leading the human quest for answers on what is the universe that surrounds us and predict its evolution; the real treatment of the topics this research involves can only be achieved using Mathematics; this is our language as are the notes for music; however all of us love music. Loving science is equally embedded in human nature; following our natural curiosity which is what helped us survive is as natural as following and imitating sounds. What we call today "High Energy Astro/Physics" is and will be an everlasting field that relates galaxies and star powder, and nothing should stop students from accessing it, everyone in his/her own frame of mind and Interest.

CERN is also a 60 year old lab that has been following and leading the evolution of measurement (and instrumentation).
Questions in science appear as theories develop; but it is the data (measurement) that decides between science and science fiction.
Teaching measurement is liberating people from prejudice, gullibility and may stop the herding of masses…it is empowering.
CERN is the ideal example of a measurement metropole where any existing technique is used or developed in order to validate models of our world therefore a great tool for introducing measurement.
CERN is, among other things, the constructor of LHC and the constructor of anything inside it…..

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We would like to work with you on possible projects that will teach programming to students, (scratch https://scratch.mit.edu/) in the context of learning to measure and control numbers; programming Provided it is done in a way accessible to their age teaches them the logic and the discipline of going about a measurement Scratch is used for programming games, playing with photos, putting together music, etc. I am sure that in this context some of You might have even used it

We would like to deal with the "Scratch for Arduino-S4A" version because it gives you the option of combining simple and visual oriented programming with the Arduino platform that makes electronics easy and students can make things happen.

All information about the Arduino platform can be accessed at https://www.arduino.cc/

We are here going to concentrate on what we will be using, the nano Arduino which we will use for all the projects we propose to you. Using the nano Arduino and scratch you can read “analog” sensors and digital “sensors”. Sensors are a huge industrial/scientific explosion of our times and CERN is a remarkable sensor consumer/producer.

Sensors provide information about everything and can be read in an analog way like current, voltage, resistance and many others (favour these for learning) or they can be digital and have an integrated microprocessor that gives you directly the numerical measured value.

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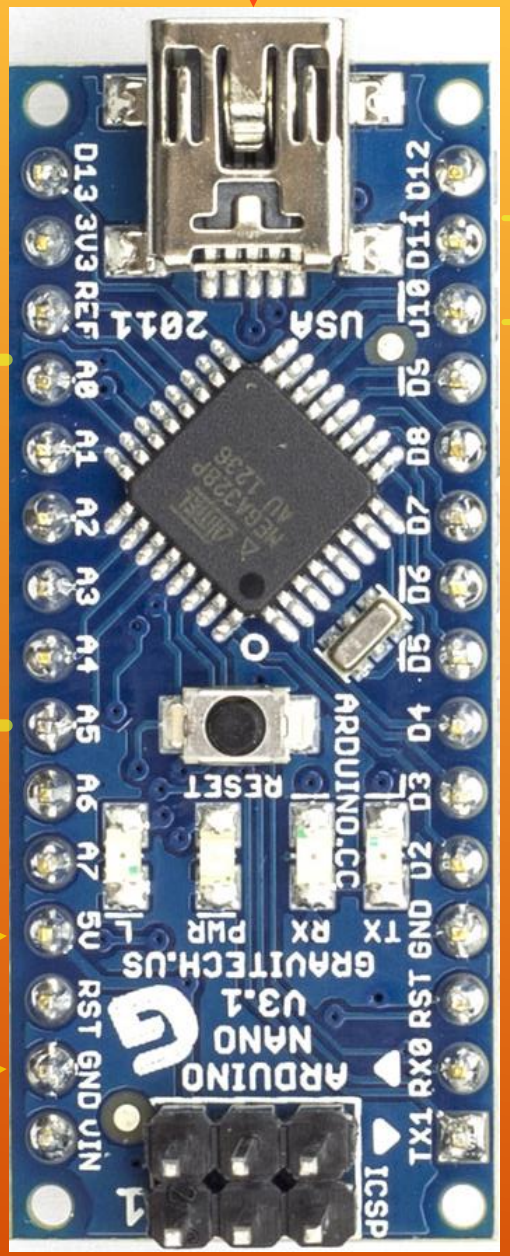
USB connection with your PC



A0-A5 Read analog values in Scratch

D10-D11-D13 "Drive" digital outputs in Scratch

D2-D3 Read digital inputs in Scratch

5V power. For (almost) every sensor

GROUND! Your reference!

The analog sensors you can read in Scratch are attached to your Arduino platform (literally)

- Thermometers
- Light level (photo resistors)
- Humidity
- Flow
- Pressure
- and many others ….

the numerical measured value.

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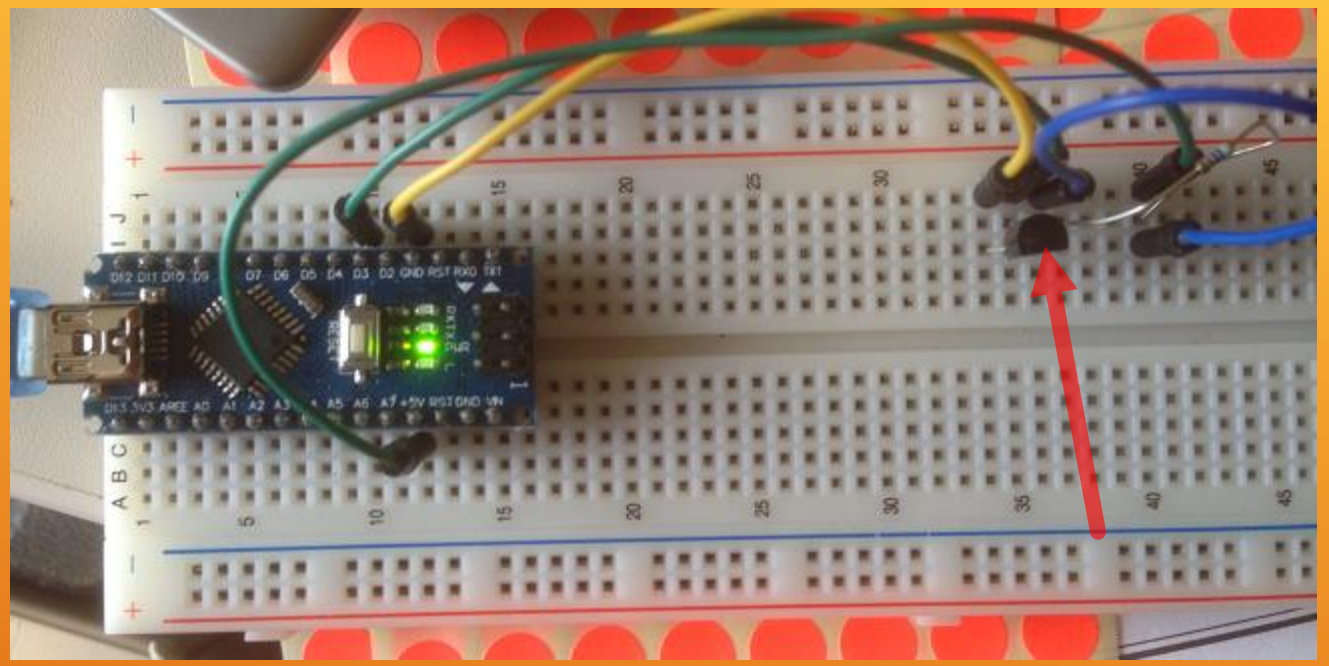

The digital sensor connections ; powering and D3 as output for a temperature sensor, DS18B20 (+125 to -55^{0}C)

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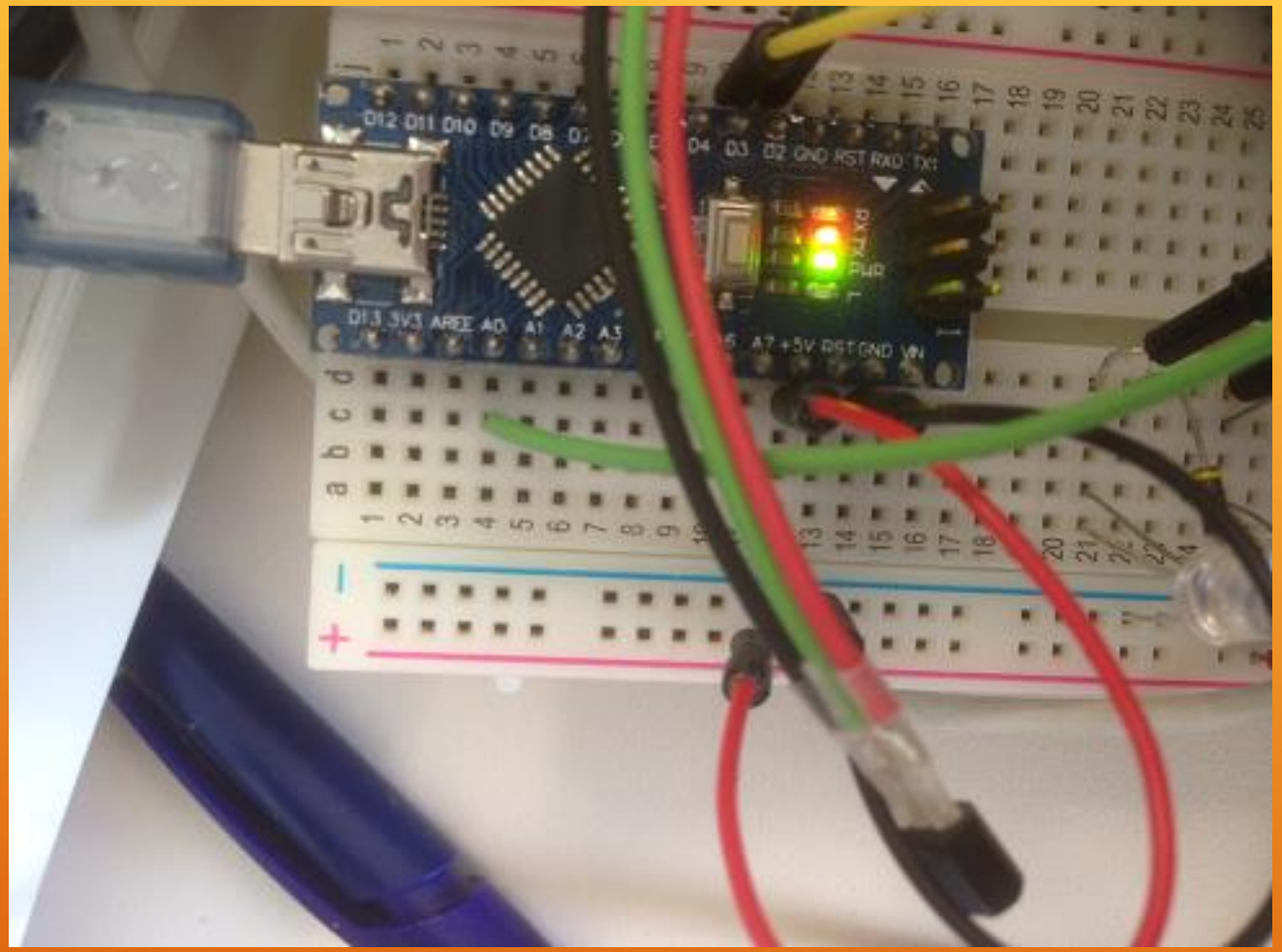

Analog sensor connections ; powering and A0 as readout channel for a temperature sensor LM35DZ (+150 to 0^0C, or other)

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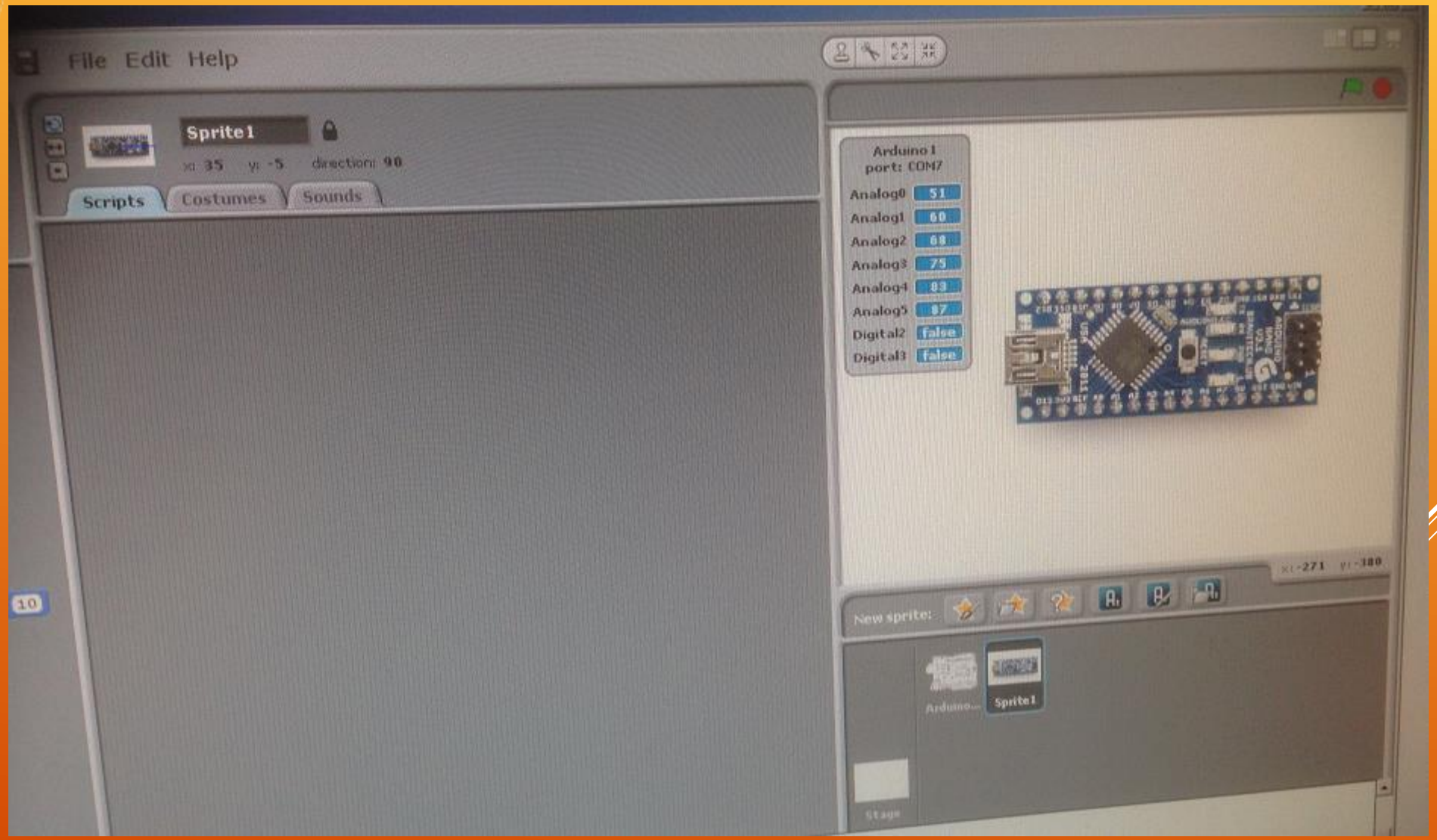
When you “read” the Arduino via Scratch, this is what it looks like:



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The LHC magnets have to be very cold (-272 ^{0}C) in order to work properly, well you can attach electronic thermometers along the LHC ring as Tina makes it and drive them with your body temperature;

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How does a LED work?

This is a very simple explanation of the construction and function of LEDs. White LEDs need 3.6VDC and use approximately 30 milliamps of current, a power dissipation of 100 milliwatts. The positive power is applied to one side of the LED semiconductor through a lead (1 anode) and a whisker (4). The other side of the semiconductor is attached to the top of the anvil (7) that is the negative power lead (2 cathode). It is the chemical makeup of the LED semiconductor (6) that determines the color of the light the LED produces. The epoxy resin enclosure (3 and 5) has three functions. It is designed to allow the most light to escape from the semiconductor, it focuses the light (view angle), and it protects the LED semiconductor from the elements. As you can see, the entire unit is totally embedded in epoxy. This is what make LEDs virtually indestructible. There are no loose or moving parts within the solid epoxy enclosure.

Therefore, a light-emitting diode (LED) is essentially a PN junction semiconductor diode that emits light when current is applied. By definition, it is a solid-state device that controls current without heated filaments and is therefore very reliable. LED performance is based on a few primary characteristics:

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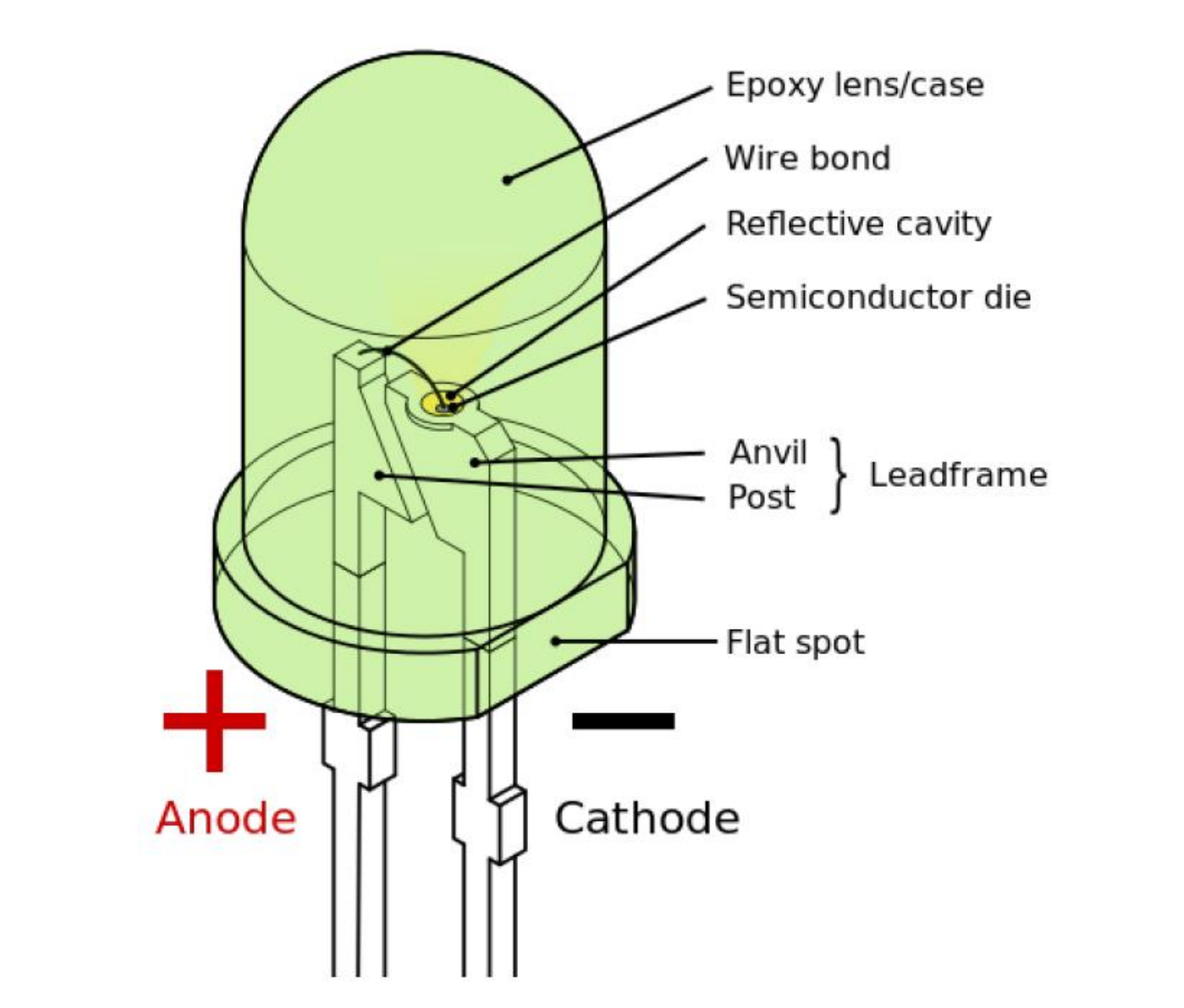

Anode – long
Cathode-short