

HIMALAYAN MAKERS GUILD

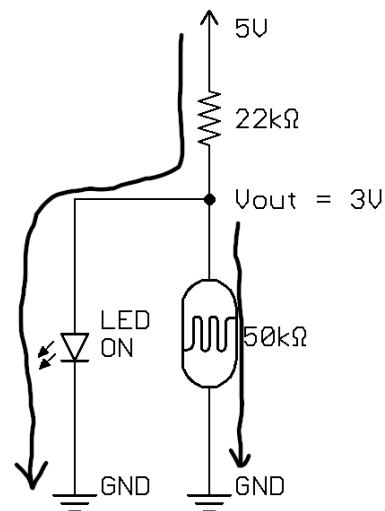
Foundation Activity 12

Transistor Nightlight

NIGHTLIGHT

In the last activity, we used a light dependent resistor (LDR) in a voltage divider to turn an LED on automatically when the room becomes dark. However, the LED was very **dim** because the current needed to flow through a **big resistance** to before going through the LED.

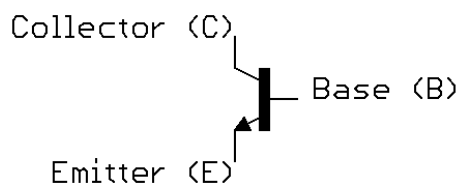
Instead, we can connect the LED to 5V using a 220Ω resistor and control it with a voltage controlled switch called a **transistor**.



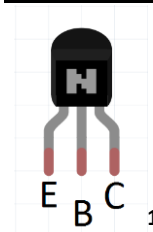
BIPOLAR JUNCTION TRANSISTOR (BJT)

BJTs can act like a switch, controlled by the voltage between the B and E pins. They have 3 pins:

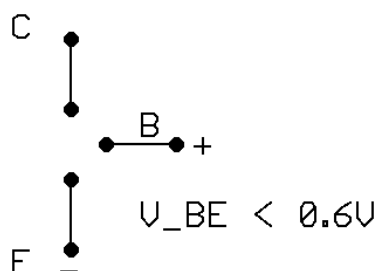
Circuit Symbol



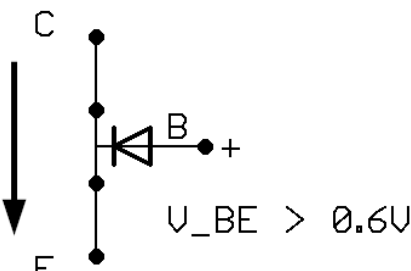
Part Image



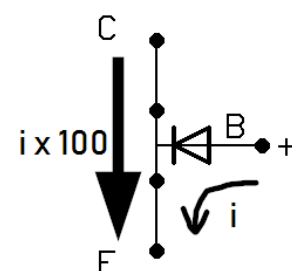
V_{BE} less than 0.6V
BJT is off



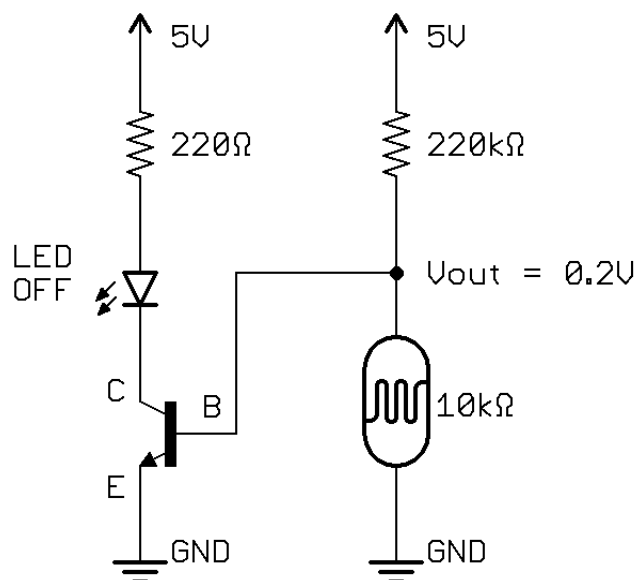
V_{BE} less than 0.6V
BJT is on



The current that can flow C to E is about 100x the current flowing from B to E

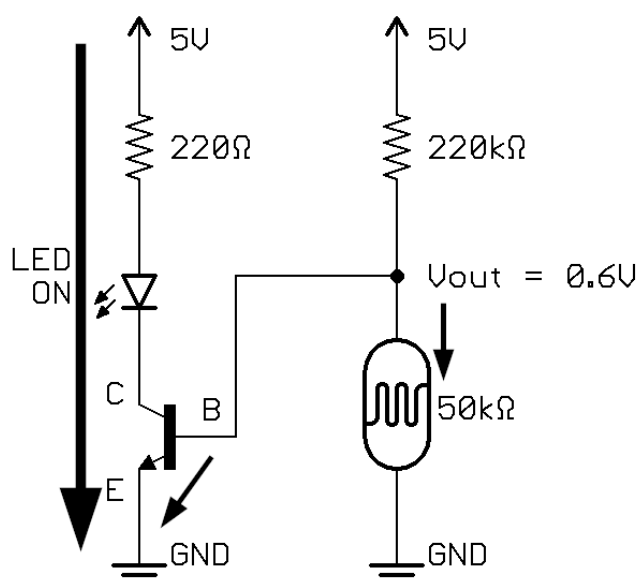


When the BJT is fully **ON**, V_{BE} will stay constant at about 0.7V, like the voltage across a **diode**. Like an LED, too much current flowing from B to E can **damage** the BJT, so we need to make sure there is a resistor attached to B. However, if that resistor is too high we will get very little current flowing from B to E, limiting the current that can flow from C to E.



When there is light, the LSR has a small resistance.

The LSR becomes much **less than** 220kΩ, so V_{out} drops **below** 0.6 V, the transistor turns **OFF** and no current flows through the LED.



When it is dark, the LSR has a big resistance.

The LSR much **greater than** 220kΩ, so V_{out} rises **above** 0.6 V, the transistor turns **ON** and current flows through the LED.

² Sun and moon icons made by [Freepik](http://www.flaticon.com) from www.flaticon.com