
THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA
Study Fresh
Understanding Indoor Air Quality and how we can improve it.

Acknowledgement of **Country**

The University of Queensland (UQ) acknowledges the Traditional Owners and their custodianship of the lands on which we meet.

We pay our respects to their Ancestors and their descendants, who continue cultural and spiritual connections to Country.

We recognise their valuable contributions to Australian and global society.

What is IAQ?

IAQ or **Indoor Air Quality** means how clean or how healthy the air is inside a building – like your classroom, bedroom, or kitchen.

Even though we can't always see it, the air around us can carry **particles** like:

CO_2

Dust

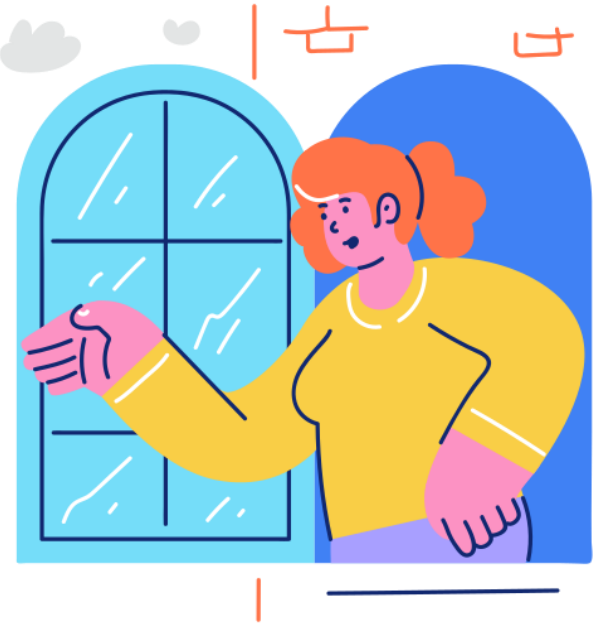
Moisture

Chemicals

What is IAQ?

When too much of these **particles** build up, it can make us:

- Feel tired or foggy
- Get headaches
- Struggle to focus
- or even feel unwell



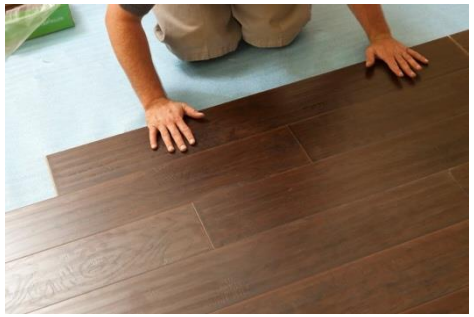
Checking Indoor Air Quality helps us know when it's time to open a window, turn on a fan, or take other steps to breathe easier.

Indoor Air Pollutants and Sources

Volatile Organic Compounds

Particulate Matter

Formaldehyde



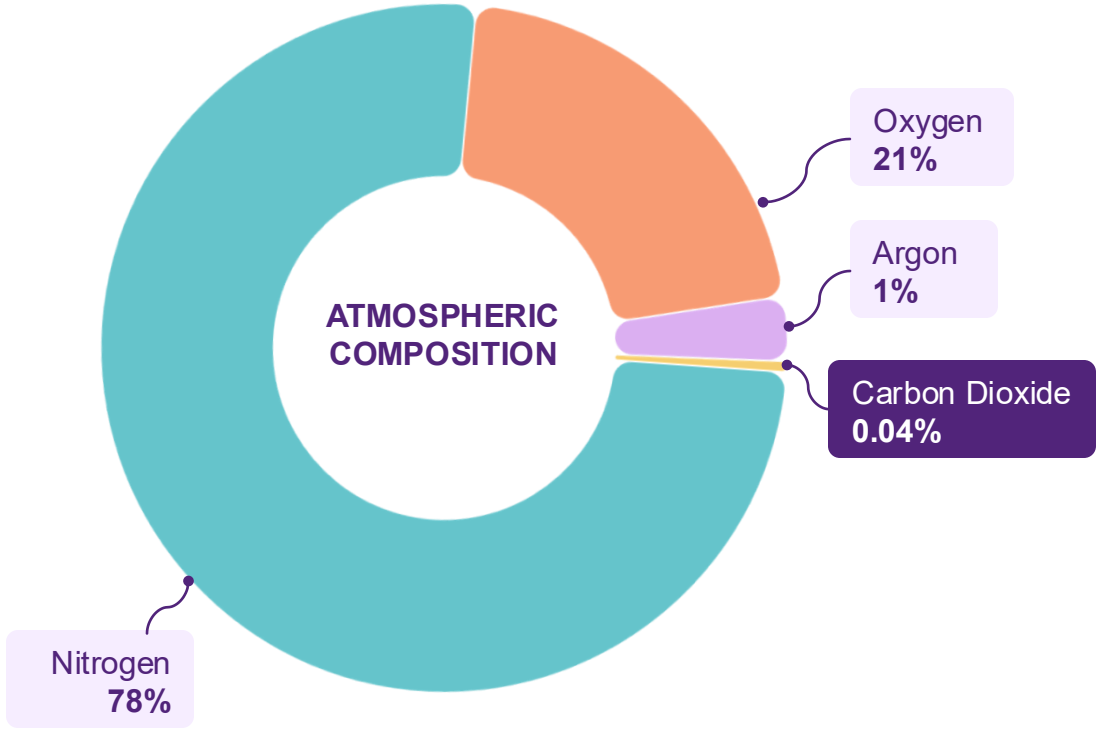
Room Occupants

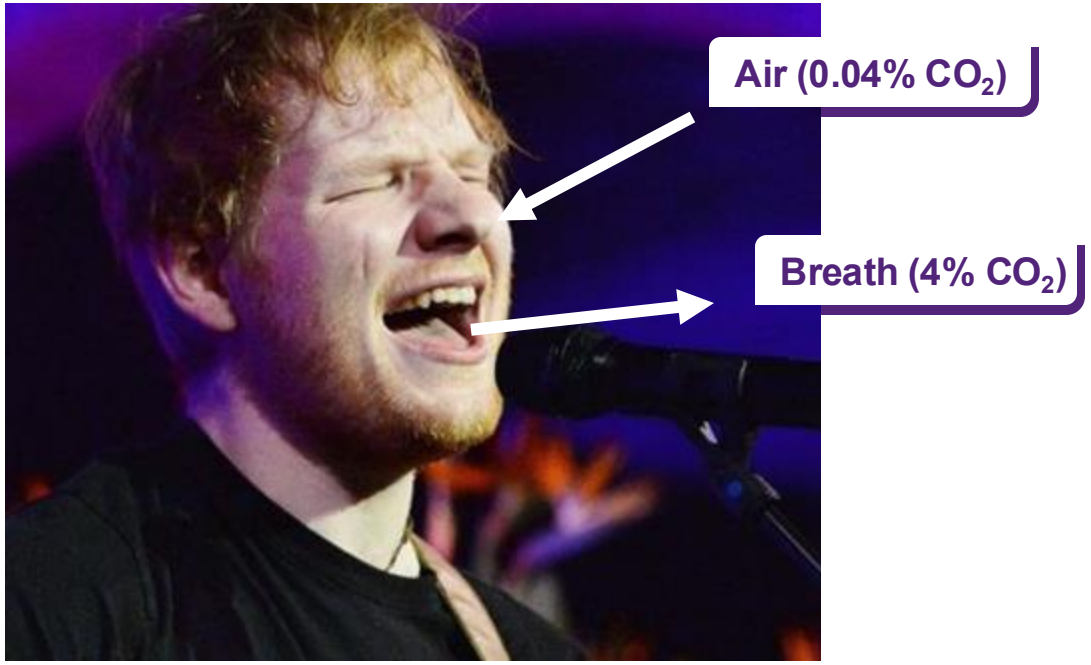
Outdoor-sourced Pollutants

Without **adequate ventilation**, all these pollutants can accumulate indoors.

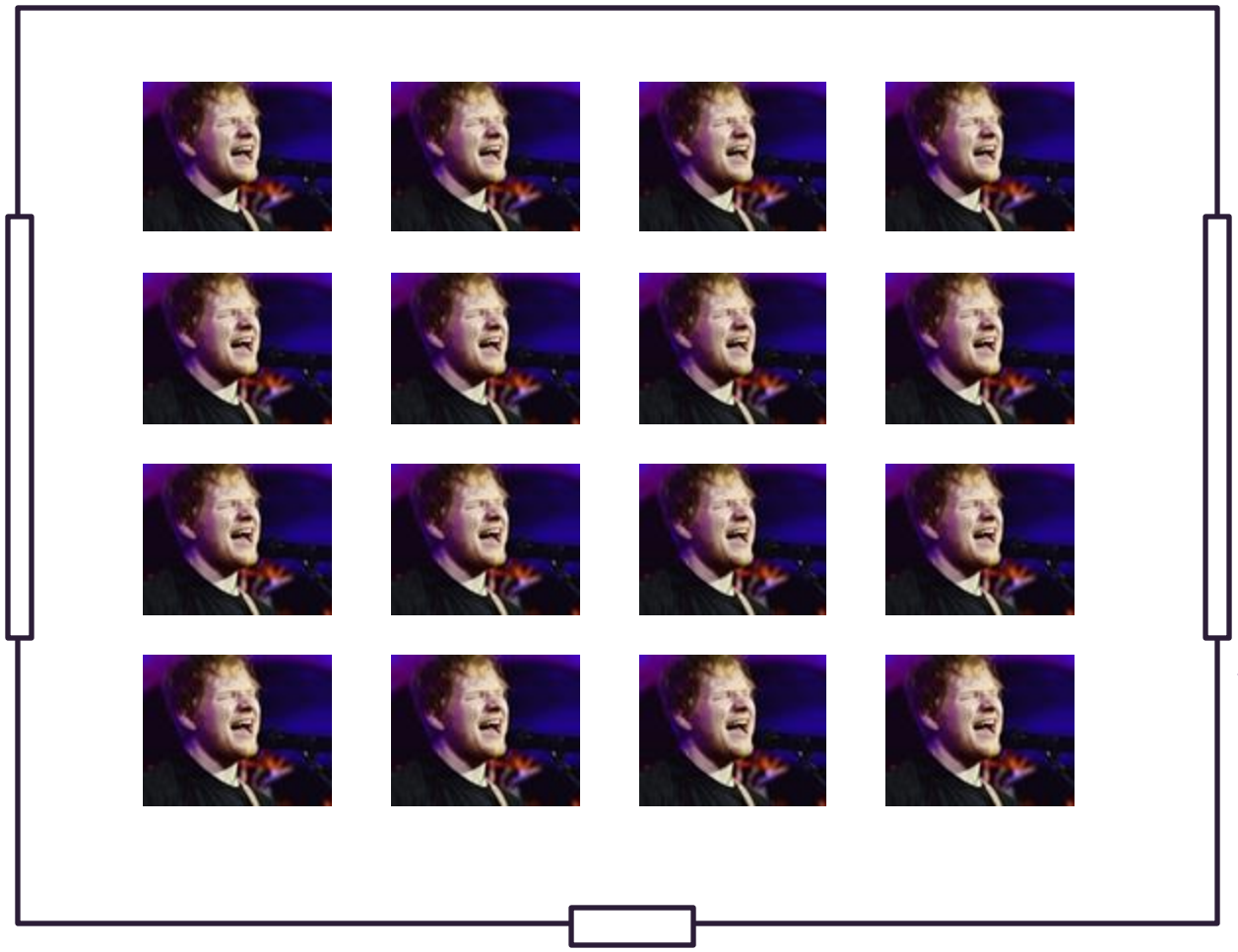
Indoor Air Pollutants: **Carbon Dioxide (CO_2)**

Exhaled air has **more than 100 times** the amount of CO_2 of atmospheric air.





Indoor Air Pollutants: **Carbon Dioxide (CO_2)**



- CO_2 builds up in occupied spaces if there isn't enough fresh air coming in (ventilation).
- If CO_2 is high, it often means other indoor pollutants might be building up.
- Measuring CO_2 is a simple and cheap way to check if the air in a room is being refreshed or not.

High CO_2 = Poor Ventilation = Poor IAQ

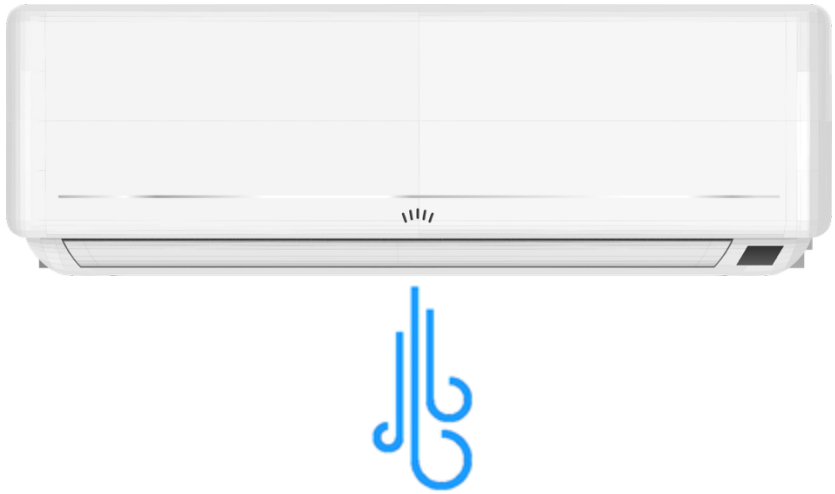
Effects of Poor IAQ

CO_2 concentration	Effects on performance	Subjective effects
400ppm (outdoor air at sea level)	No effects	No effects
400 - 1000ppm (normal indoors)	No significant effects on performance	No major effects, room may begin to feel “stuffy” around 1000ppm
1000 - 1800ppm	Potential for minor effects on task performance	Room may feel “close” or “stuffy”
1800 - 2500ppm	Reduced performance on decision making and sustained attention tasks	Increased perceived workload, sleepiness, potential minor health symptoms headache, dry eyes etc.
> 2500ppm	(In addition to above): Reduced performance on cognitive performance tasks	Increased intensity of headache and other health symptoms

- Cognitive performance can be affected **before** occupants become aware of poor IAQ. That’s why we have to measure it!

Pop Quiz!

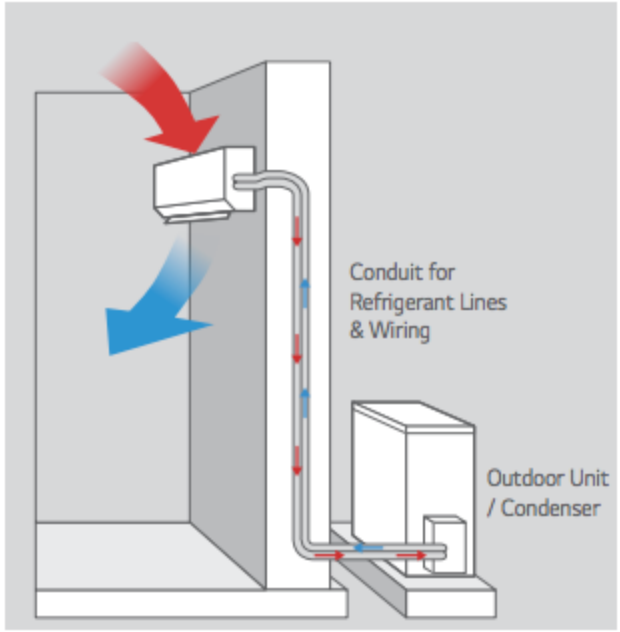
Do split system AC’s introduce fresh air?



What do these symbols they mean?

Pop Quiz Answers

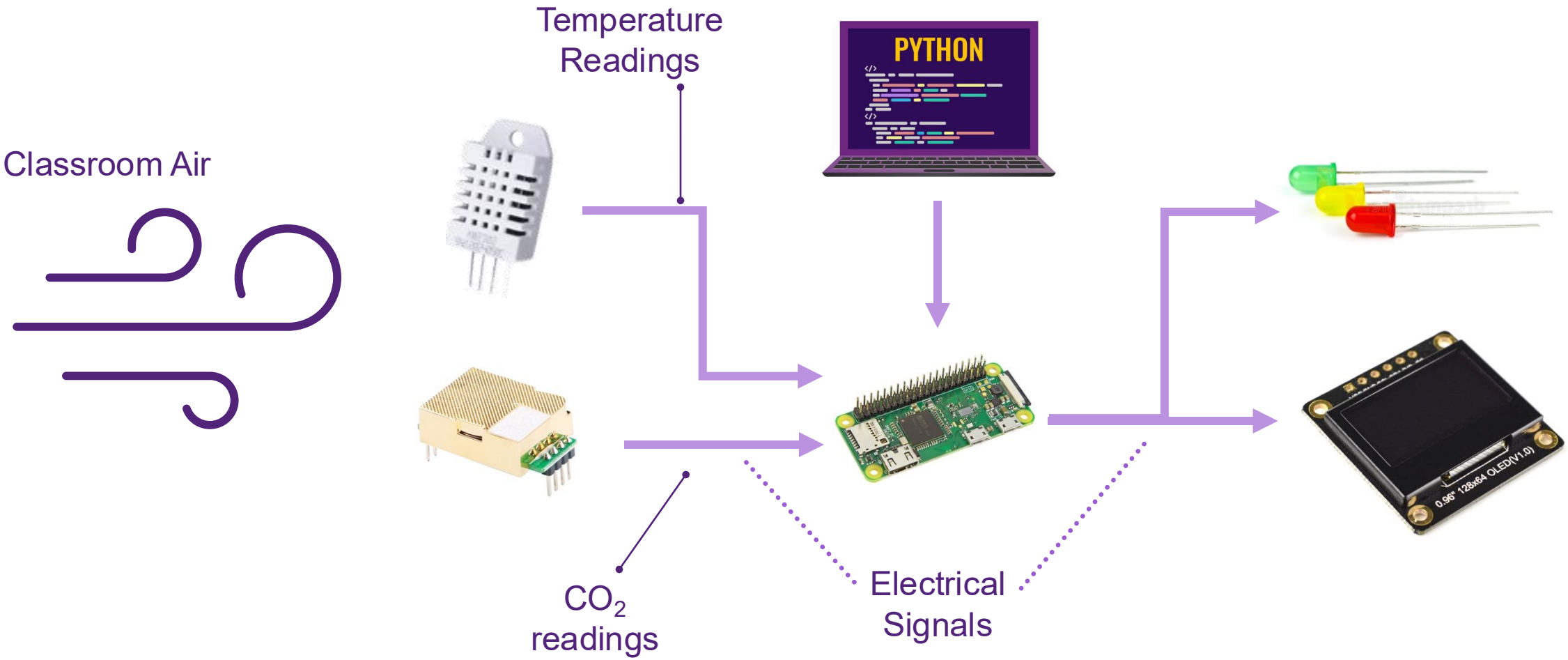
No. The lines connecting the compressor to wall unit transfer electricity and refrigerant only.



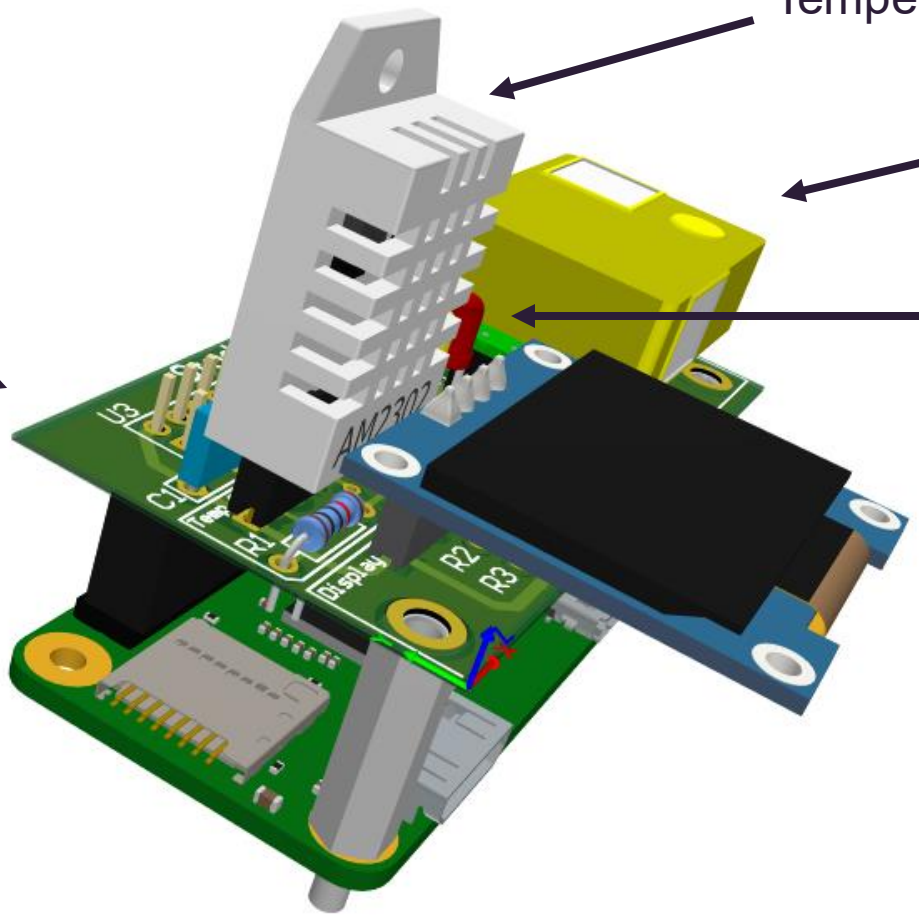
Fresh or **re-circulated air** for car air conditioning. Recirculated air is more energy efficient as it is re-cooling pre-cooled air. However, remember to open the windows every now and again!

Introducing **Study Fresh**

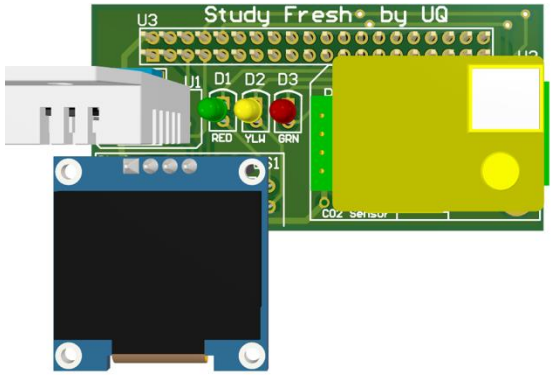
How Do We Measure CO_2 Concentration?



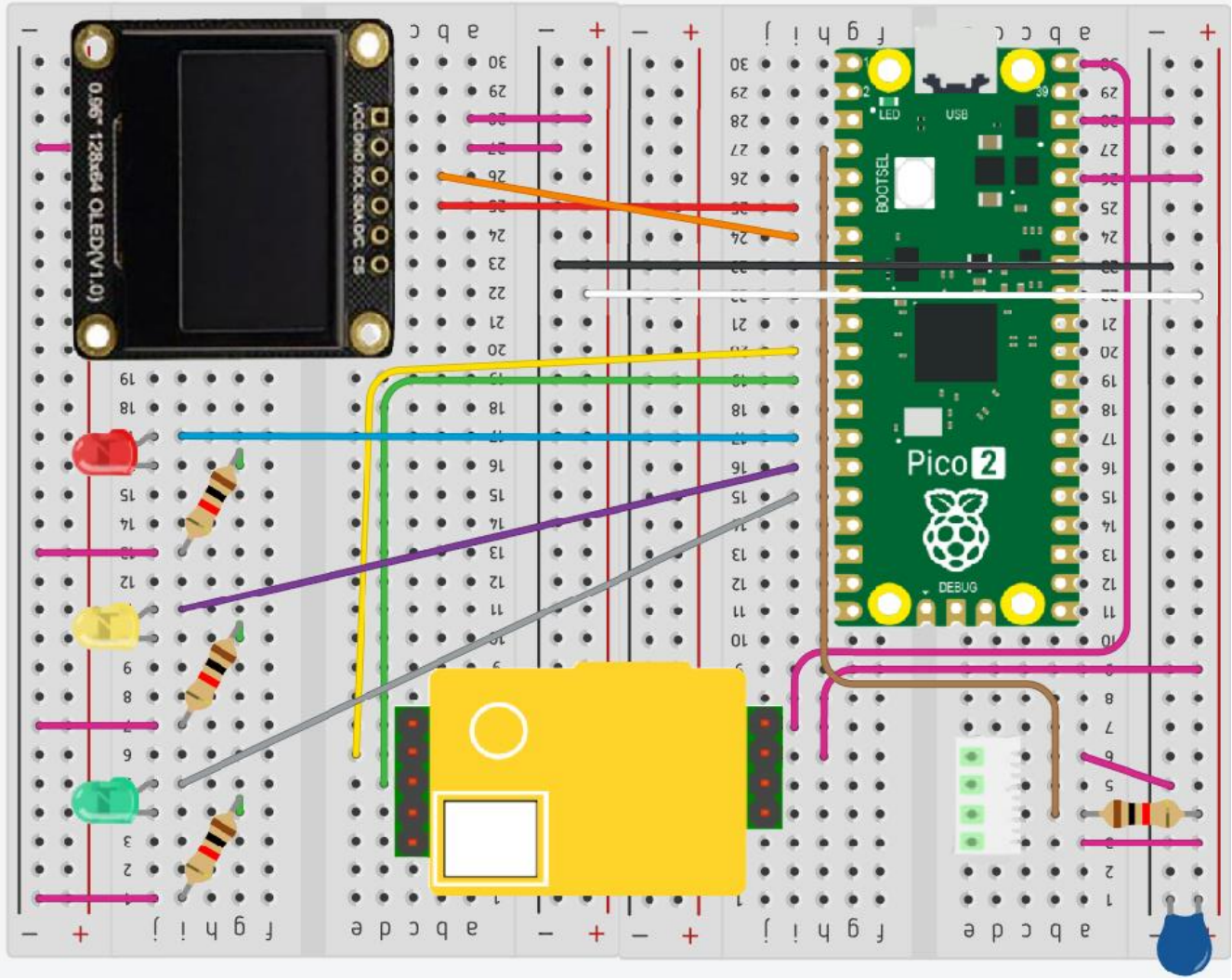
Study Fresh IAQ Logger



Top view



How Electrical Engineers Design Circuits

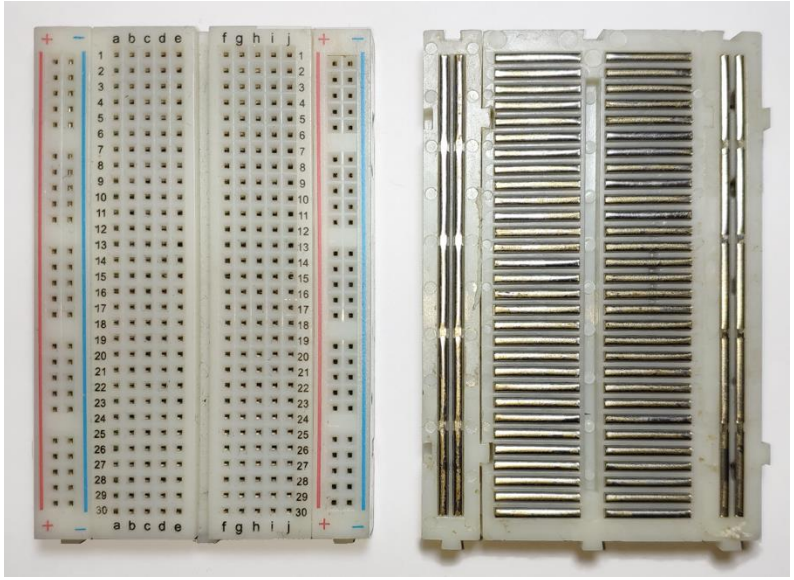


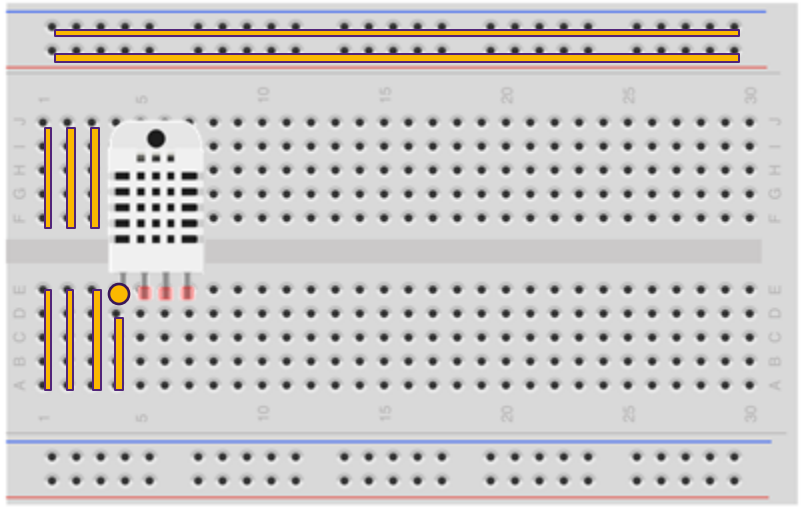
We build breadboard prototypes!

Raspberry Pi Pico 2

- A single board computer specifically designed for sensing and controlling the physical world
- Raspberry Pi Pico 2 model is one of the smallest, thinnest, most-affordable single board computers ever!
- Raspberry Pi can be programmed. The programming environment that we will use is Python.

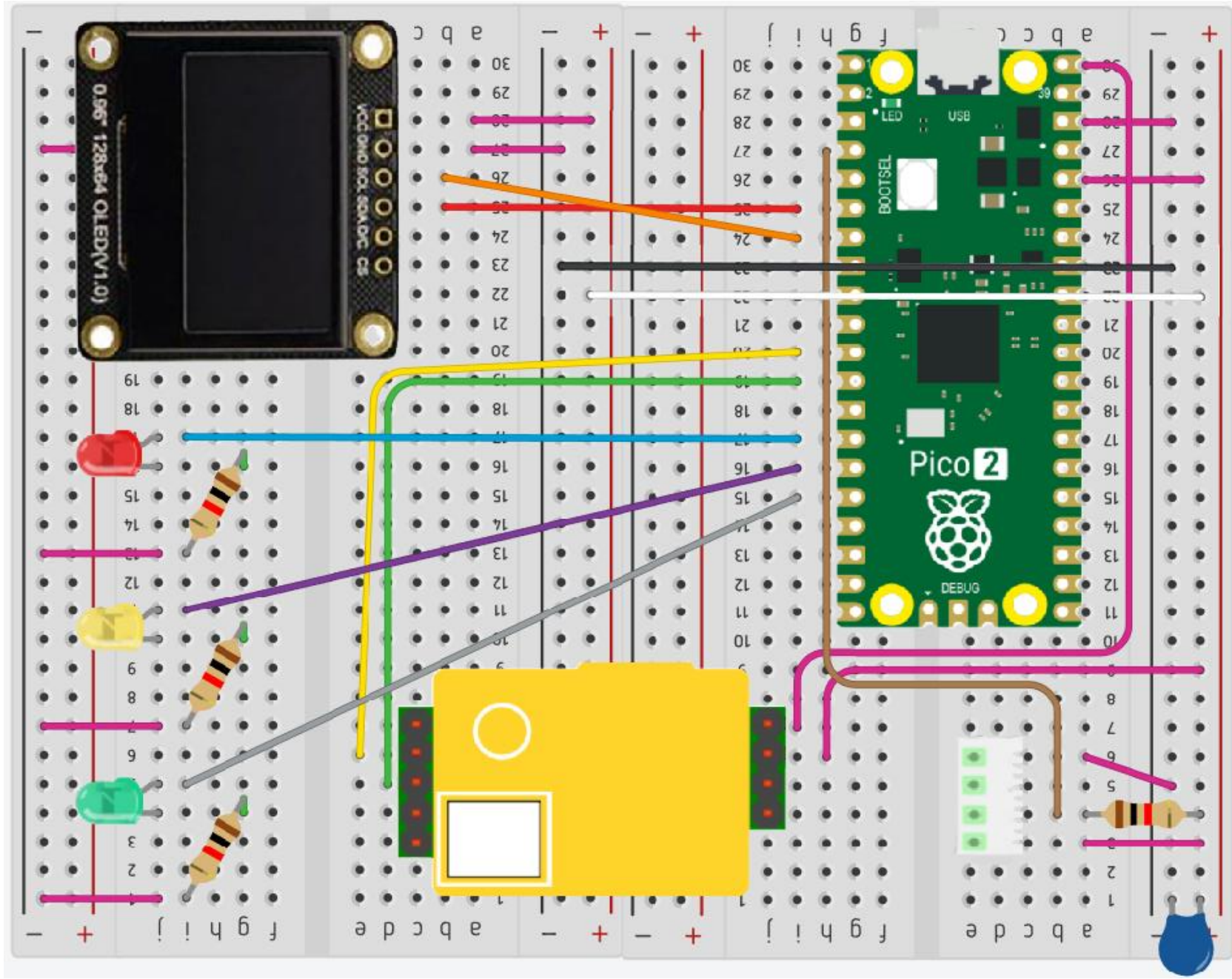
Solderless Breadboard





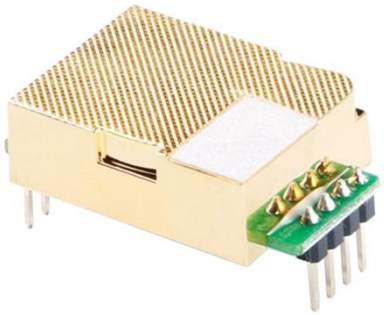
We will be using a **solderless** breadboards for creating circuits.

- These are great for prototyping circuits.
- All components can be reused because they are not permanently held down by soldering components to it.
- When connecting a component to a solderless breadboard, make sure the pins are connected to separate conductive rails.
- Pins along the **same** conductive rail are electrically **connected** to each other.


0.96" 128x64 OLED(V1.0)
VCC GND SCL SDA DC CS
LED
USB
BOOTSEL
Pico 2
DEBUG

Other Equipment

Temperature Sensor (DHT22)



CO_2 Sensor (MH-Z19C)

OLED Display

LEDs

Resistors

Capacitor

Rules of Programming

- Programs run from top to bottom
- An executable command is written in a single line
- Comments can be written using a **#** in the beginning of a line
- Tab spaces are used to indent/layer the code
- The language is **case sensitive** so keep an eye on your capitals!

StudyFresh.py | StudyFresh_completed.py

```
1  from machine import Pin, UART, I2C
2  from time import sleep
3  import dht
4  import ssd1306
5  import time
6
7  # --- Sensor Initialization ---
8  dht_sensor = dht.DHT22(Pin(2))  # DHT22 temp/humidity sensor
9  uart = UART(1, baudrate=9600, bits=8, parity=None, stop=1, tx=Pin(8),
10
11 # --- LED Pins ---
12 green_led = Pin(12, Pin.OUT)
13 yellow_led = Pin(11, Pin.OUT)
14 red_led = Pin(10, Pin.OUT)
15 status_led = Pin(25, Pin.OUT)  # onboard LED (optional)
16
17 # --- OLED Setup (adjust pins if needed) ---
18 i2c = I2C(0, scl=Pin(5), sda=Pin(4))  # Use appropriate pins for your
19 oled = ssd1306.SSD1306_I2C(128, 64, i2c)
```

Shell

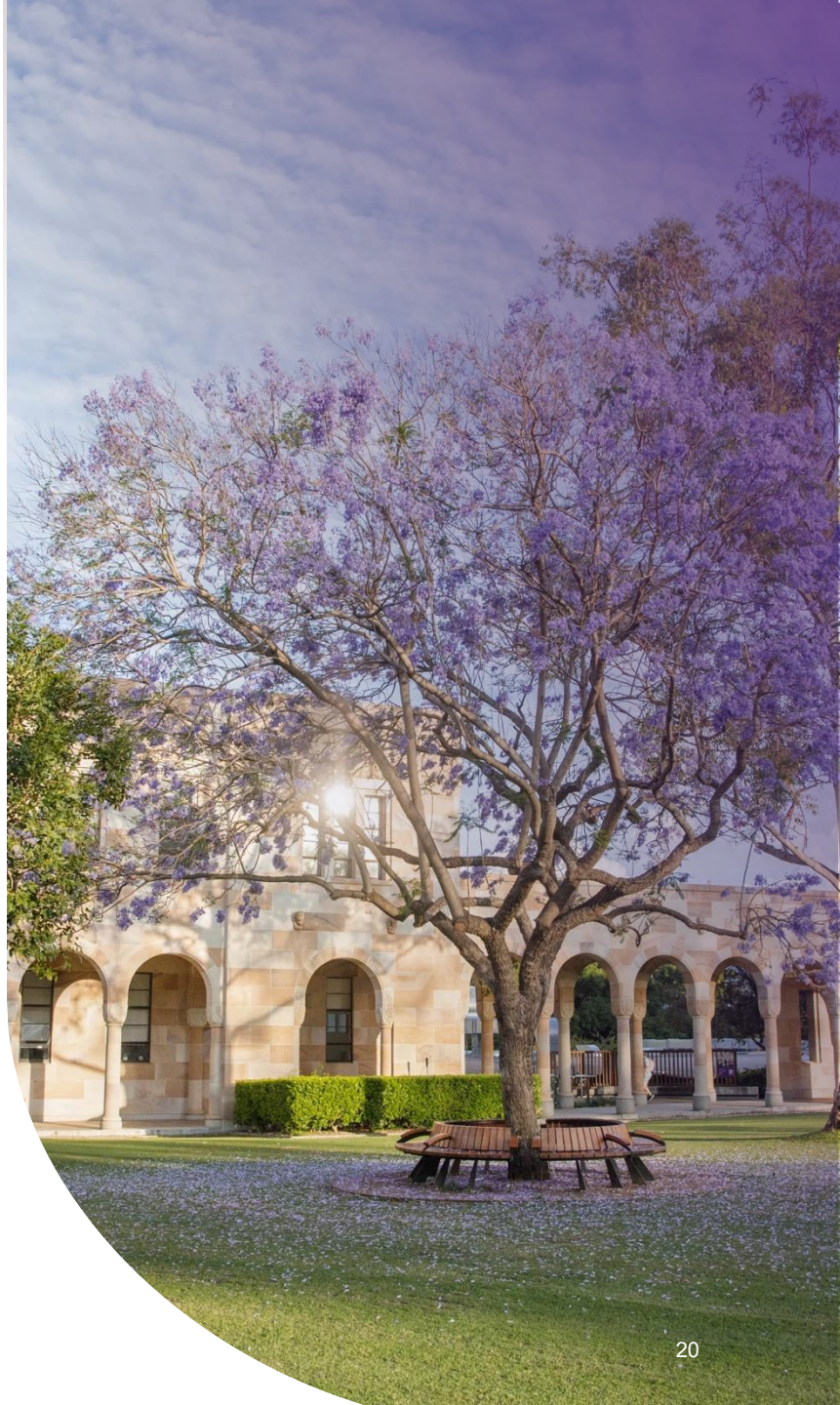
```
MPY: soft reboot
Temperature: 22.40 °C Humidity: 71.50 % CO2: 437.00 ppm
Temperature: 22.60 °C Humidity: 70.50 % CO2: 437.00 ppm
Temperature: 22.60 °C Humidity: 70.10 % CO2: 437.00 ppm
Temperature: 22.60 °C Humidity: 70.20 % CO2: 437.00 ppm
```

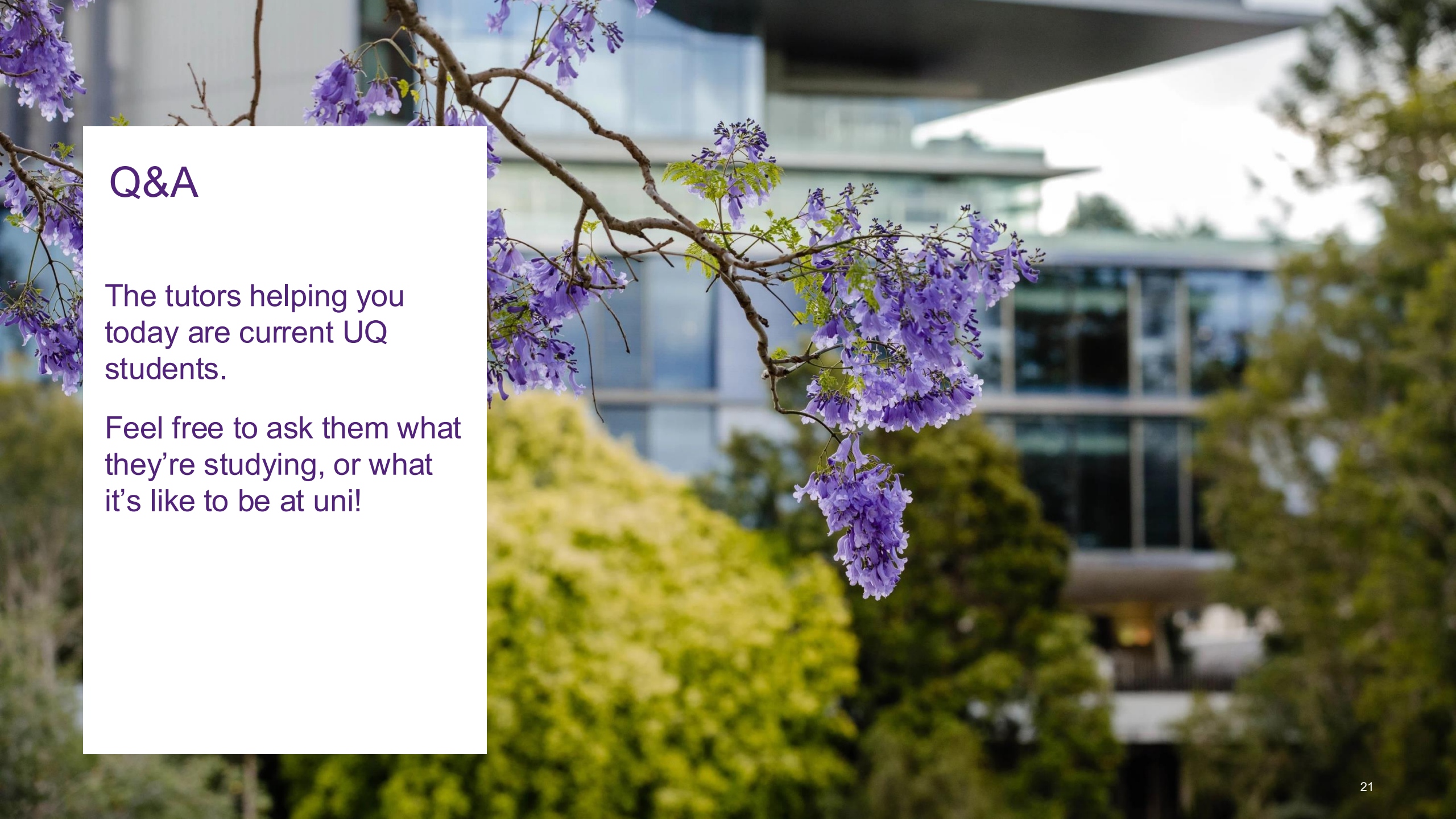
The skills you used today are part of what you can study at UQ!

Some of the degrees related to to the work we did:

- Bachelor of Engineering (Electrical, Software, Mechatronic, Civil)
- Bachelor of Computer Science
- Bachelor of Information Technology
- Bachelor of Science

Teamwork matters here too. At UQ, collaboration is part of how you learn! You'll share ideas, build together and solve real problems.





Q&A

The tutors helping you today are current UQ students.

Feel free to ask them what they’re studying, or what it’s like to be at uni!

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA
CREATE CHANGE

Thank you!

Study Fresh Team

UQ School of Electrical Engineering & Computer Science

Faculty of Engineering, Architecture and IT