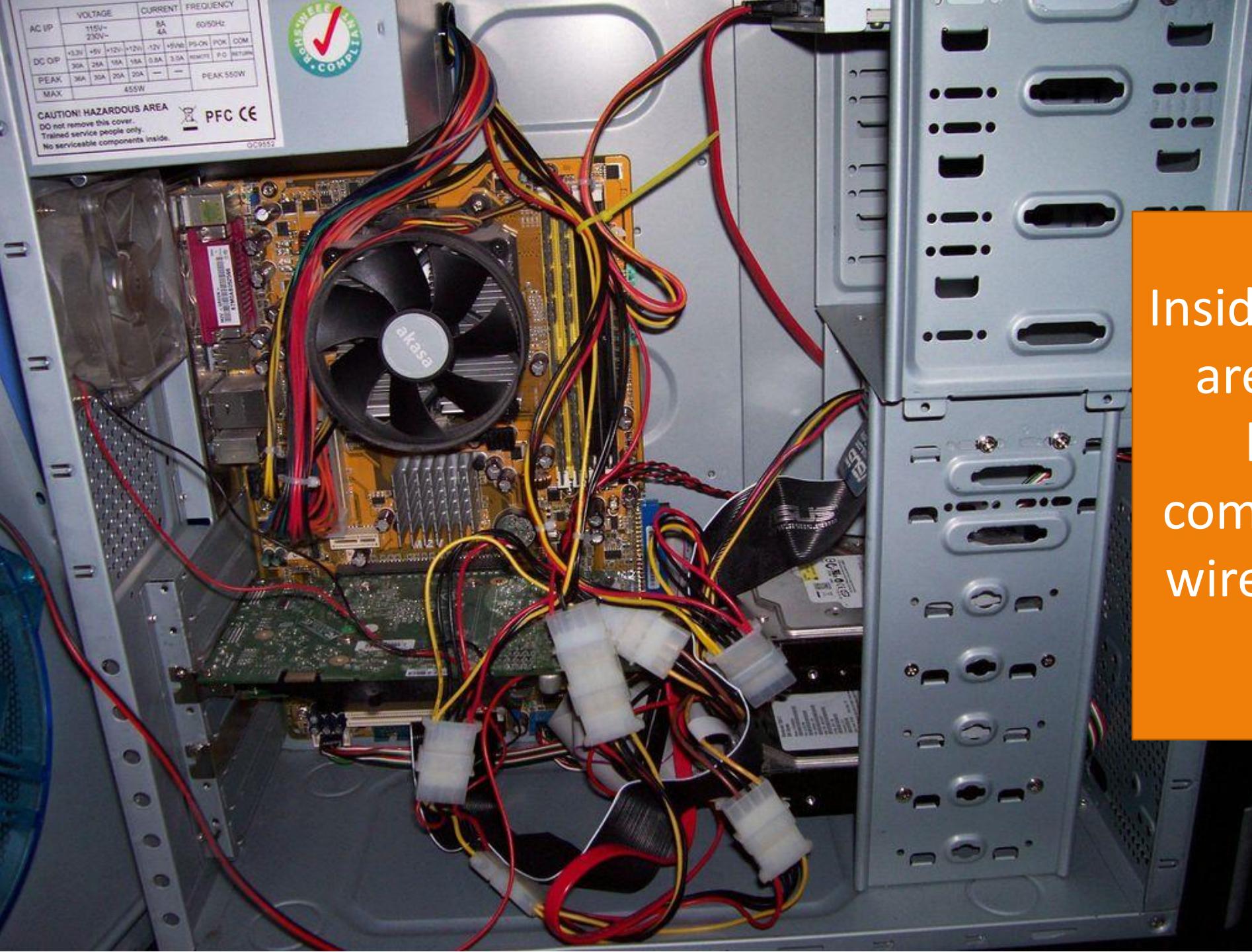
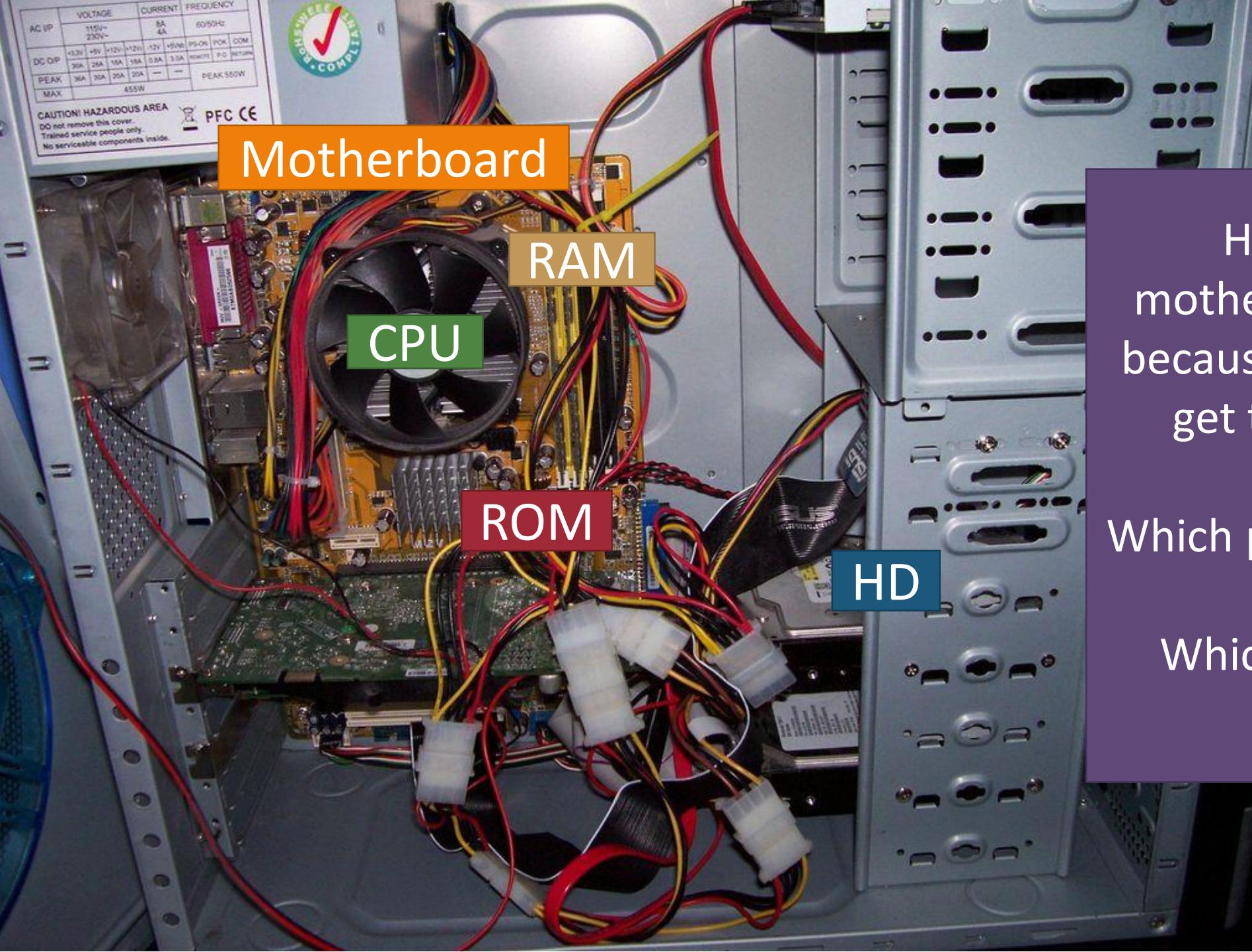


# Hardware Comparisons

RAM vs. ROM, RAM vs. HardDrive



Inside a computer are a series of hardware components and wires to connect them all.



HW on the motherboard is fast because the CPU can get to it quickly.

Which pieces are fast?

Which pieces are slow?

RAM



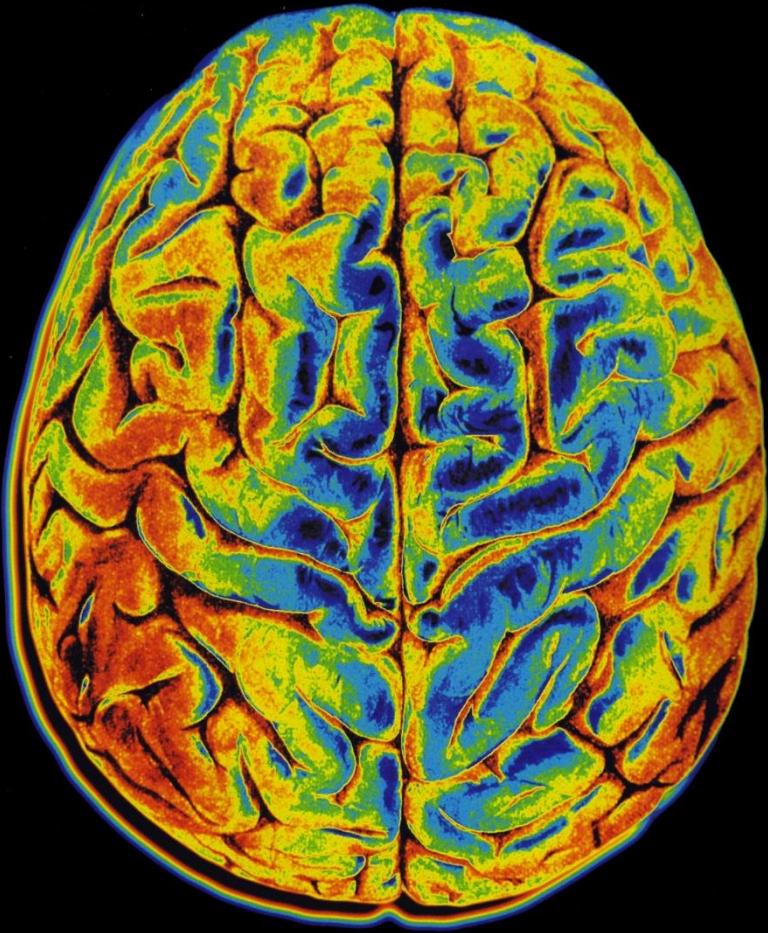
ROM



HD

The physical size of items impacts how much they can store.

Put RAM, HD, ROM in order smallest to biggest.



Brain Imaging has hugely improved recently.  
These has lead to big improvements in “cognitive neuroscience”, with huge impacts on teaching.

Before, we suspected some things were helpful,  
Now, we can see the results in the brain.  
This has lead us to re-evaluate what is important.

Two things we now know are more important than we thought:

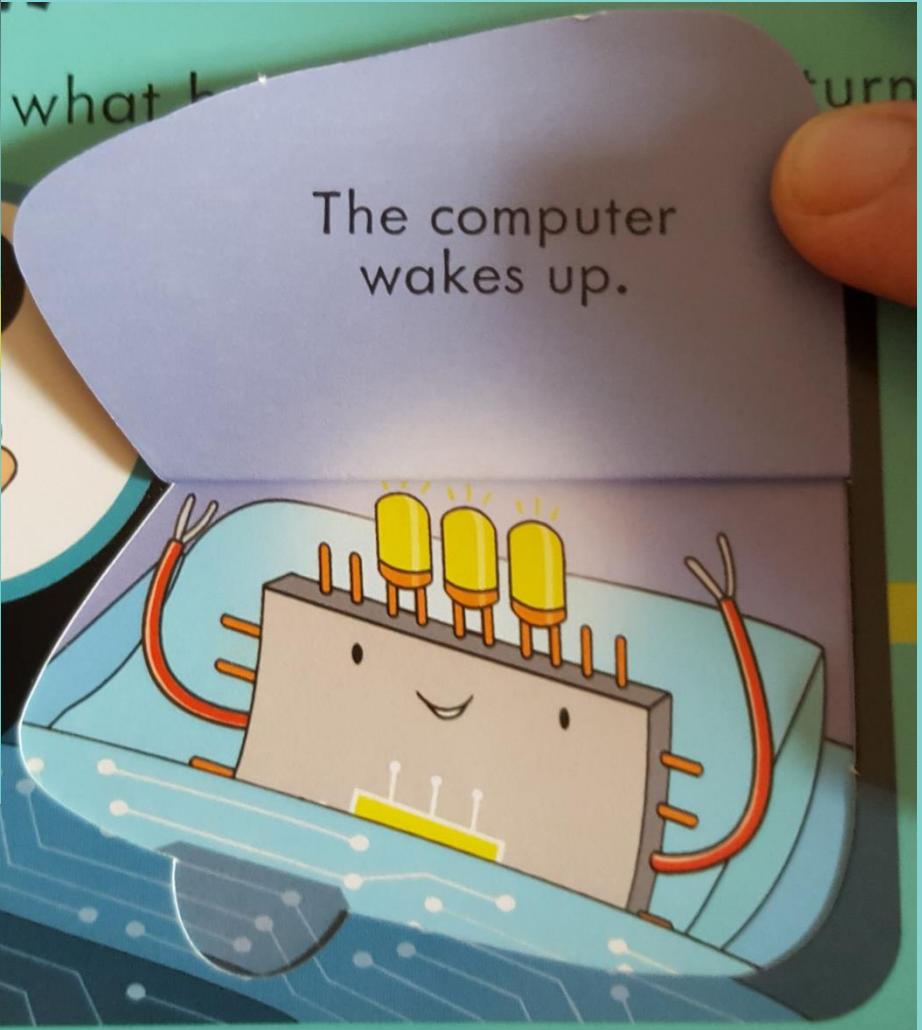
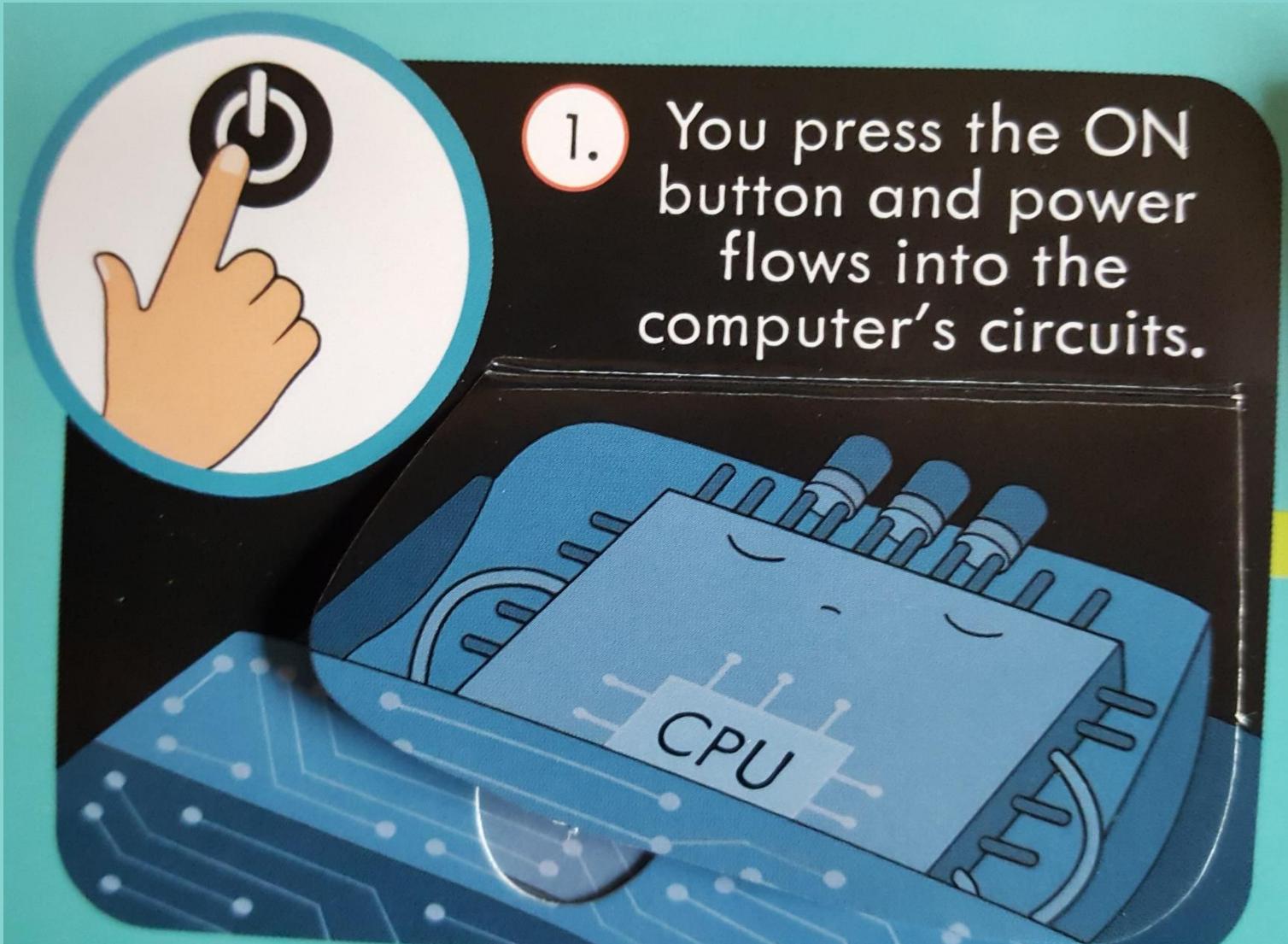
- (1) Images are really useful to improve understanding.
- (2) Analogies are also really important to encoding.



It is also important that students engage in their learning.

An analogy to explain the inner-workings of the computer follows.

- (1) Pay attention!
- (2) Look at the pictures, try to remember them.
- (3) Try to figure out what specific analogy is used for ROM, RAM, HD, CPU, Program.



 Award Modular Bios v.4.01, An Energy Star Ally.  
Copyright (C) 1984-1994, Award Software, Inc.



i486-DX2 CPU at 50 mhz

Memory Test: 3277 OK

Award Plug and Play BIOS Extension v1.0

Copyright (C) 1994, Award Software, Inc.

Detecting IDE Primary Master ... WDC-20

Detecting IDE Primary Slave ... None

Detecting IDE Secondary Master... Generic CD-ROM

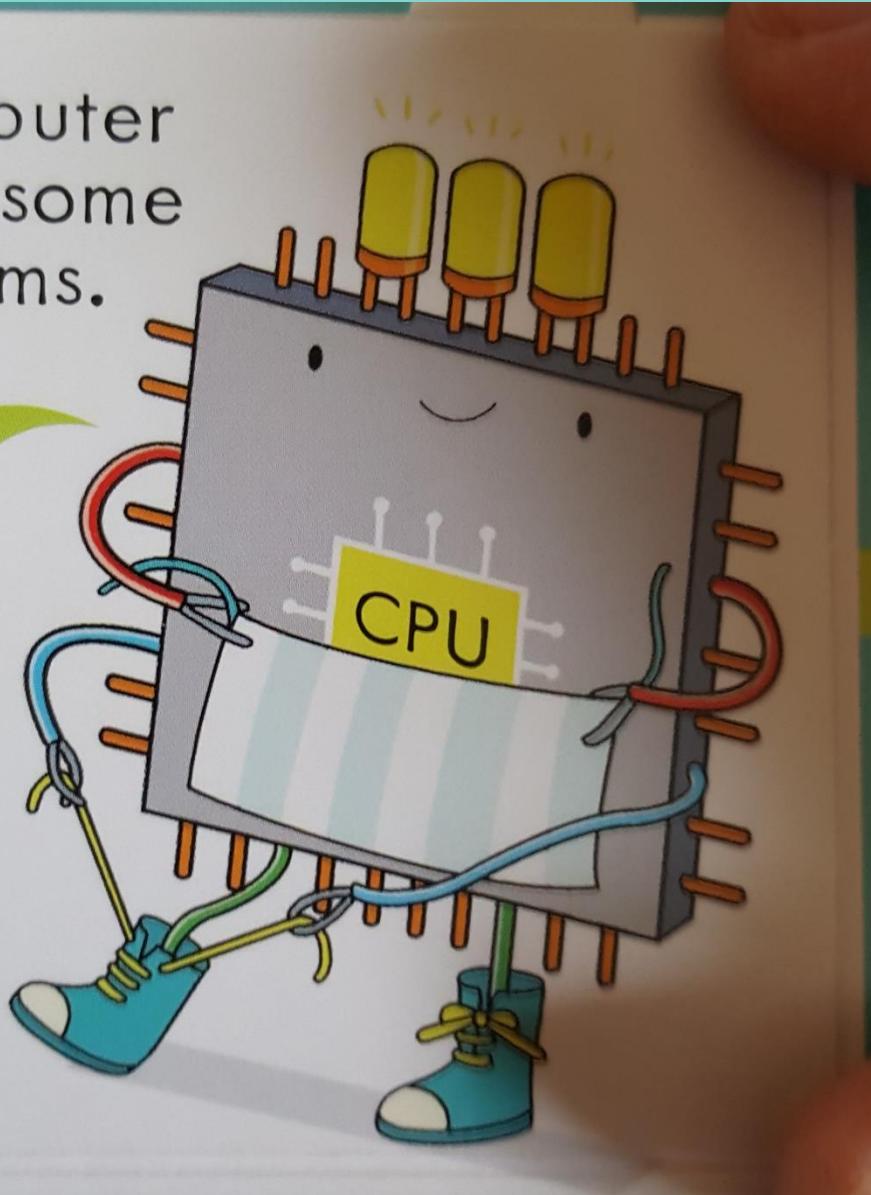
<DEL>: BIOS Setup, <F12>: For Boot Menu  
06/27/1995

While the wake-up commands from ROM are running, your screen looks something like this.

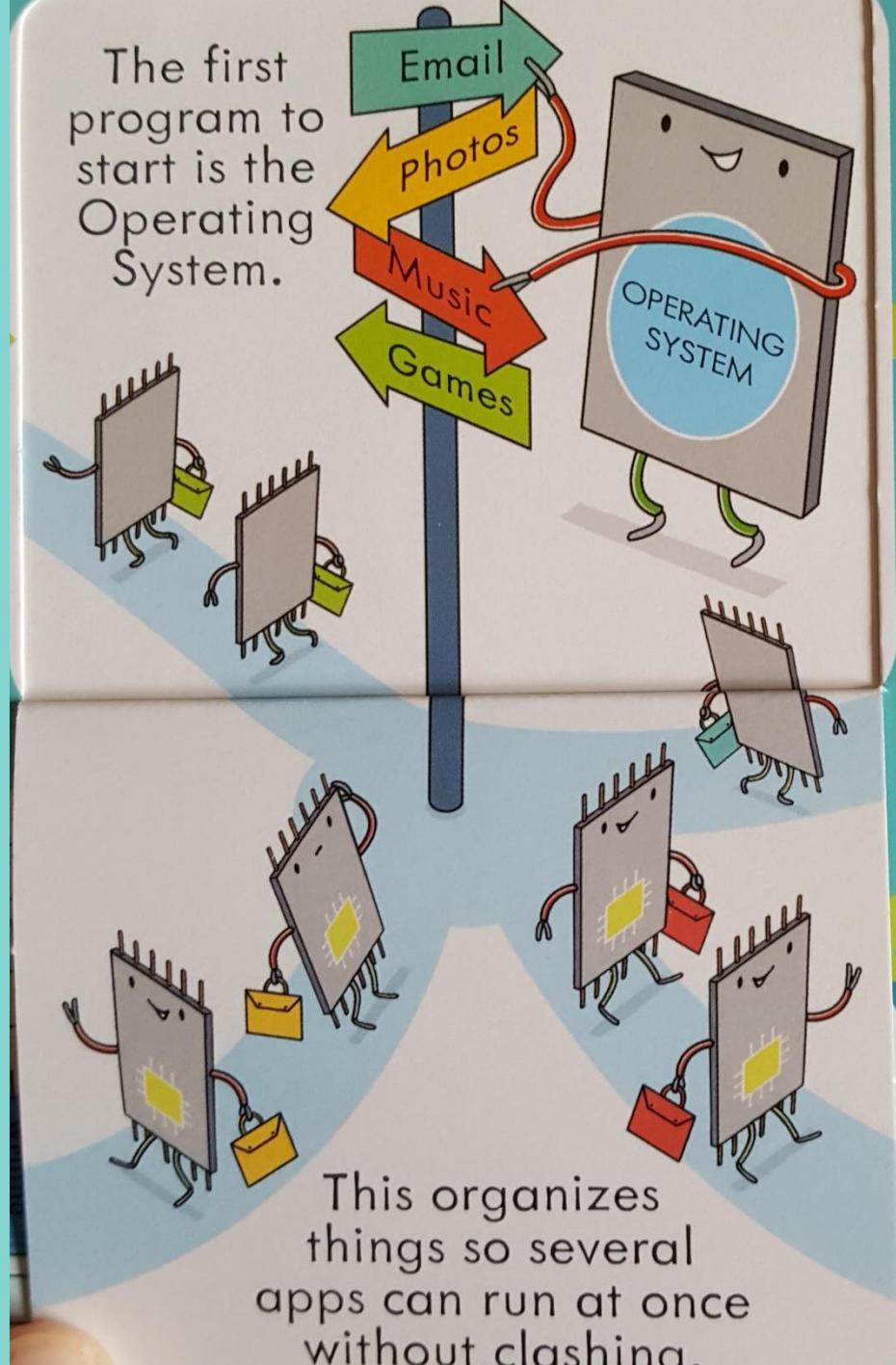
2. The computer starts up some programs.

I'm getting ready for work.

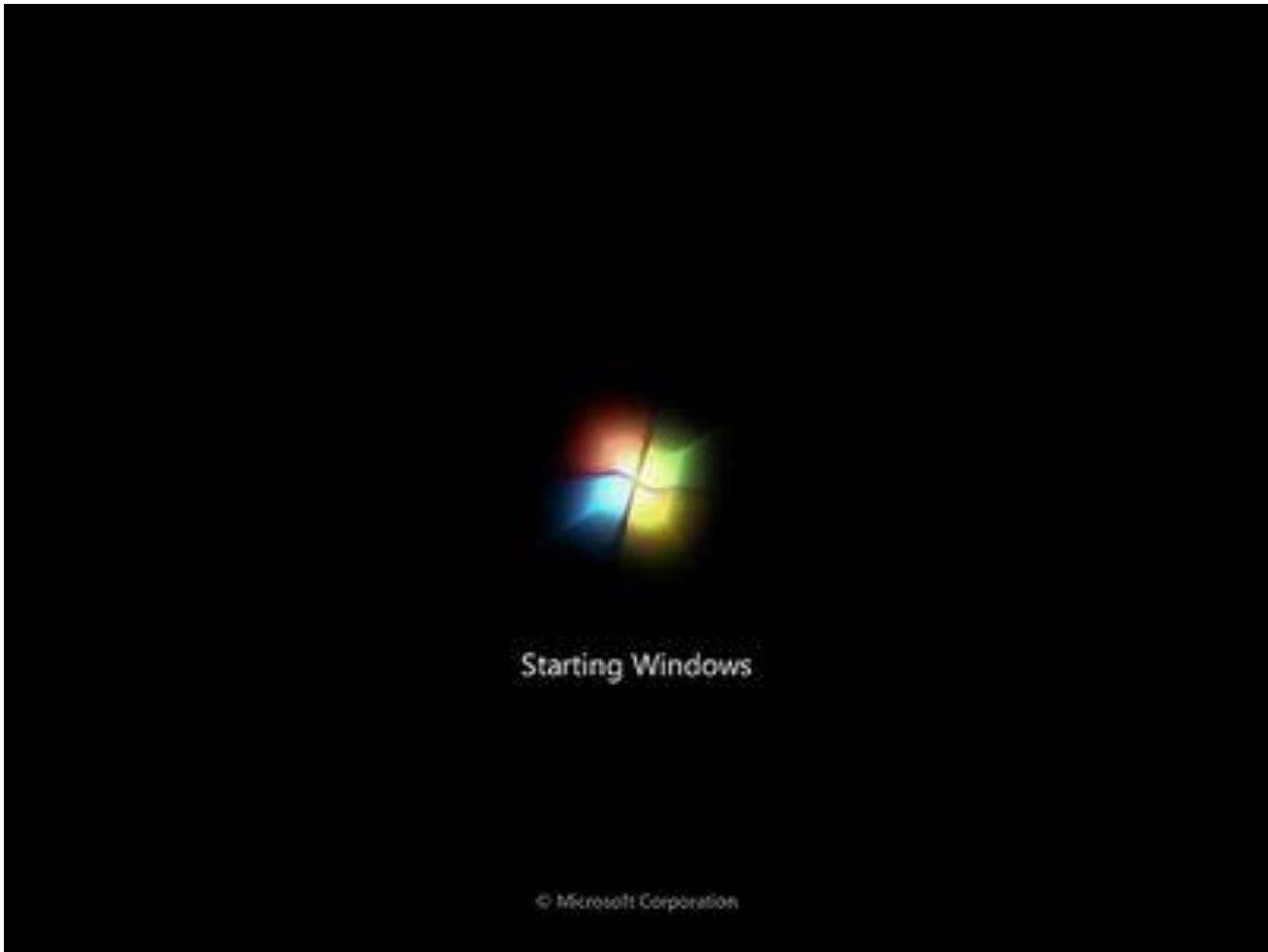
This is known as booting up.



The first program to start is the Operating System.



This organizes things so several apps can run at once without clashing.

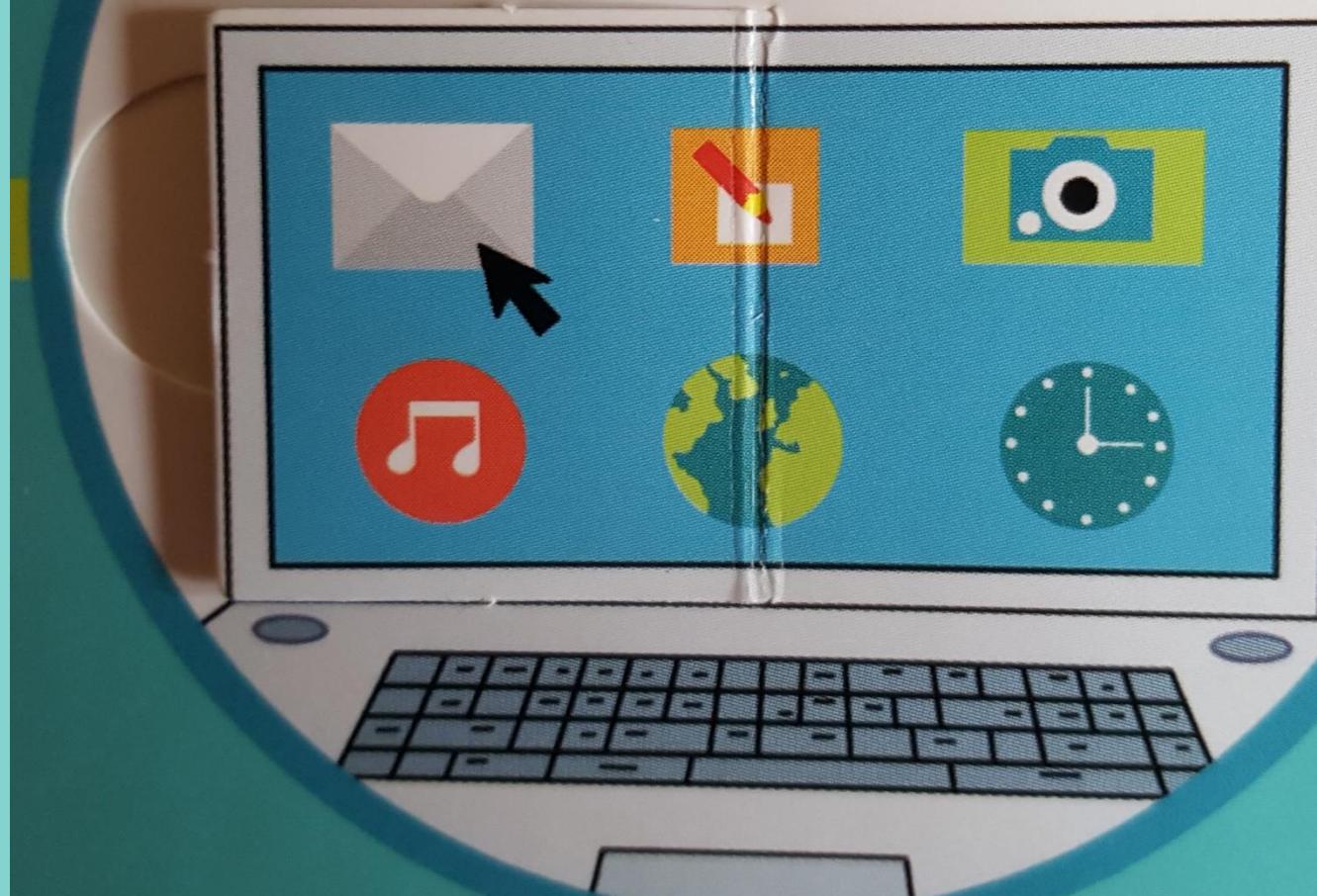


While the ROM commands the OS to open, the screen looks something like this.

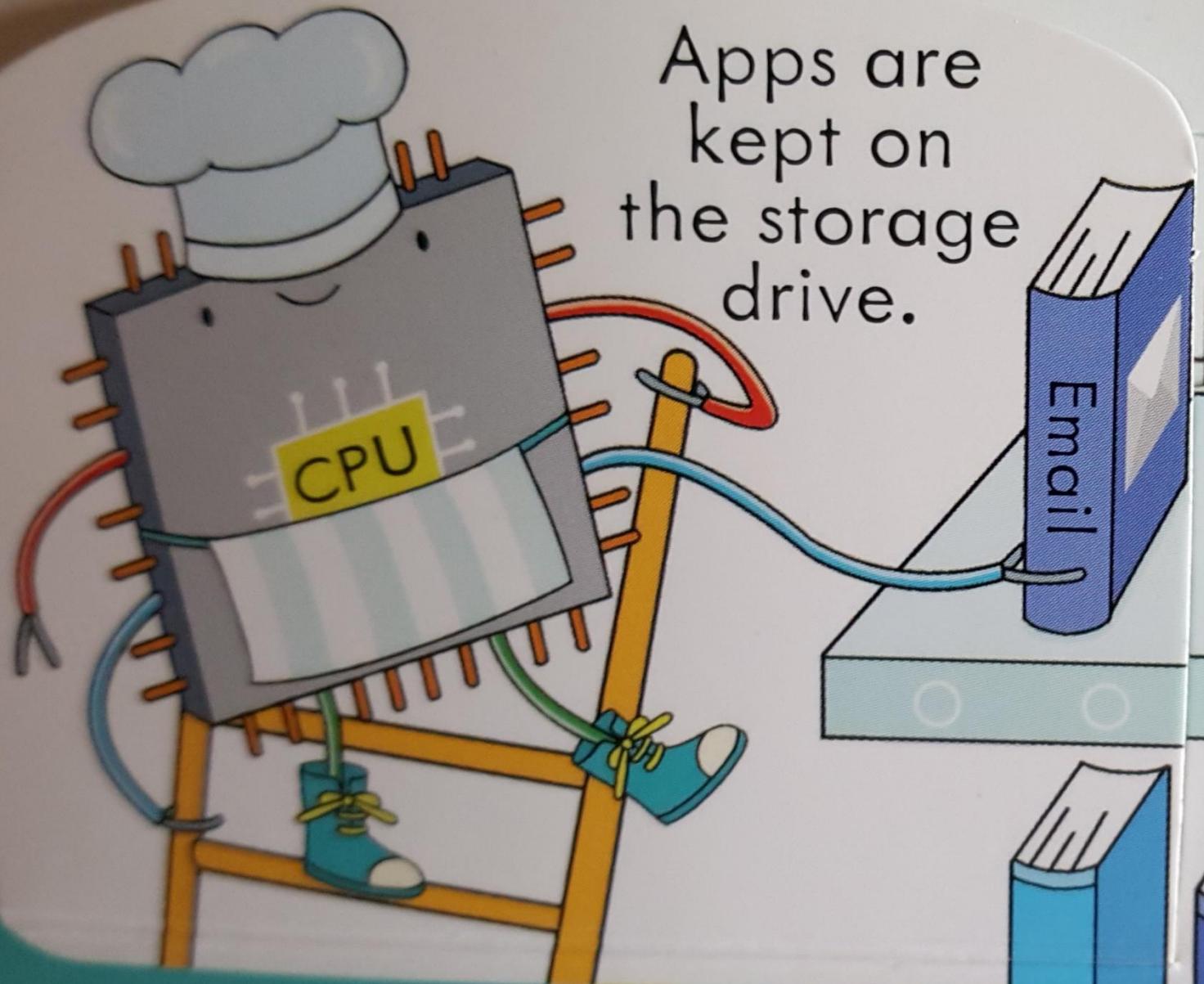
Then, ROM's job is done. The hardware is checked and the OS is running.

Your computer is ready to use.

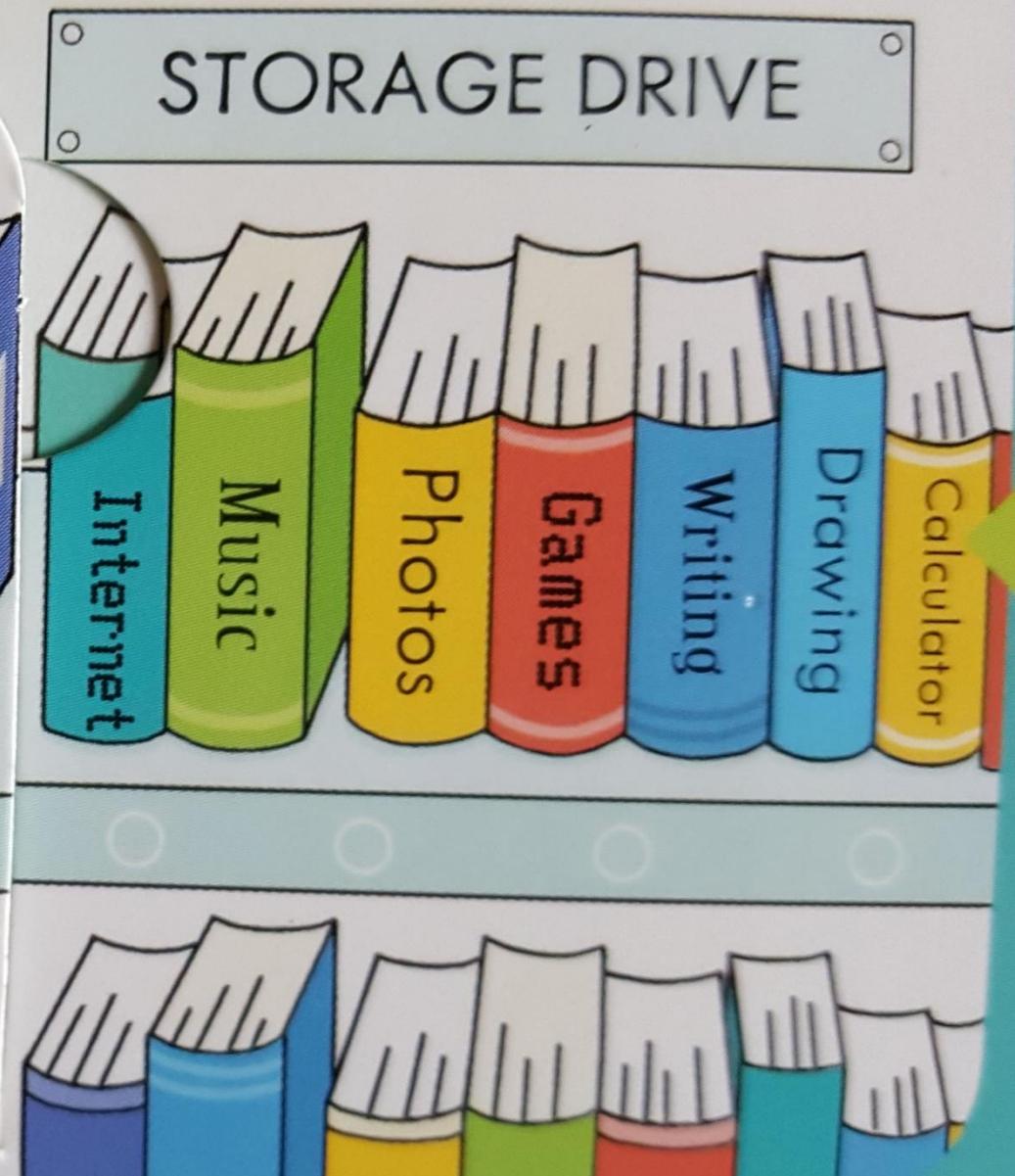
3. You click on an icon to open an app.

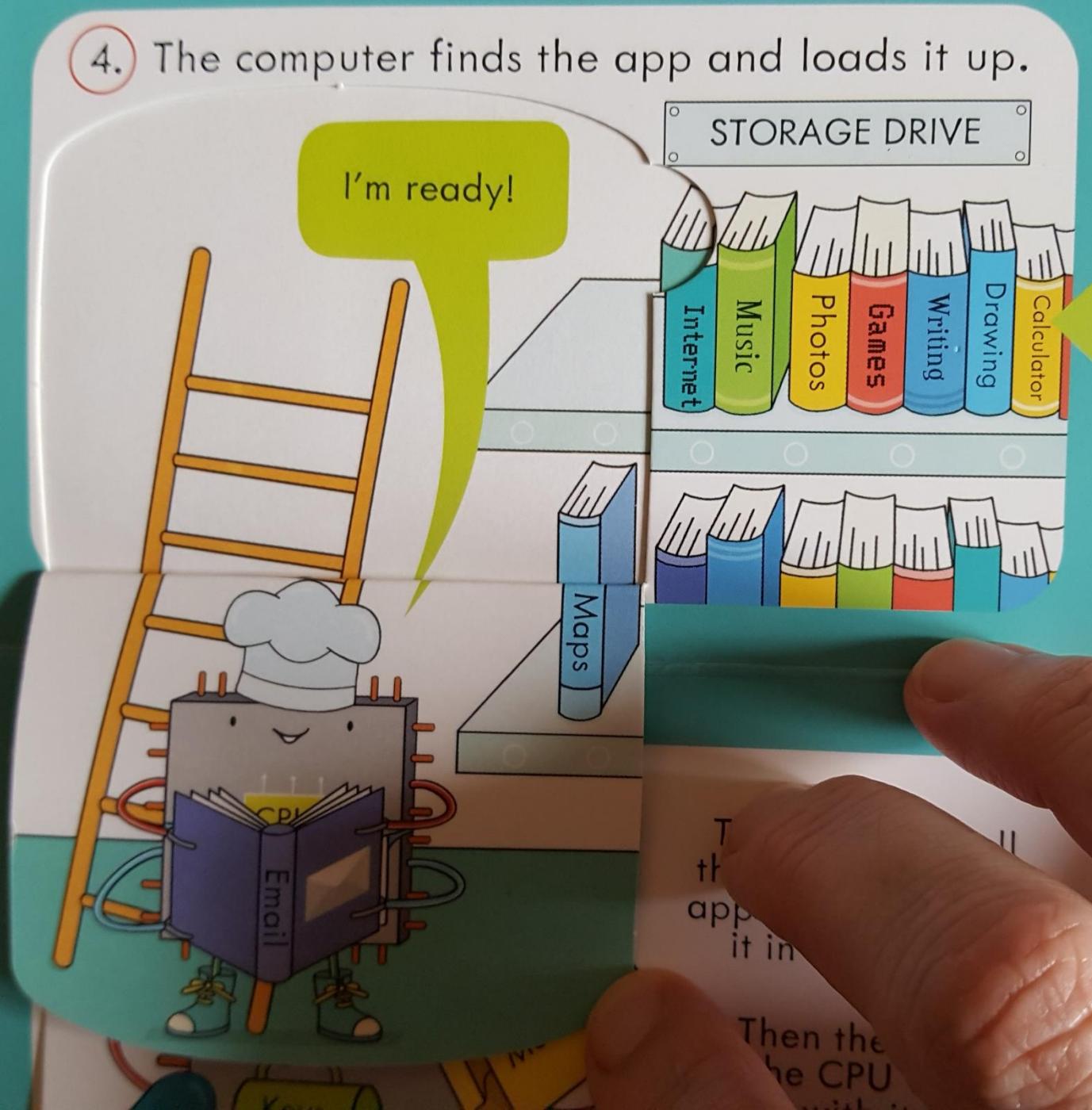


4. The computer finds the app and loads it up.



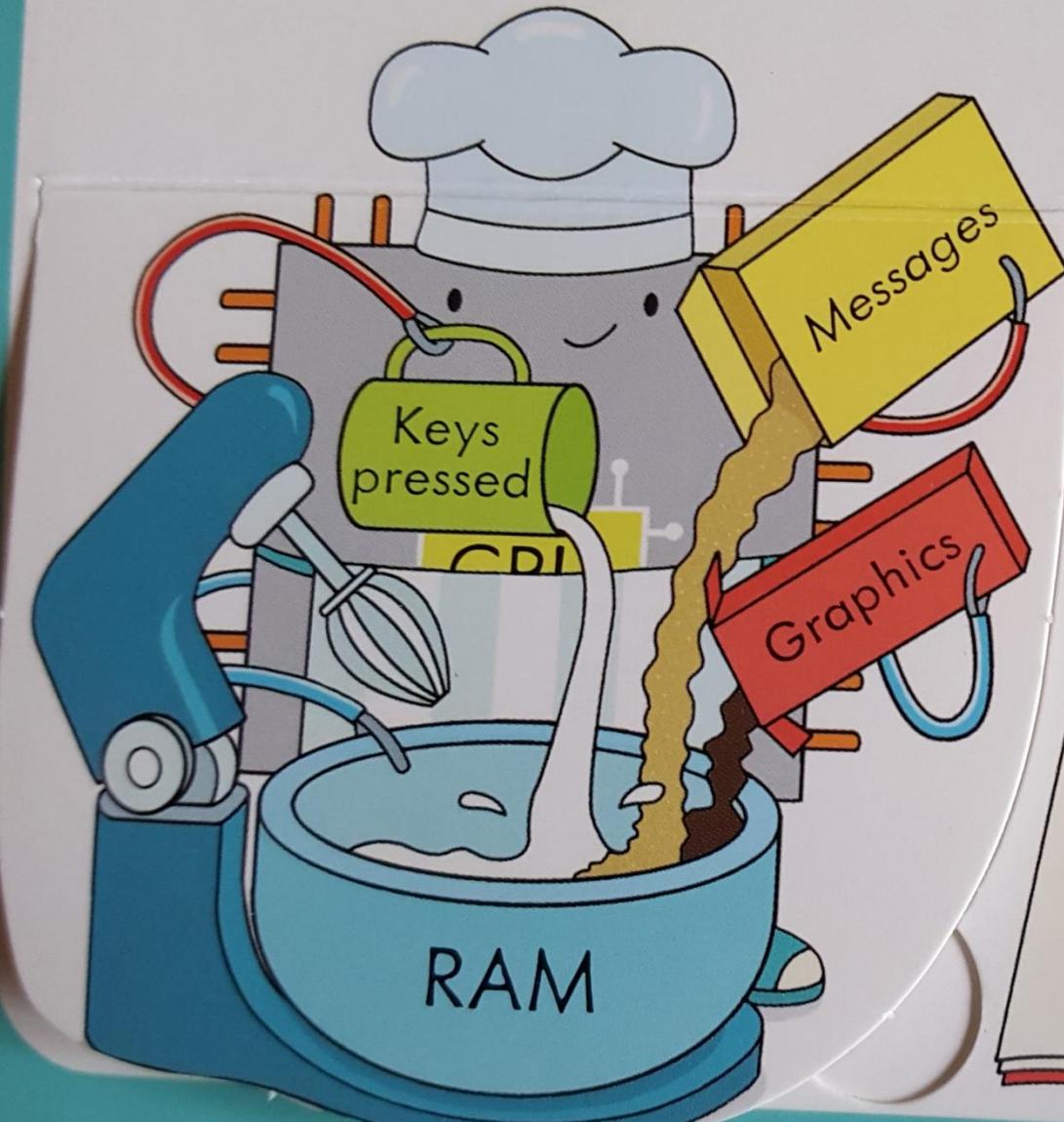
Apps are kept on the storage drive.





This step is done by moving the code for the software from the Hard Drive to the RAM so the CPU can easily read it.

5. You start using the app.



The CPU finds all the information the app needs, and puts it in the RAM...

Then the app tells the CPU what to do with it. This is called **processing**.

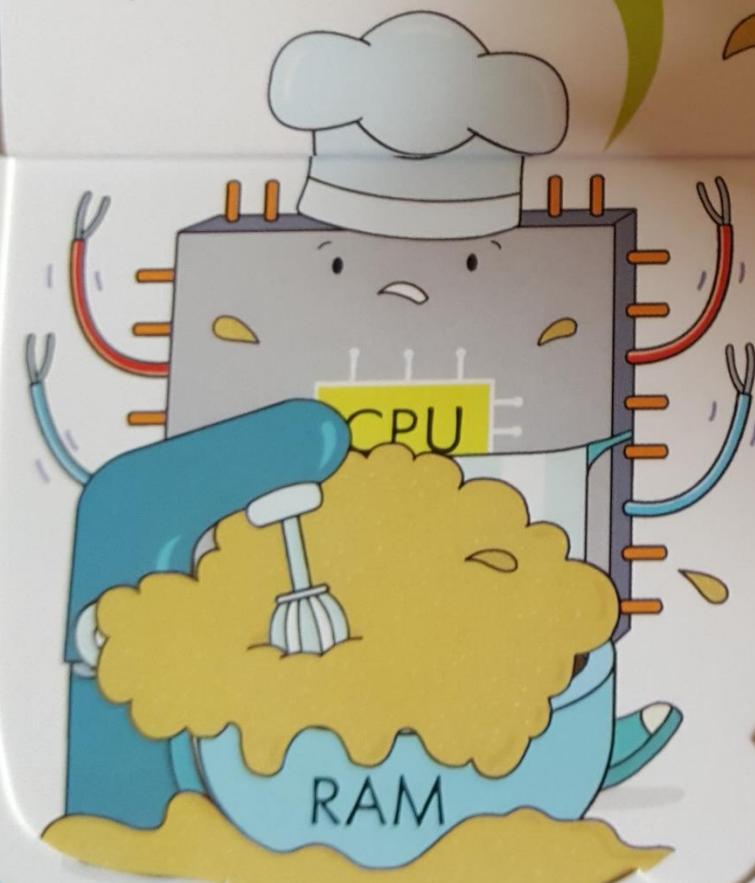
An app is a little like a recipe...



1. Measure out ingredients.
2. Mix them all together.
3. Bake.

The RAM must have enough space for everything, or the app will get stuck.

Uh-oh, too much information!



The CPU finds all the info

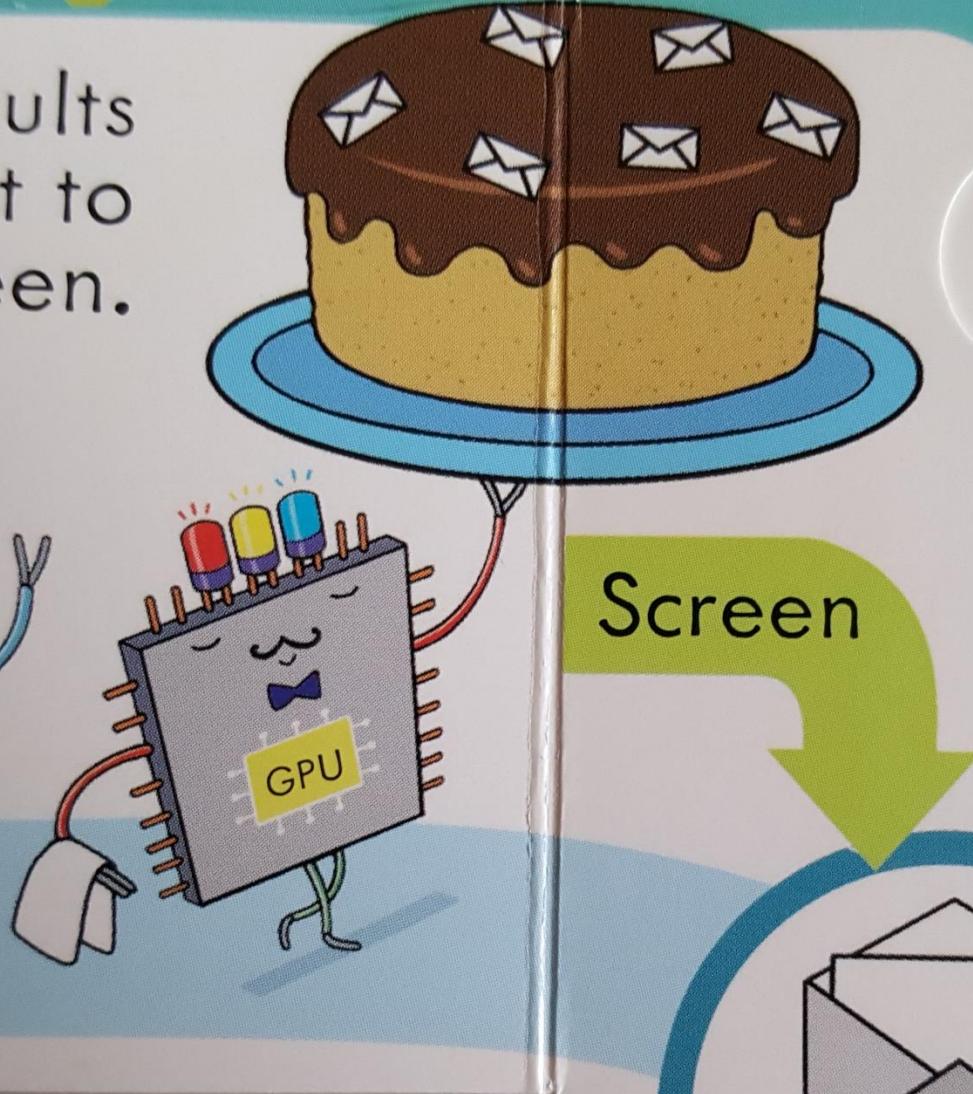
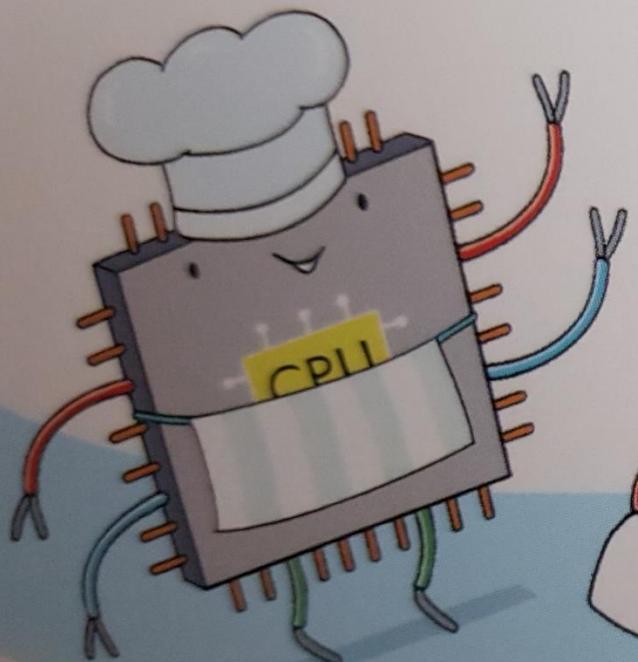
the CPU won't do with it. It's called **process**..

An app is a little like a recipe...

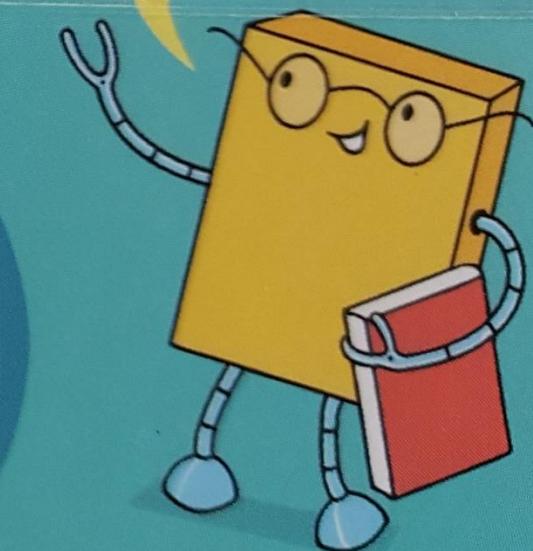


1. Measure out ingredients.
2. Mix them all together.
3. Bake.

6. The results are sent to the screen.



The CPU collects the results and tells the GPU to display them.

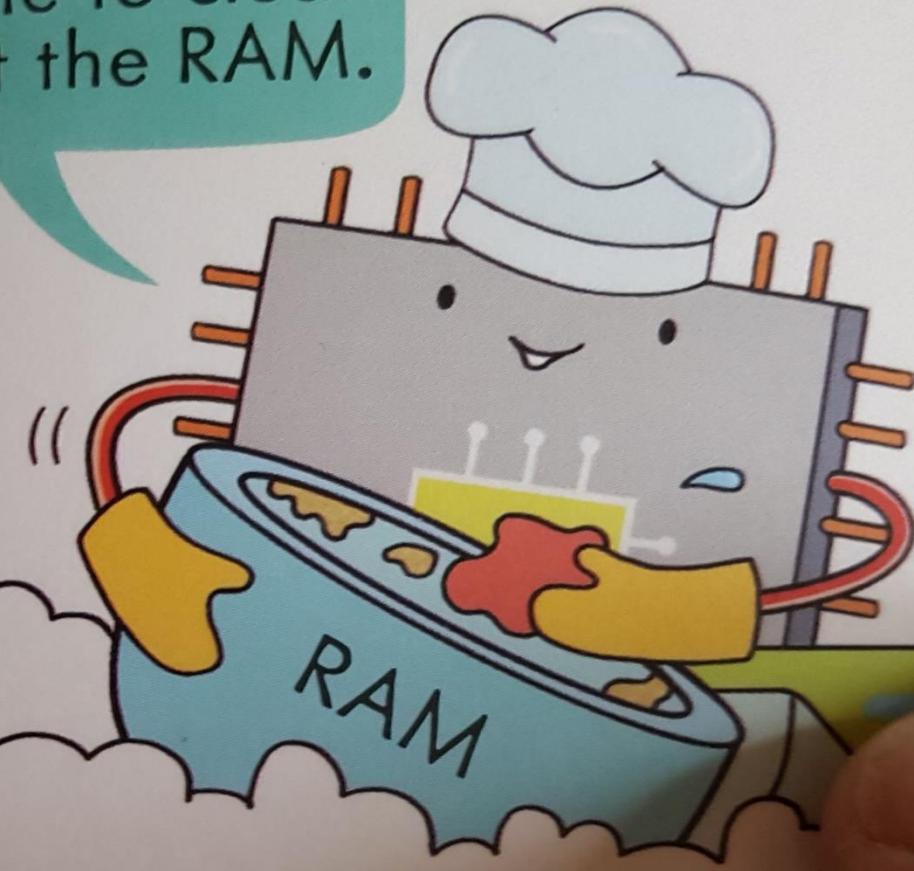


It all works smoothly as long as the computer has the right instructions.

Meanwhile, the CPU cleans up by getting rid of anything it has finished with.

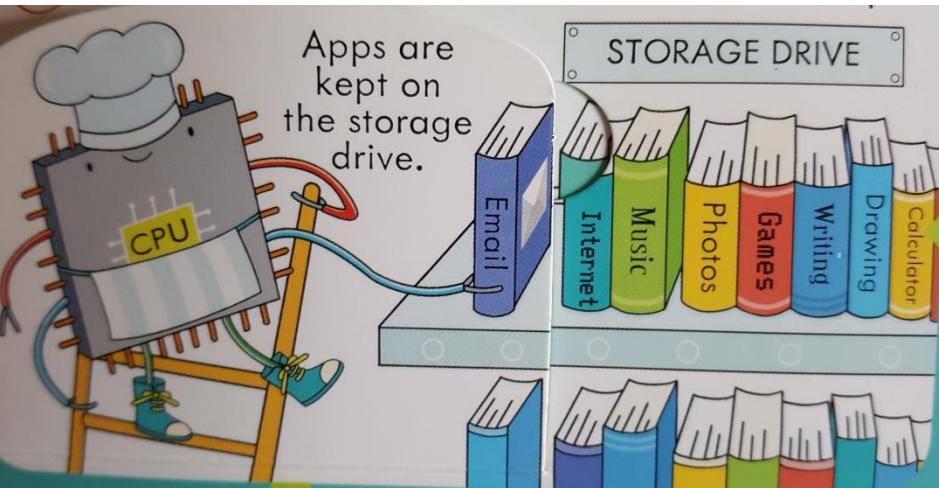
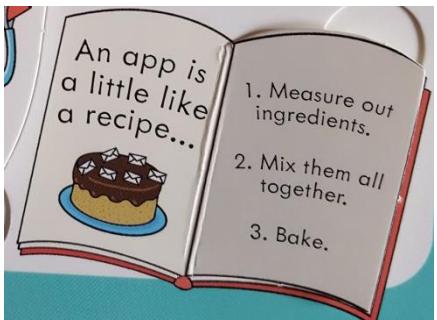
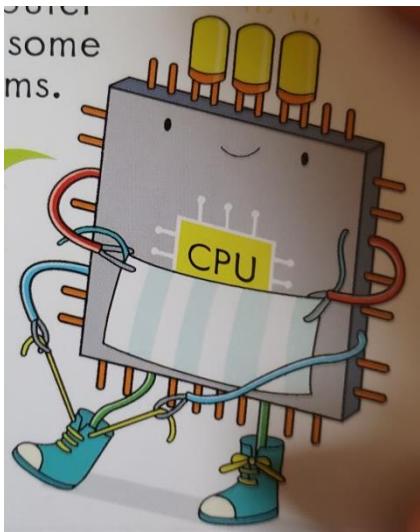
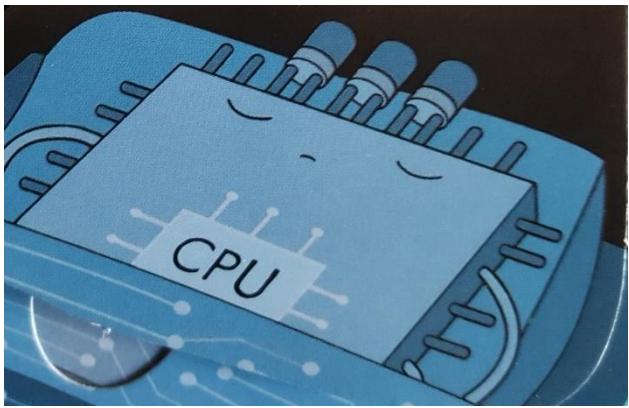


Time to clean out the RAM.

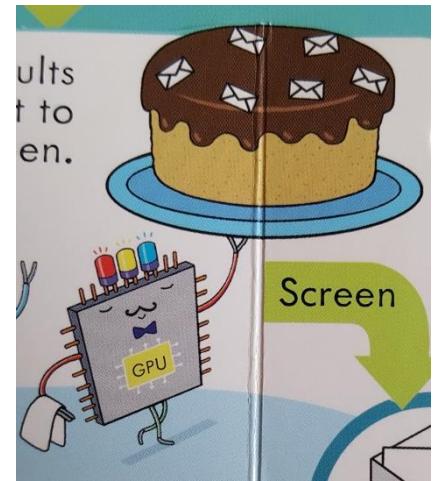
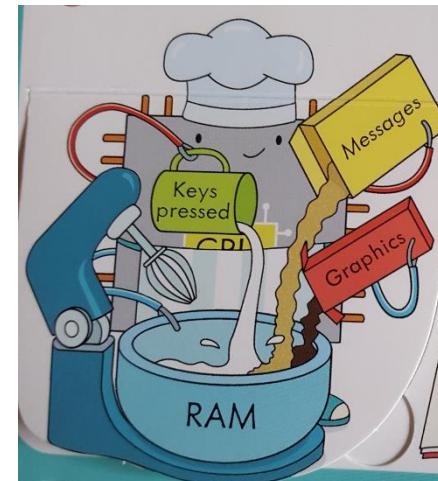


The CPU collects the results and tells the GPU to display them.

NEW  
MESSAGES



Part	Analogy
CPU	Baker
ROM	Alarm Clock to wake the baker
Program, App	Recipe
Hard Drive	Library with the Recipe Books
RAM	Mixing Bowl
Output/Screen	Holds the Cake



# Memory and Storage Comparison

	ROM	RAM	HD
Stands For	Read-Only-Memory	Random-Access-Memory	Hard Drive
Purpose	Hold instructions to turn on the computer.	Holds data and programs the CPU is using right now.	Long term storage for data and programs.
Volatile	Non-volatile. Saved if no power.	Volatile. Lost if no power.	Non-volatile. Saved if no power.
Size	Smallest.	Larger.	Really, really large.
Speed	Fast, on motherboard.	Fast, on motherboard.	Slow, off motherboard.