3.2.4 – HARDWARE DEVICES

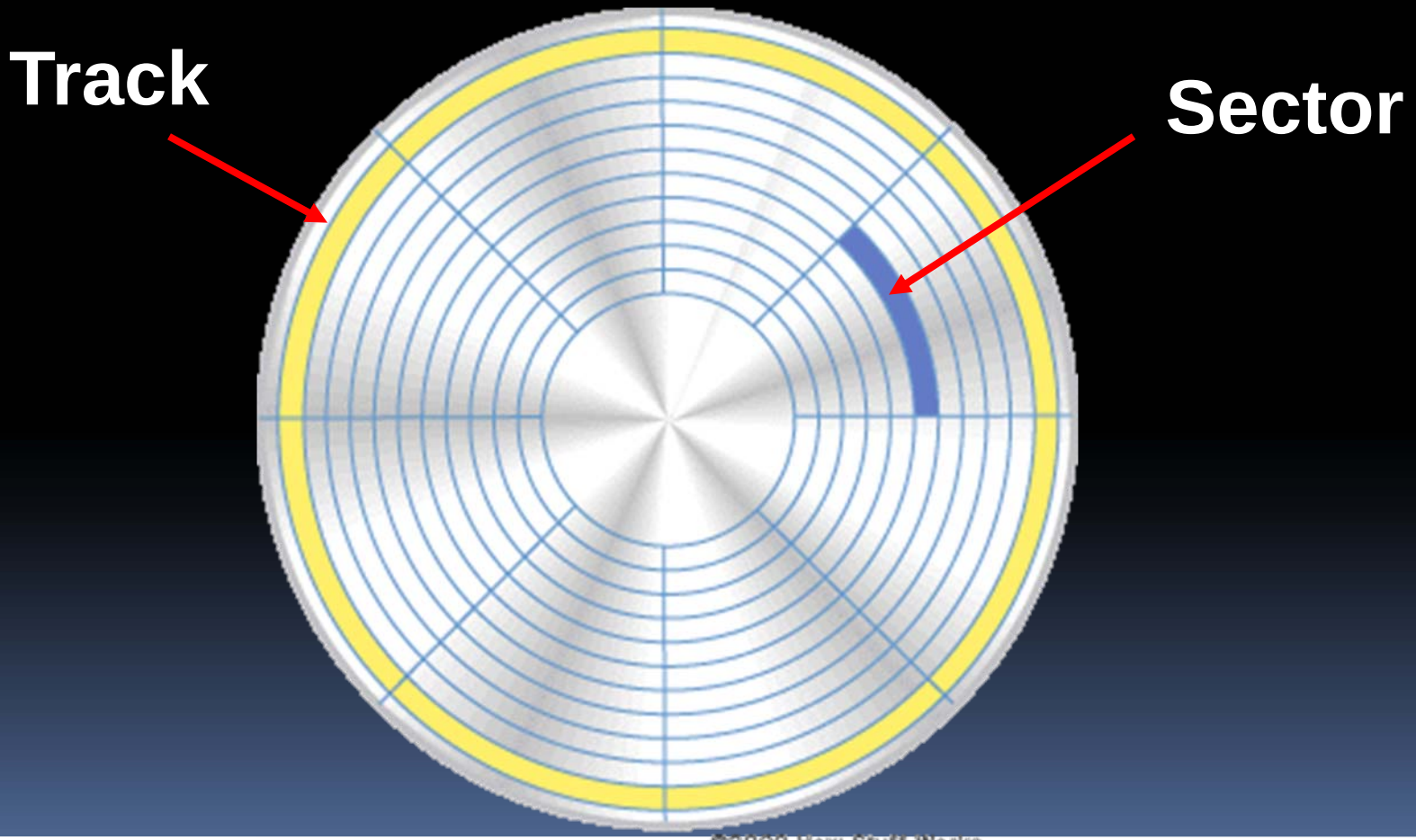
- Secondary storage devices

Storage devices

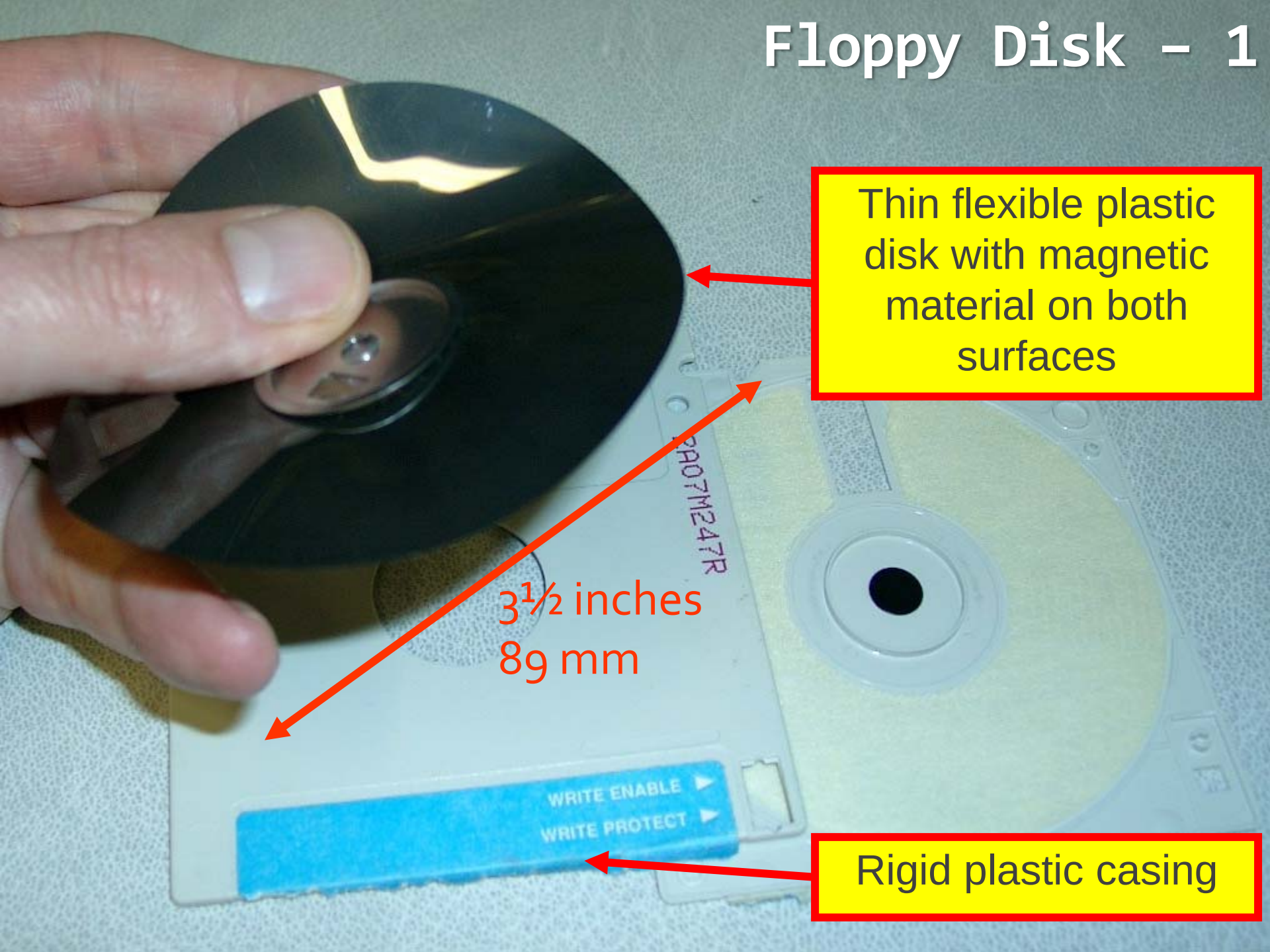
- Hard disk
- Magnetic tape
- Optical media
- CD-ROM
- CD-R
- CD-RW
- DVD-ROM
- DVD-R
- DVD-RW
- DVD-RAM
- Blu-ray disk
- HD DVD
- Flash memory

Magnetic disks

Data is stored in concentric circular tracks, which are divided into sectors.



Floppy Disk - 1

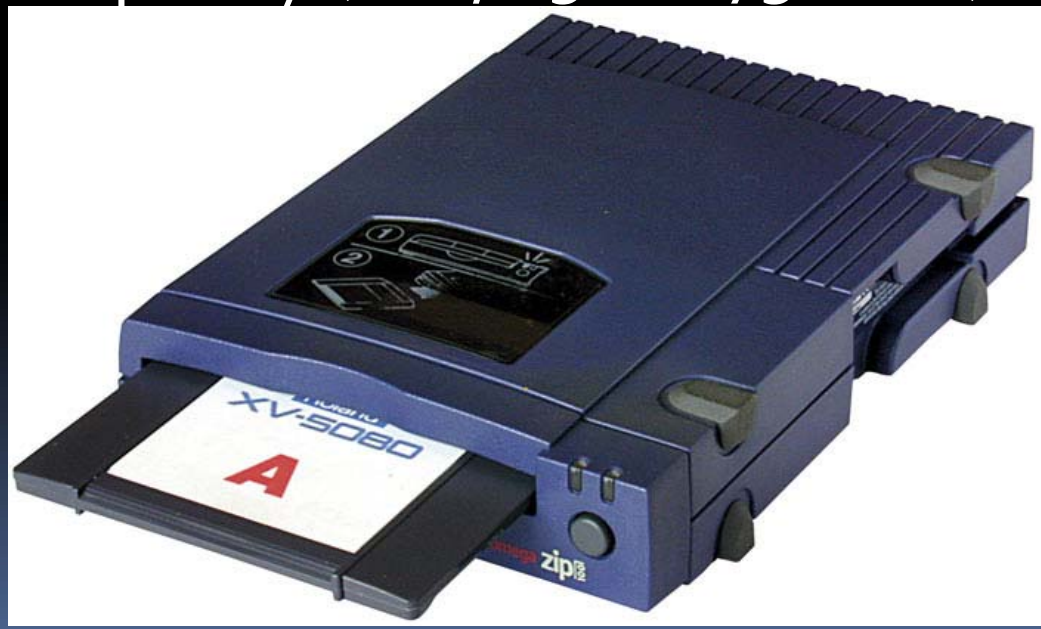


Floppy Disk – 2

- small storage capacity (1·44 MB)
- long random access time (≈ 200 ms), because it only spins slowly
  - time it takes from the start of a random read operation until the data starts to be read from the disk
    - spindle motor to change to the correct speed.
    - drive to move the heads to the right location on the disk.
    - disk to turn so that the right information spins under the read head.
- Can be removed from the drive unit and is highly portable
- Inexpensive and used to be widely used, but easily damaged.

ZIP Disk

- Slightly larger version of standard 3½" disk
- Needs a special disk drive
- Much larger storage capacity (100, 250 or 750 MB)
- more expensive
- less widely used



Hard Disk – 1

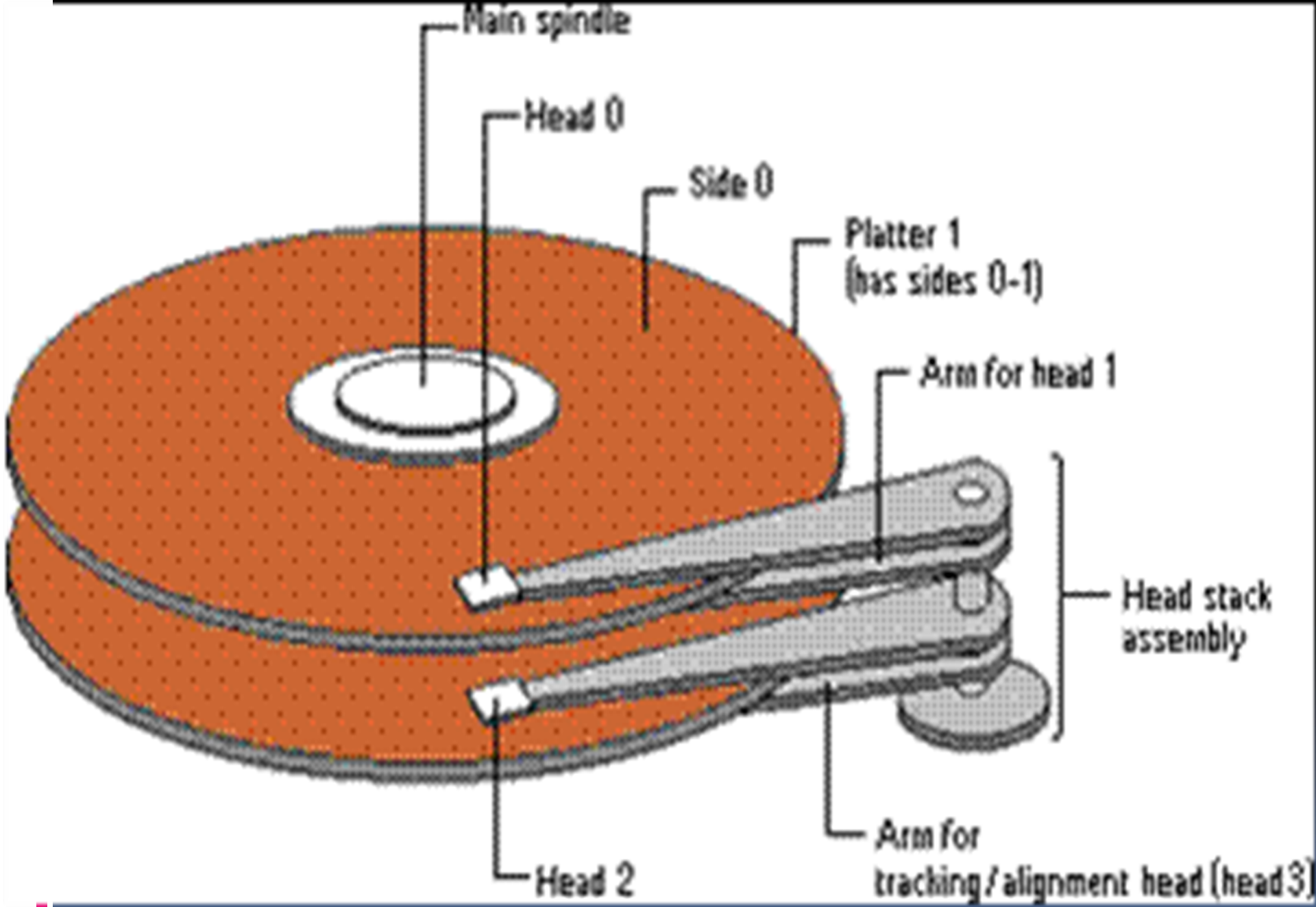
- an aluminium platter
  - several millimetres thick
  - magnetic material on both surfaces
- Modern hard disks are not removable from the drive – removal of the drive's cover is likely to ruin the unit by letting in dust
- The drive itself may be removable to provide security for the stored data
- Lower random access time than floppy disk (in region of 10 ms)

Hard Disk – 2

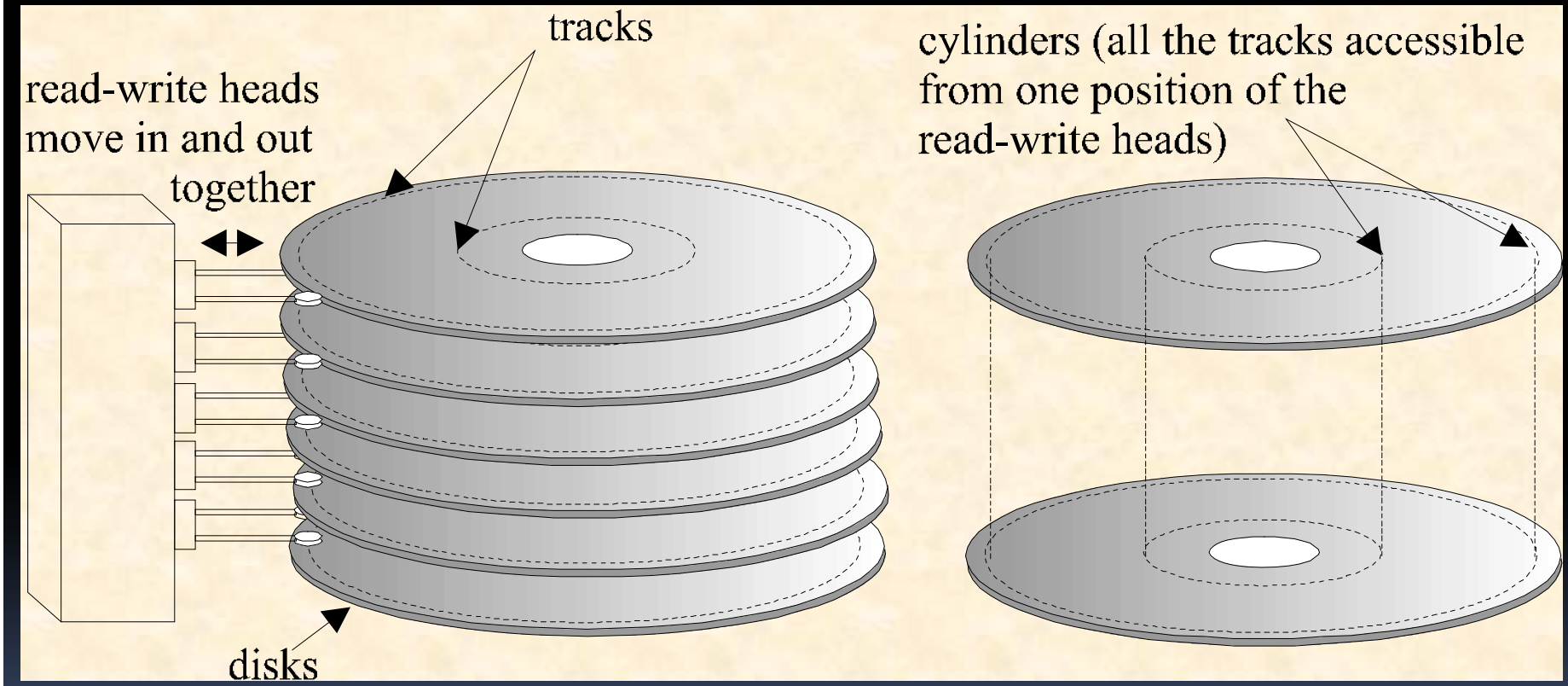
- Typical storage capacity is ……..? – much greater than floppy disk
- External hard drives for extra storage
  - Find out what is the storage range (up to ……?)
  - What would you be able to store using this space?
- Find out the cost per unit of data stored – say, per GByte.

Hard Disk – 3

- Larger capacity drives have several platters revolving on the same spindle
- Each surface has its own read-write head
- The set of tracks that are accessible from one position of the read-write heads form a "cylinder"
- Data is recorded cylinder by cylinder
  to minimise movement of the read-write heads, thereby minimising random access time


Main spindle
Head 0
Side 0
Platter 1
(has sides 0-1)
Arm for head 1
Head stack
assembly
Head 2
Arm for
tracking / alignment head (head 3)

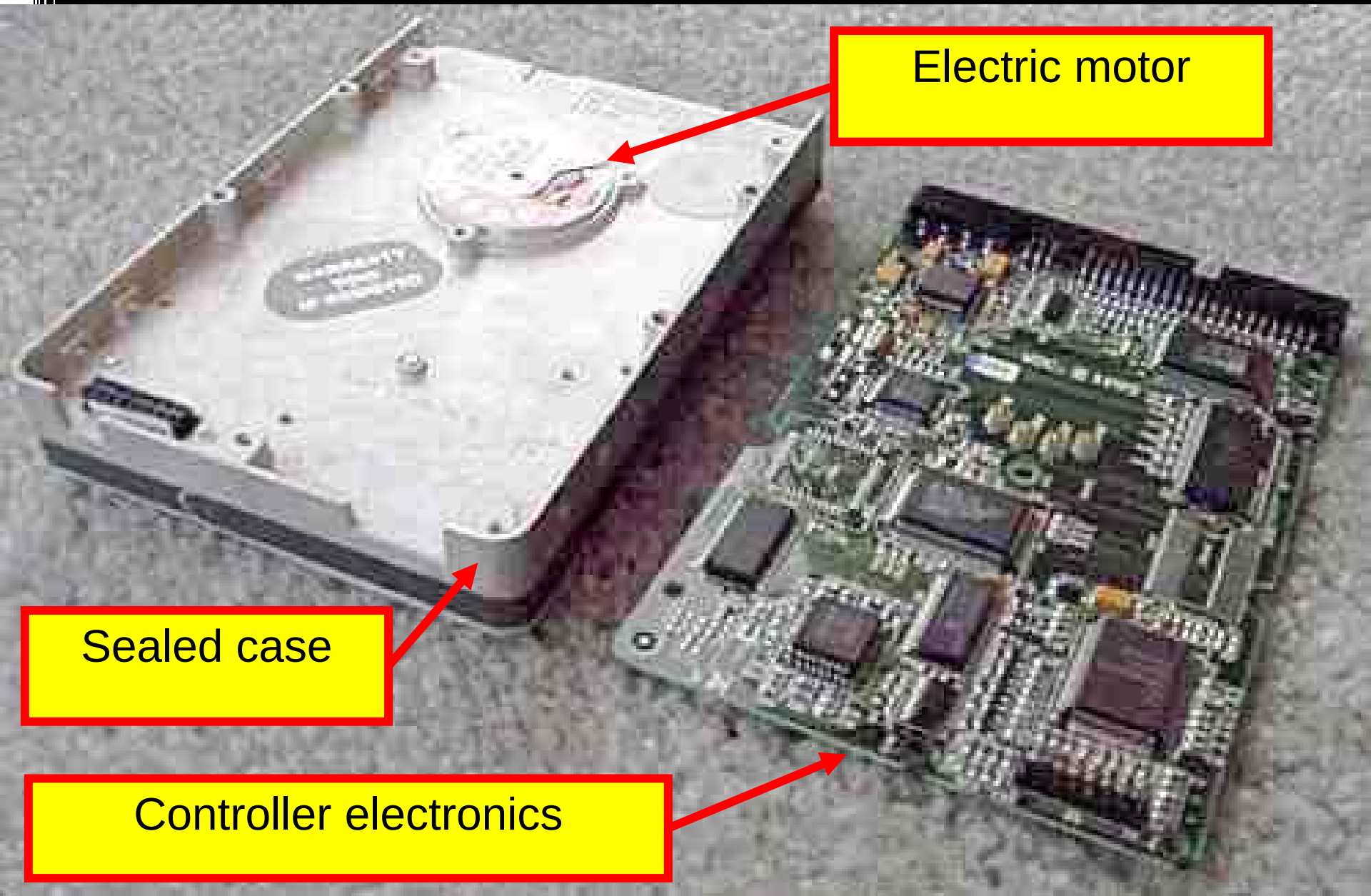
Hard Disk – 4


tracks
read-write heads
move in and out
together
disks
cylinders (all the tracks accessible
from one position of the
read-write heads)

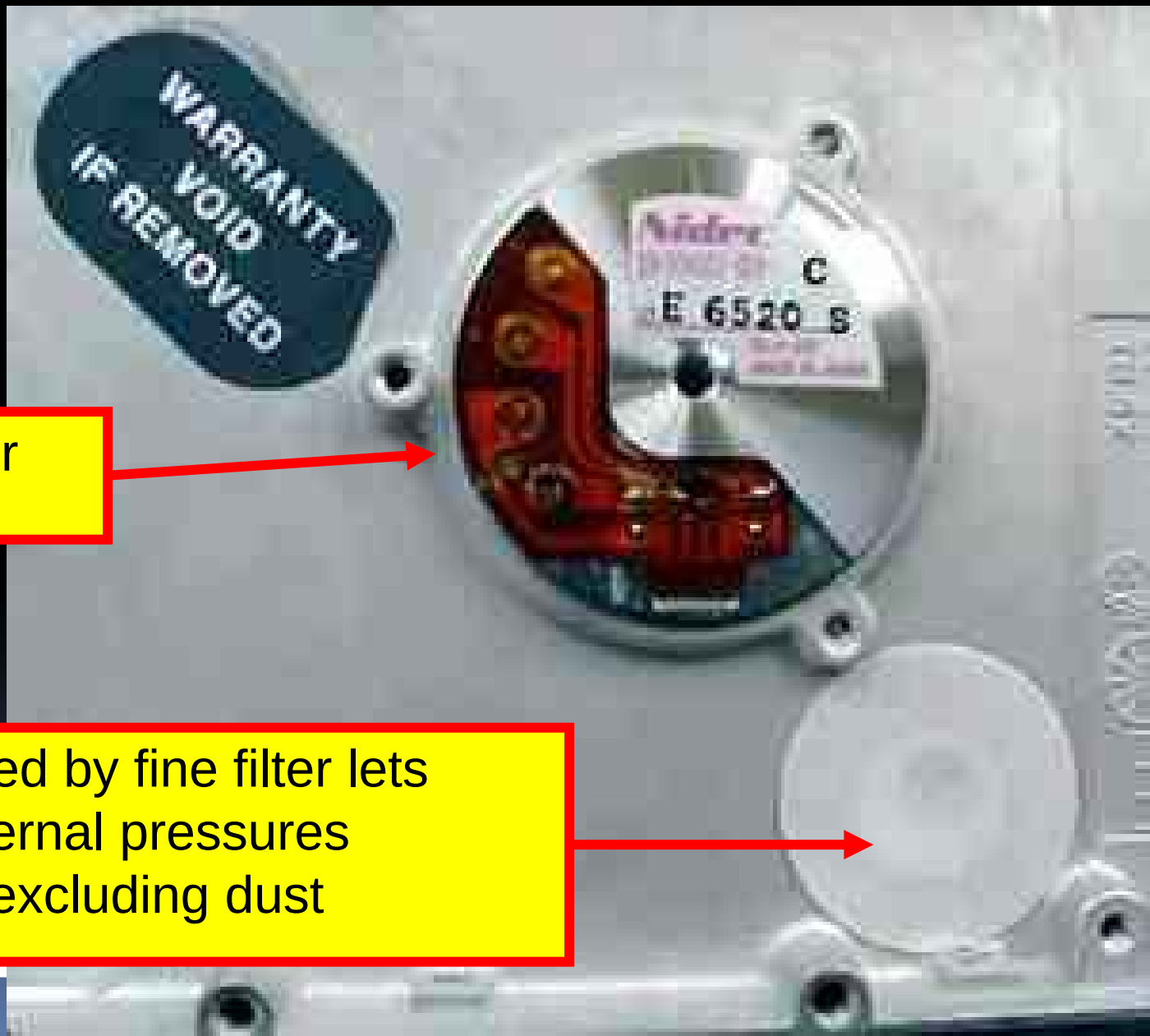
Hard Disk – 5

A typical hard disk drive

Hard Disk – 6



Hard Disk – 7



Electric motor

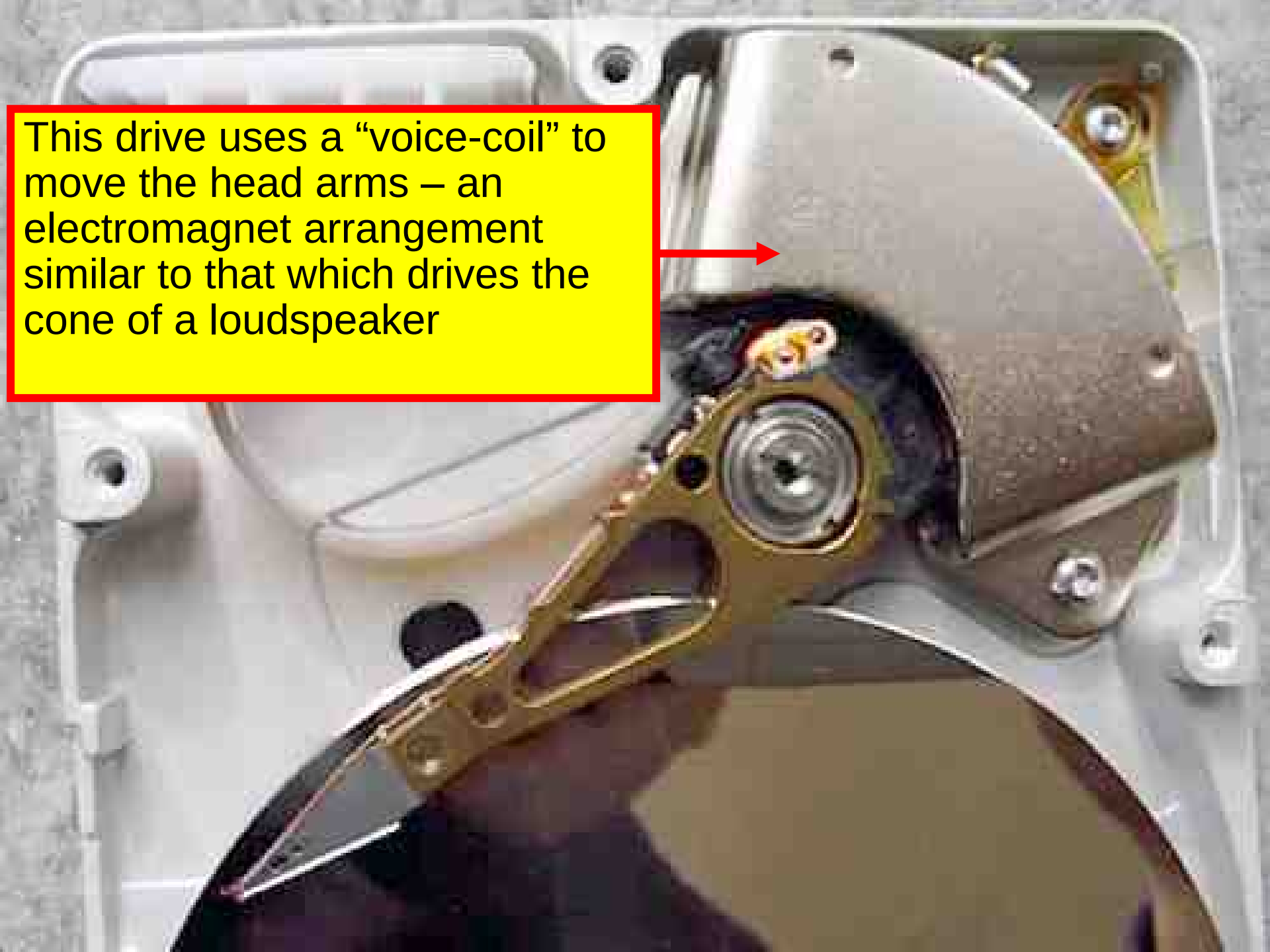
Vent hole covered by fine filter lets internal and external pressures equalise, while excluding dust

Hard Disk – 9

- Three platters
- Six read-write heads

Hard Disk – 10

- The head arms need to be driven in and out to access different cylinders
- In some cases this is done by a high-speed, precision, rotary motor


This drive uses a “voice-coil” to move the head arms – an electromagnet arrangement similar to that which drives the cone of a loudspeaker

Hard Disk – 12

- Because hard disk drives gives rapid read/write access to random sectors, they are used to store a computer's frequently used programs and data.

- New miniature hard disk drives storing up to 4 GB are making it increasingly feasible to embed hard disk drives in MP3 players and mobile phones.

Magnetic Tape

- Data is recorded in 'frames' across the tape with one frame representing one byte
- The frames form tracks along the tape with 9 tracks being common, giving 8 data tracks and one parity track
  - A **parity bit** is a binary digit that is added to tell whether the number of bits with value of one in a given set of bits is either even or odd. Parity bits are used as the simplest error detecting code
- It is a serial medium

Digital Data Storage (DDS) Tape Drive

Uses of Magnetic Tape

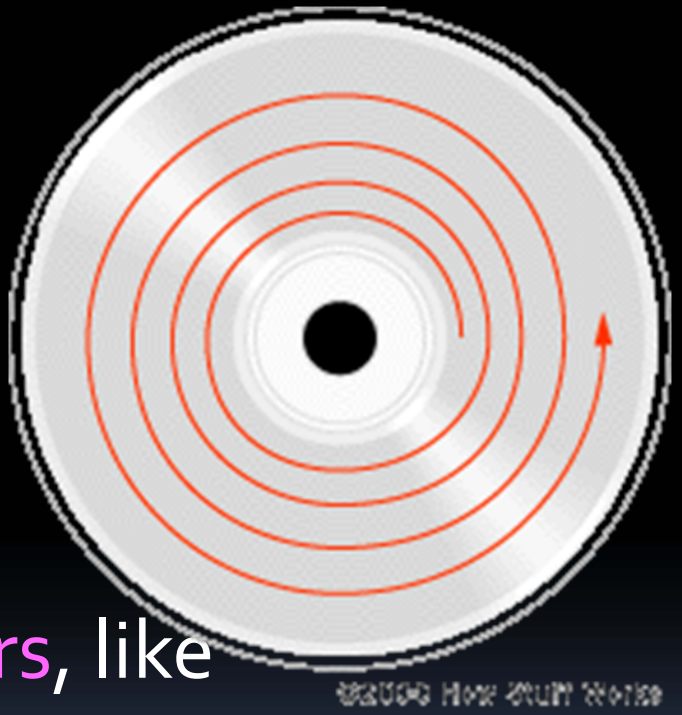
- Cheap and convenient for Backup
- Archiving past transactions or other data
- Cartridge tape drives are common - e.g. tape streamer for backup
- Single 36-track, 12" tape cartridge can store several gigabytes

Secondary storage – Optical

- Random access time is longer than that of a hard disk (in the region of 100 ms)
- Some, but not all, optical storage is writable or re-writable
- Types of optical storage
  - CD-ROM, CD-R, CD-RW
  - DVD-ROM, DVD-R, DVD-RW

CD-ROM – 1

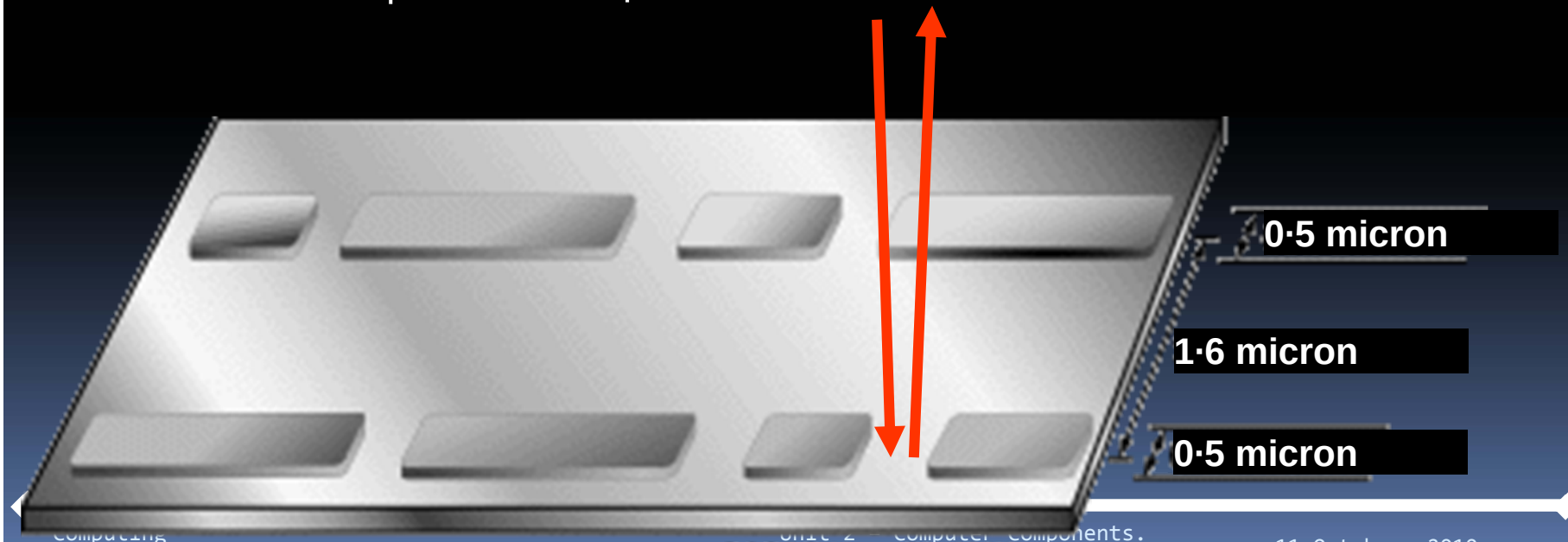
- Read-Only Memory
- In a factory, a powerful laser etches binary digital information on a metal disk by burning microscopic pits in a single outward spiral track to form an original



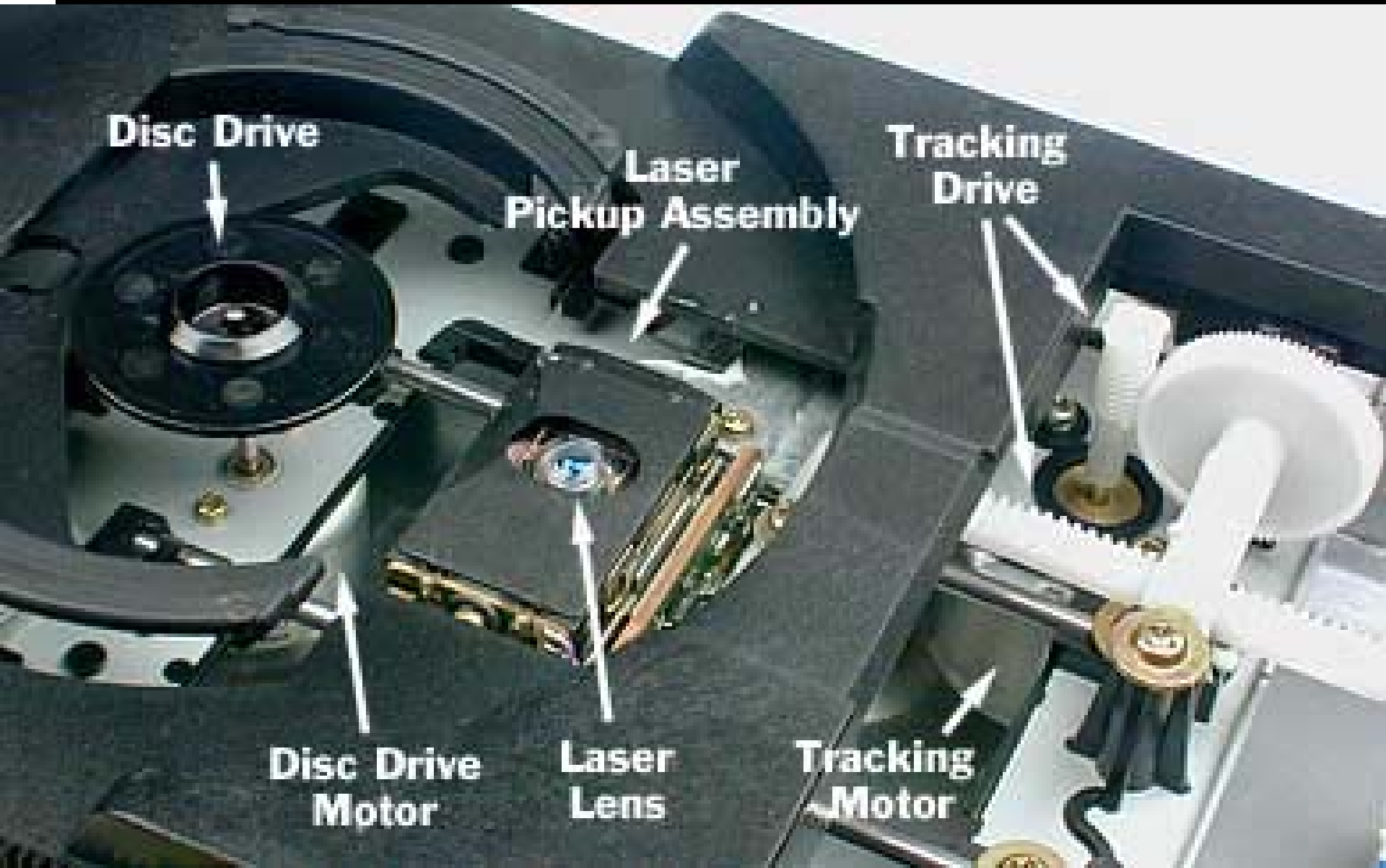
- The track is divided into sectors, like those on magnetic disks.

CD-ROM – 2

- A read-only copy is made from the original by
  - pressing the upper surface of a blank clear plastic disk
  - this side is then coated with aluminium, plastic and a label
- The presence or absence of pits can be read optically by detecting the reflection of a laser beam from the aluminium layer through the *under* side of the disk
  - One micron equals 0.00004 of an inch



Inside a CD drive



CD-ROM – 3

- A single CD-ROM can hold 650 to 700 Mb of data (74 to 80 min of music)
- Used for wide distribution (for immediate use) of:
  - software program and multimedia data files,
  - large amounts of text, graphics, audio or video, such as encyclopaedias, catalogues or technical manuals

CD-R and CD-RW

- Same storage capacity as CD-ROM
- Writing performed by stronger laser beam
- CD-R: record once (cheaper disks)
  – an example of a Write Once Read Many (WORM) disk
- CD-RW: re-writable (more expensive disks)
- Hardware: CD-writer drive find out how much they cost

Uses of CD-R and CD-RW

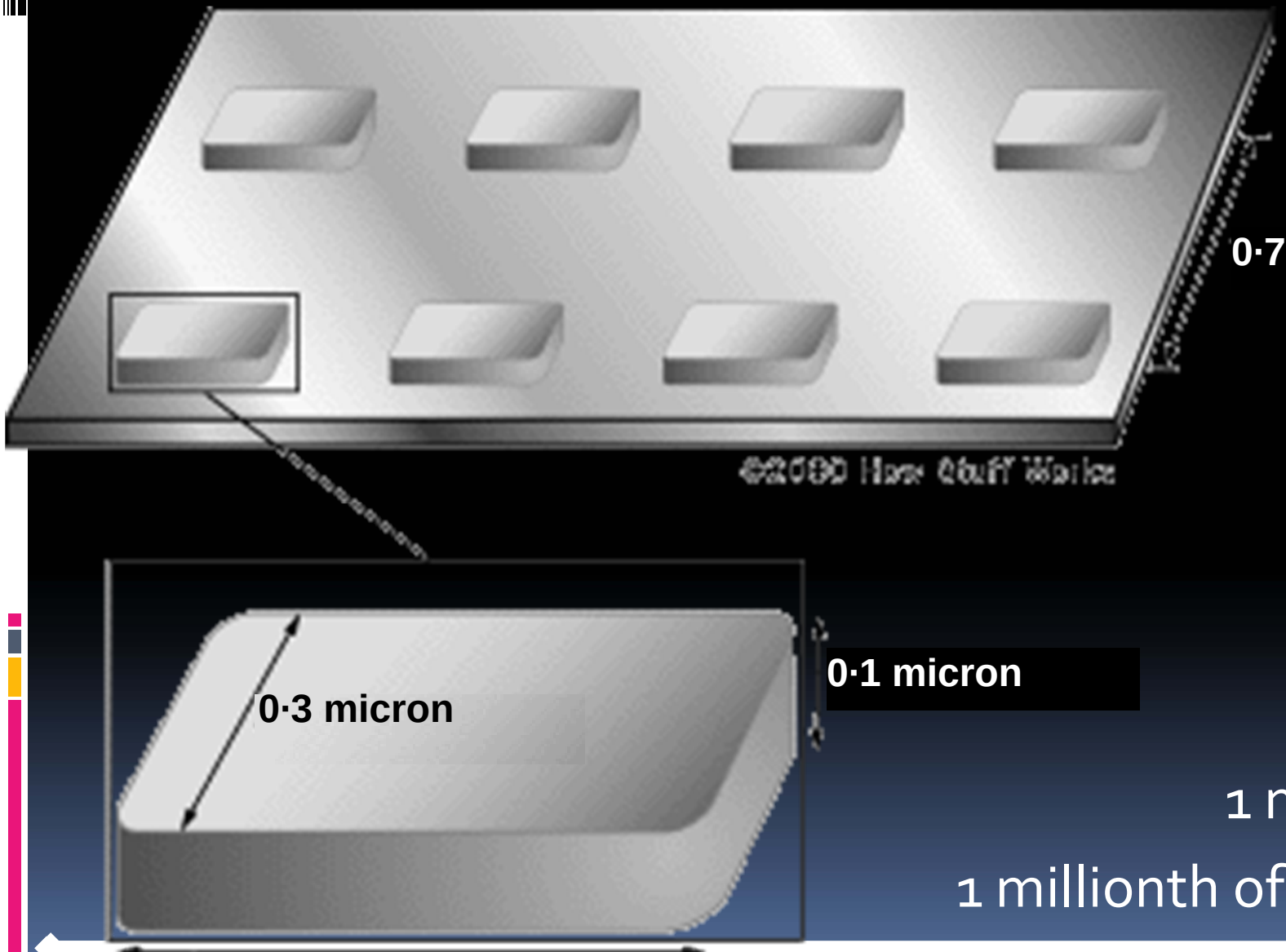
- small scale distribution (for immediate use)
- archiving (keeping files that are unlikely to, or should not, be changed for possible later use)
  - use CD-R to create a Read Only archive
  - use CD-RW to create a Read/Write archive

- Types of file:
  - as for CD-ROM

DVD-ROM – 1

- Digital Versatile Disk Read-Only Memory
  - Used to mean "digital video disk" until non-video applications were stored on it.
- Same size (physical) as CD-ROM and made using similar materials and manufacturing techniques
- Basic format stores about 7 times as much data as a CD-ROM, because the track spacing and "pit" dimensions are smaller

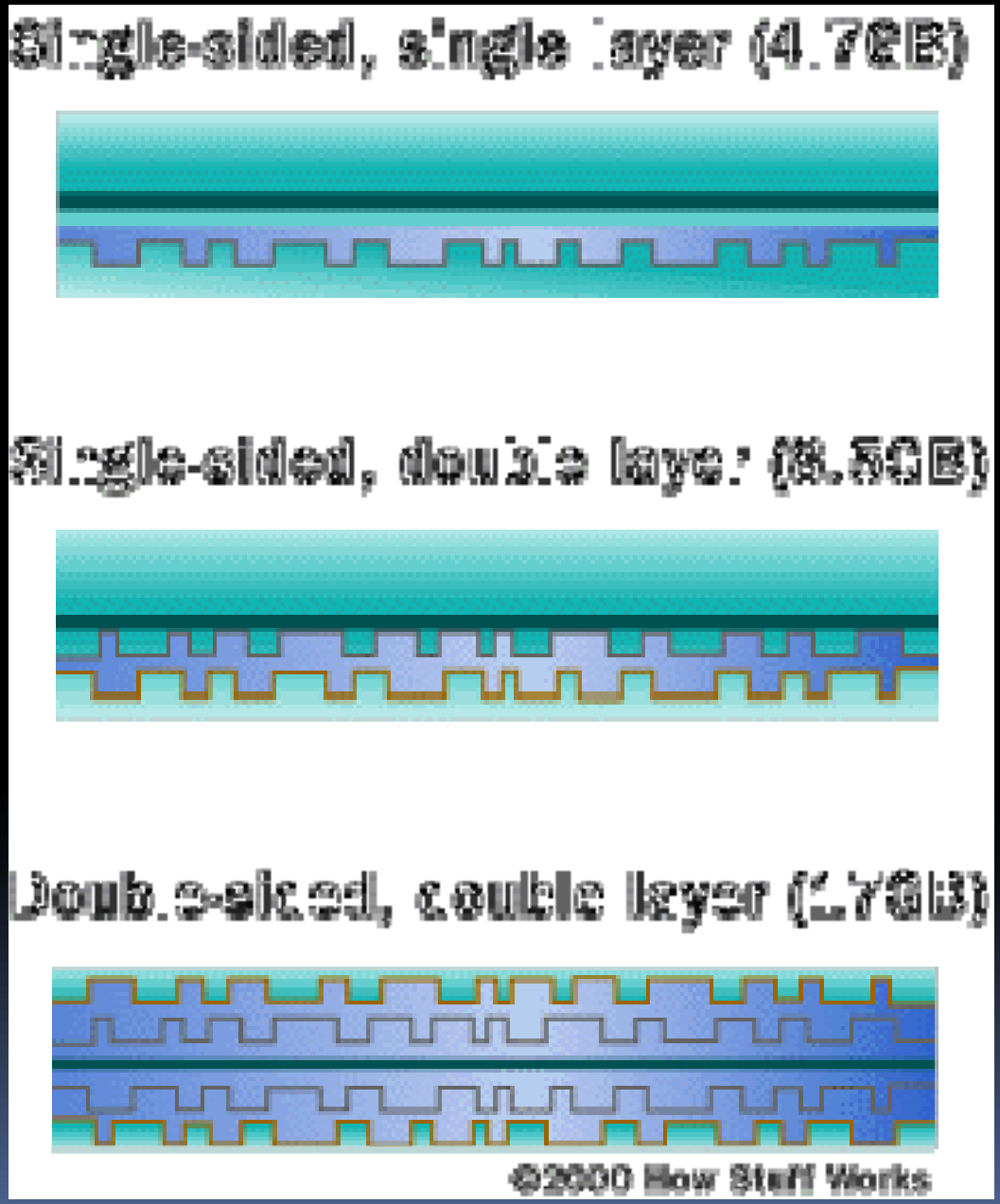
DVD-ROM – 2



1 micron is

1 millionth of a metre

DVD formats

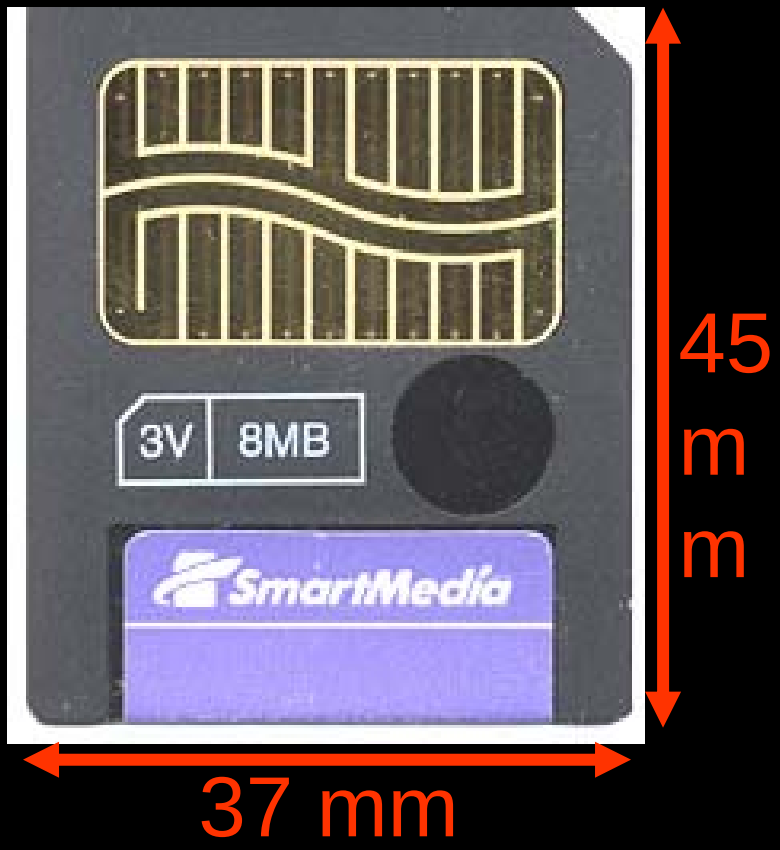

Single-sided, single layer (4.7GB)
Single-sided, double layer (8.5GB)
Double-sided, double layer (17GB)
©2000 How Stuff Works

Flash memory 1

- Flash memory consists of silicon chips that are the non-volatile equivalent of RAM, so
  ..... is not .....
  when the power goes off
- Like RAM, flash memory has a random access time in the region of tens of billionths of a second (nanoseconds)
  - What's random access time?

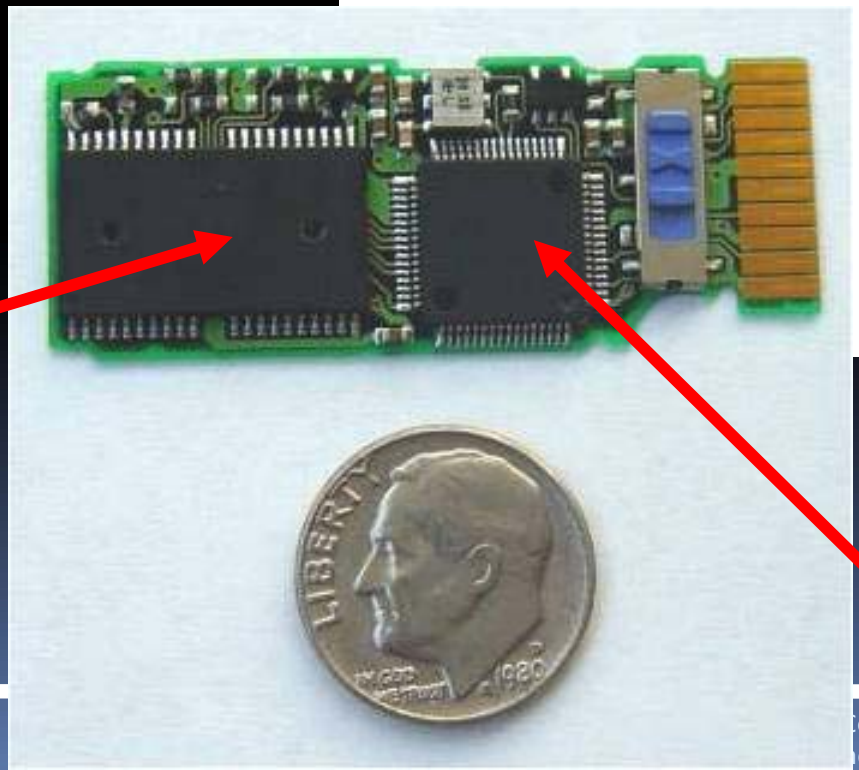
Flash memory 2

Memory cards are used in peripheral devices such as cameras and MP3 players



Flash memory 3

A memory stick behaves like a portable disk drive



Assignment2

- Working in pairs, complete second part of the assignment you started last lesson (same worksheet)