



Chapter 4

Storage



Learning Objectives

- Explain the difference between storage systems and memory.
- Name several general properties of storage systems.
- Identify the two primary types of magnetic disk systems and describe how they work.



Learning Objectives, *cont'd.*

- Discuss the various types of optical disc systems available and how they differ from each other and from magnetic systems.
- List at least three other types of storage systems.
- Summarize the storage alternatives for a PC, including which storage systems should be included in all PCs and when the other systems would be appropriate.



Overview

- This chapter covers:
 - Common characteristics of storage systems
 - Magnetic disk storage
 - Optical disc storage
 - Magnetic tape and other types of storage systems



Properties of Storage Systems: Physical Parts

- Involve two physical parts: a *storage device* and a *storage medium*.
- Can be *internal* (configured into the system unit), or *external* (separate devices).
- Media must often pass by a *read/write head* in the storage device to be read from or written to.



Properties of Storage Systems: Nonvolatility Property

- Storage media are **nonvolatile**:
 - When power to the device is shut off, data stored on the medium remains.
 - This is in contrast to most types of memory, which are **volatile**.



Properties of Storage Systems: Removable vs. Fixed Media

- *Fixed media*: typically faster and less expensive
- *Removable media*: unlimited capacity and can be easily transported and secured



Properties of Storage Systems: Random vs. Sequential Access

- *Sequential access*: records in a file can be retrieved only in the same sequence in which they are physically stored (like tape)
- *Direct access (random access)*: records can be retrieved in any sequence, independent of physical storage (most disks and optical media)



Properties of Storage Systems: Logical vs. Physical Representation

- *Logical file representation* refers to the user's view of the way data is stored.
- *Physical file representation* is the actual physical way the data is stored on the storage media as viewed by the computer.

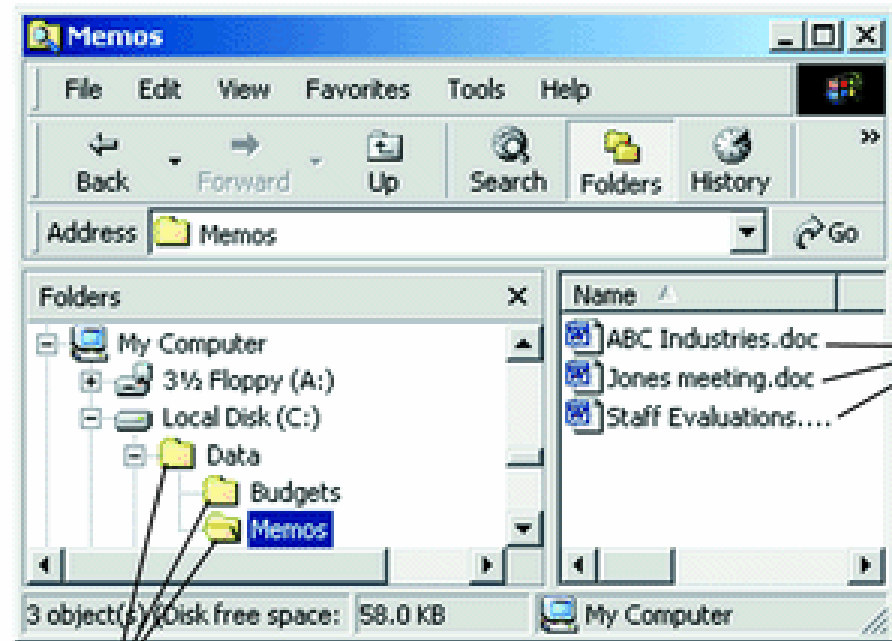
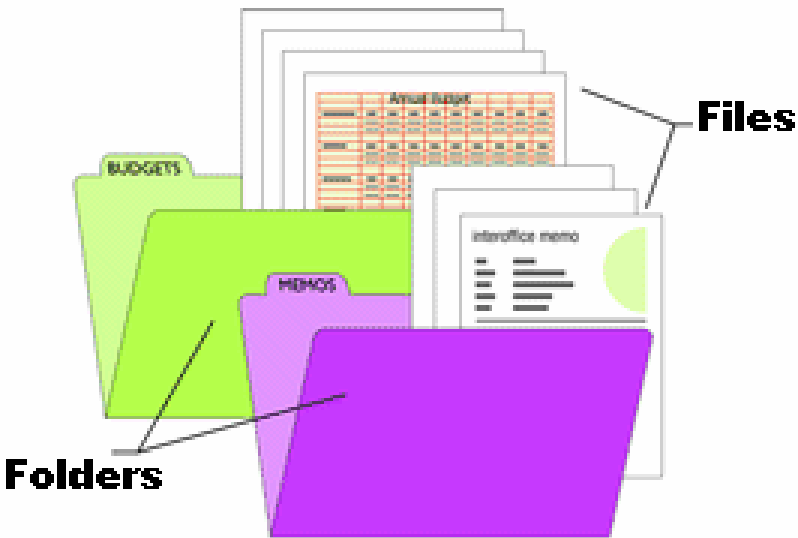


FIGURE 4-2
Organizing data.



Magnetic Disk Systems

- **Magnetic disks** are the most important storage medium in computers today.
- Two popular types:
 - *floppy disks*
 - *hard disks*
- Data is written by magnetizing particles on the disks in a certain way to represent 1s and 0s.

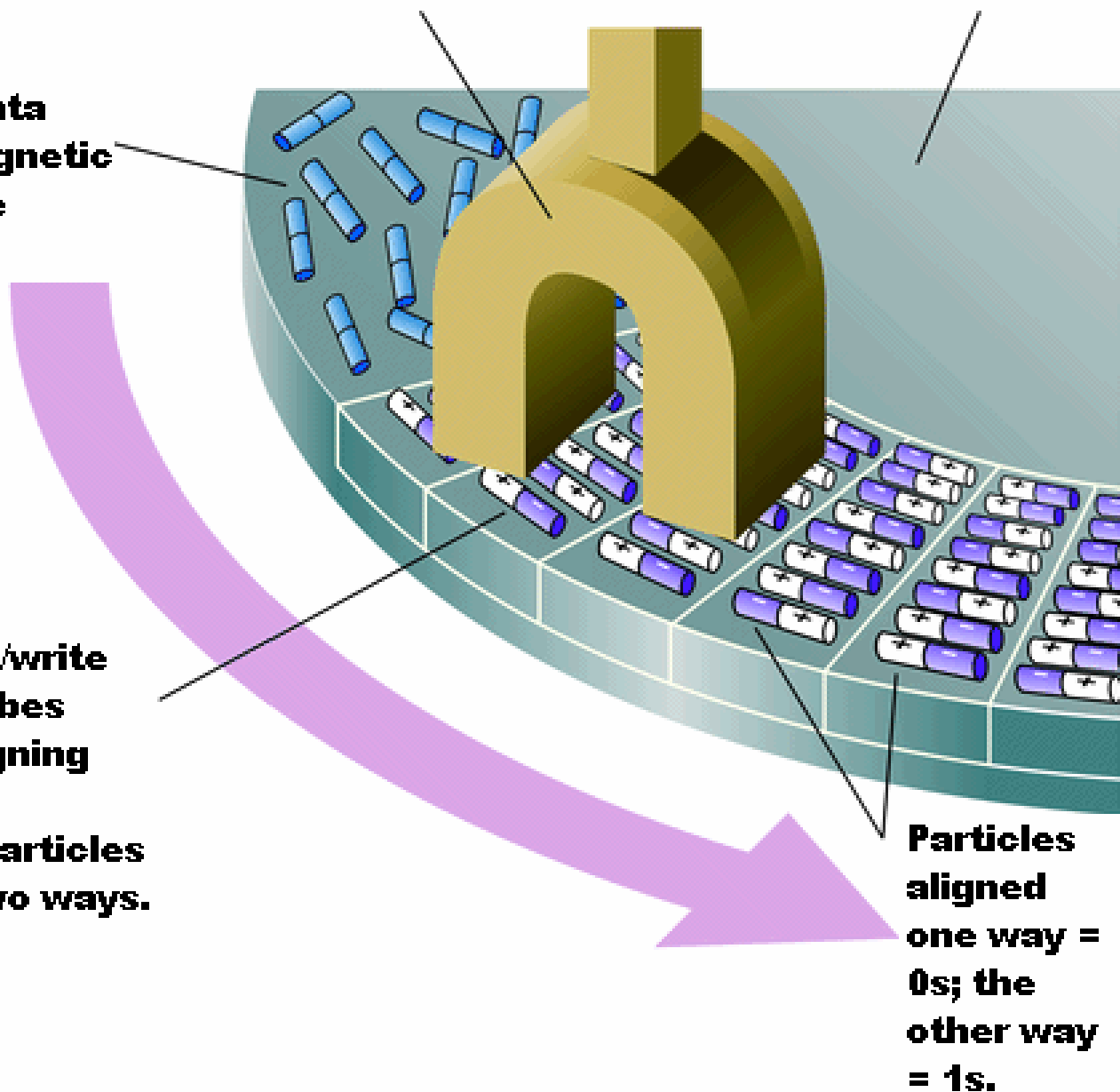
FIGURE 4-3
Storing data on magnetic disks.

1. Prior to data storage, magnetic particles are unaligned.

2. The read/write head inscribes data by aligning each of the magnetic particles in one of two ways.

Read/write head

Disk surface



Particles aligned one way = 0s; the other way = 1s.



Floppy Disks

- Physical properties
 - Most are 3½ inches in diameter and hold 1.44 megabytes.

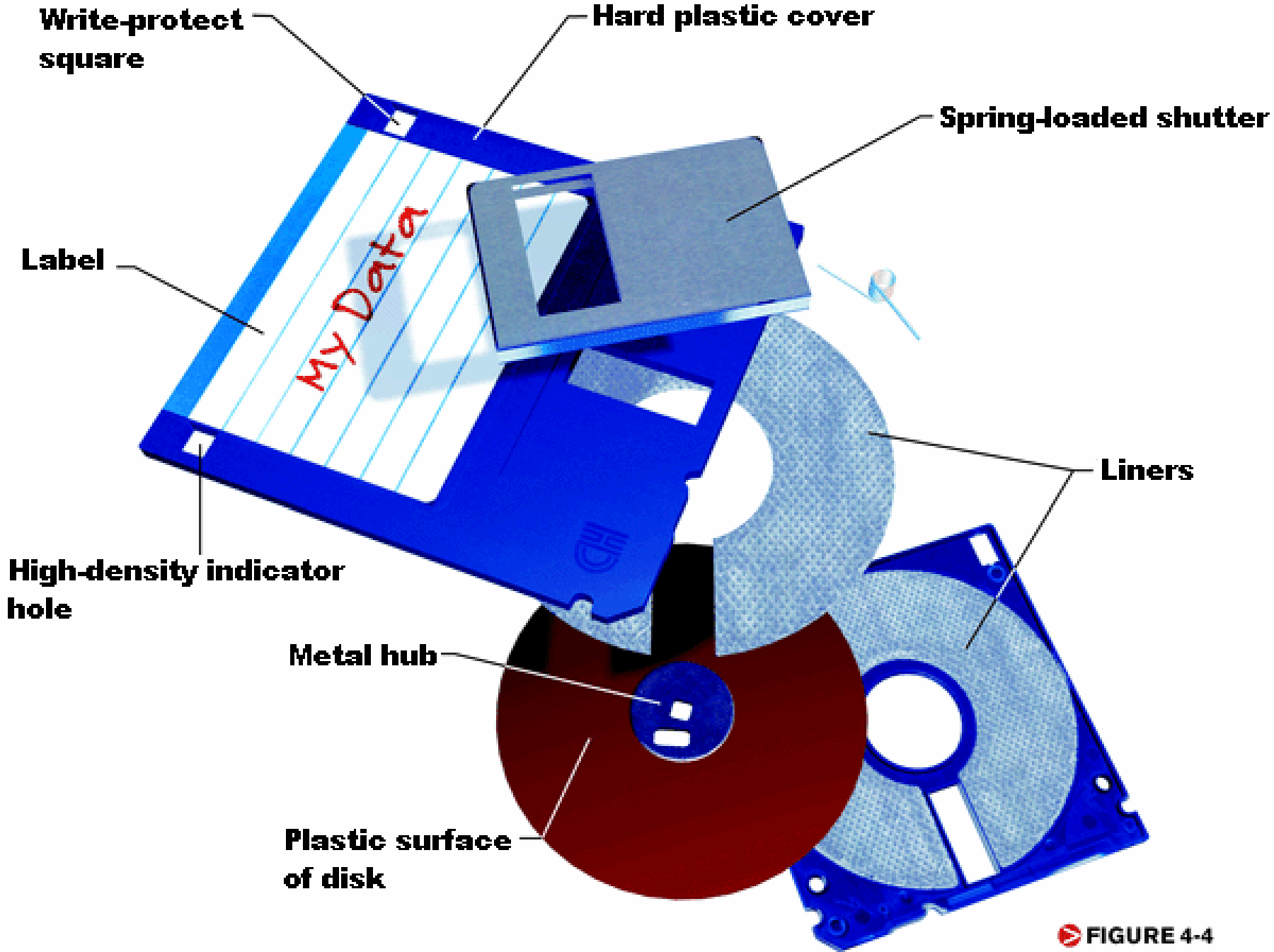
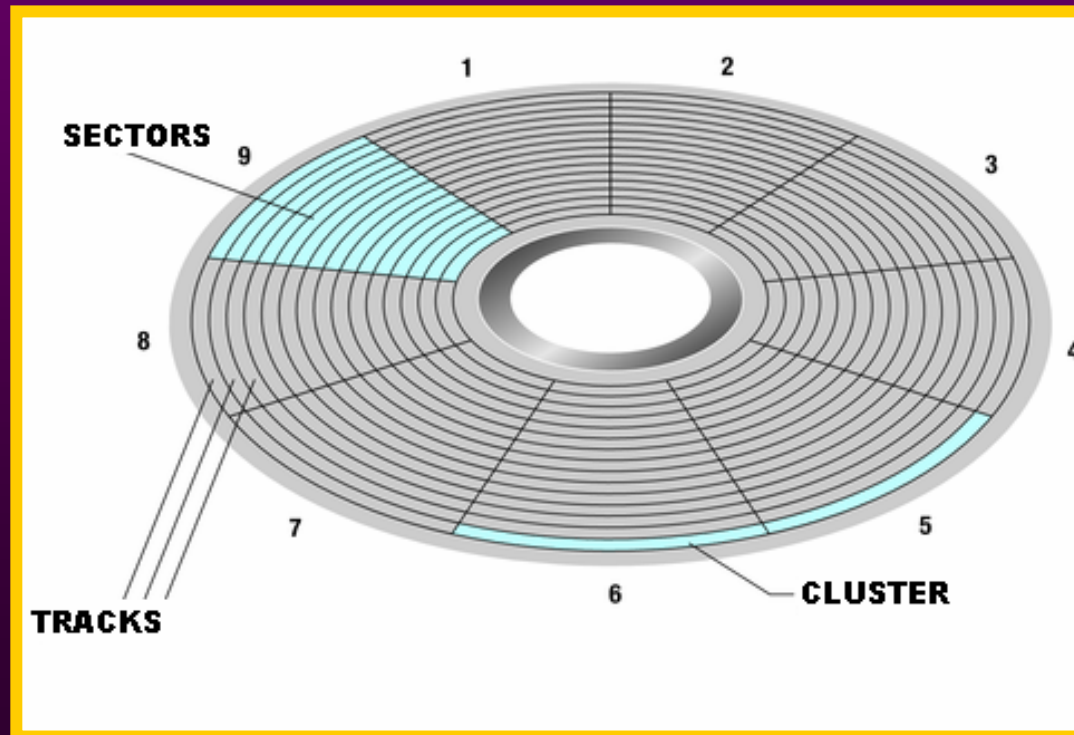


FIGURE 4-4
The anatomy of a floppy disk.

Floppy Disks, *cont'd.*

- Tracks, sectors, and clusters
 - The disk's file directory keeps track of the contents of the disk.





Floppy Disks, *cont'd.*

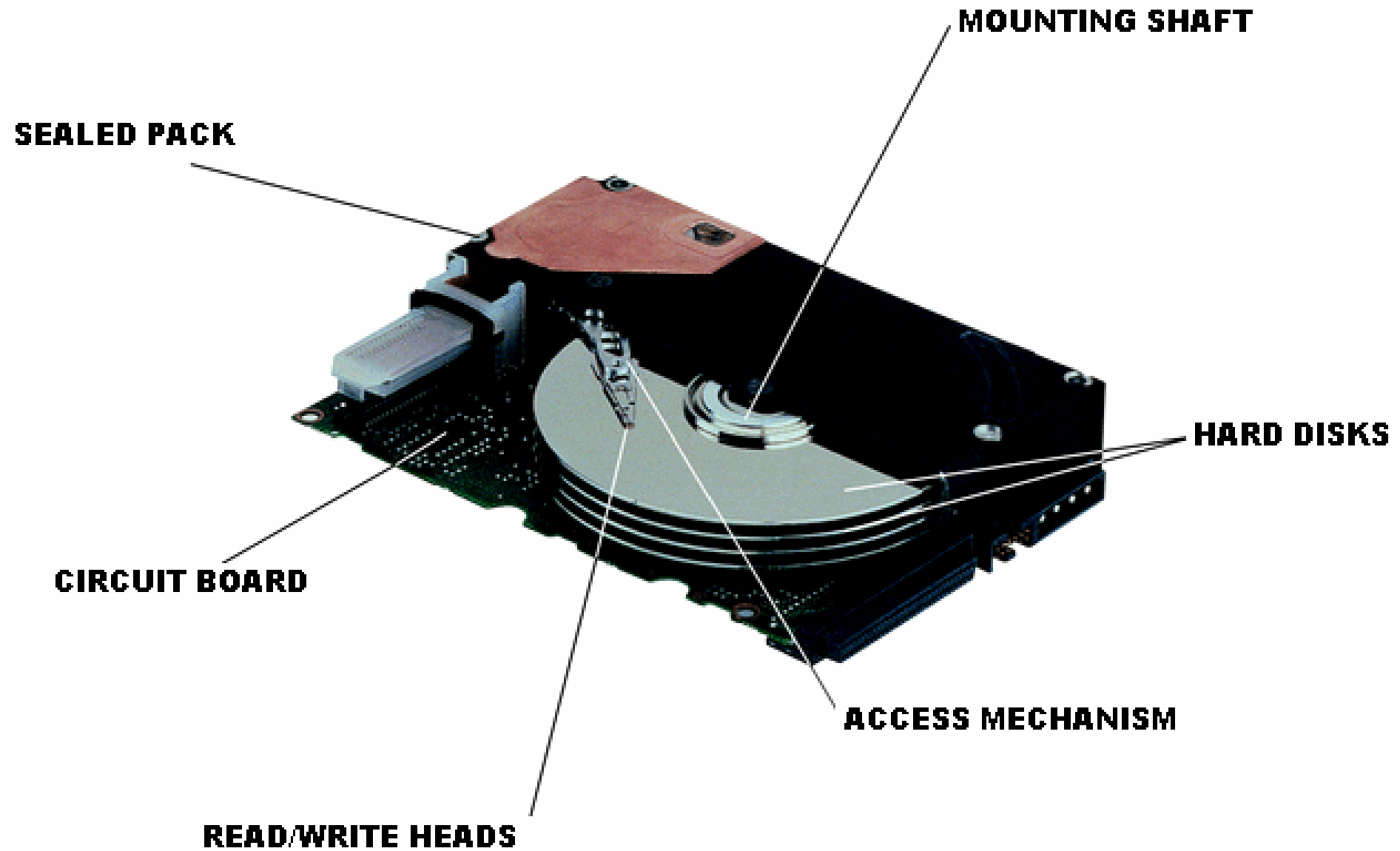
- Using floppy disks
 - Must be inserted into the proper drive in the proper direction
 - Should not be removed when the disk is being accessed
- Superdiskettes
 - Zip drives, SuperDisk drives, HiFD drives



Hard Disks

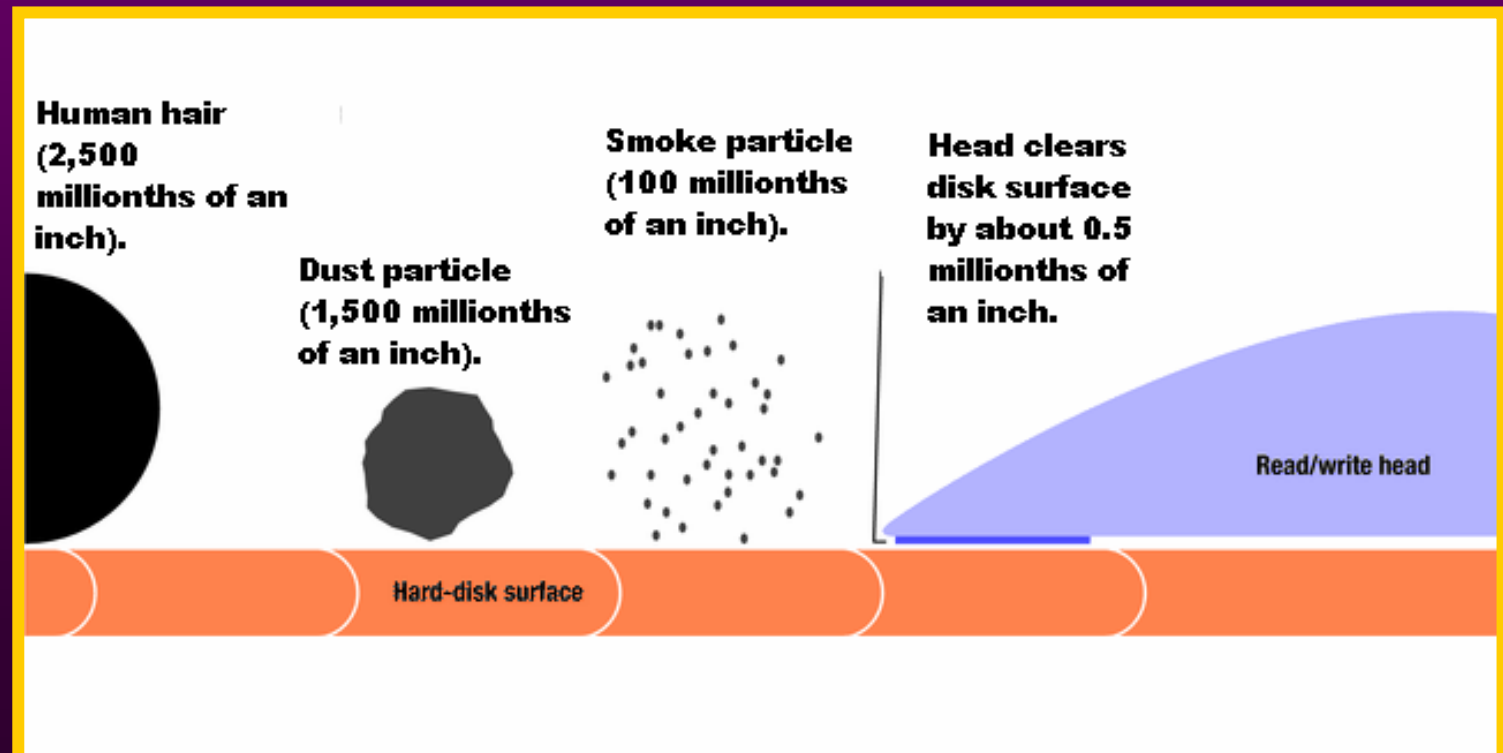
- Physical properties
 - Permanently sealed inside the hard drive—allows faster speeds than removable systems
- Hard disk addressing
 - Disk cylinder—the collection of tracks located in the same location on a set of hard disk surfaces

FIGURE 4-8
A hard disk drive.



Hard Disks, *cont'd.*

- Reading and writing data
 - Obstacles on a hard-disk system can damage the surface and read/write head.





Hard Disks, *cont'd.*

- Disk access time
 - Factors: seek time, rotational delay, data movement time
- Disk cache
 - Strategy for speeding up system performance
- Disk standards
 - ATA/IDE and SCSI, Fibre Channel

Hard Disks, *cont'd.*

- Removable hard disk systems
 - Offer large storage capacities and portability



Hard Disks, *cont'd.*

- Hard disk systems for notebooks
 - Can use either internal or removable hard drives



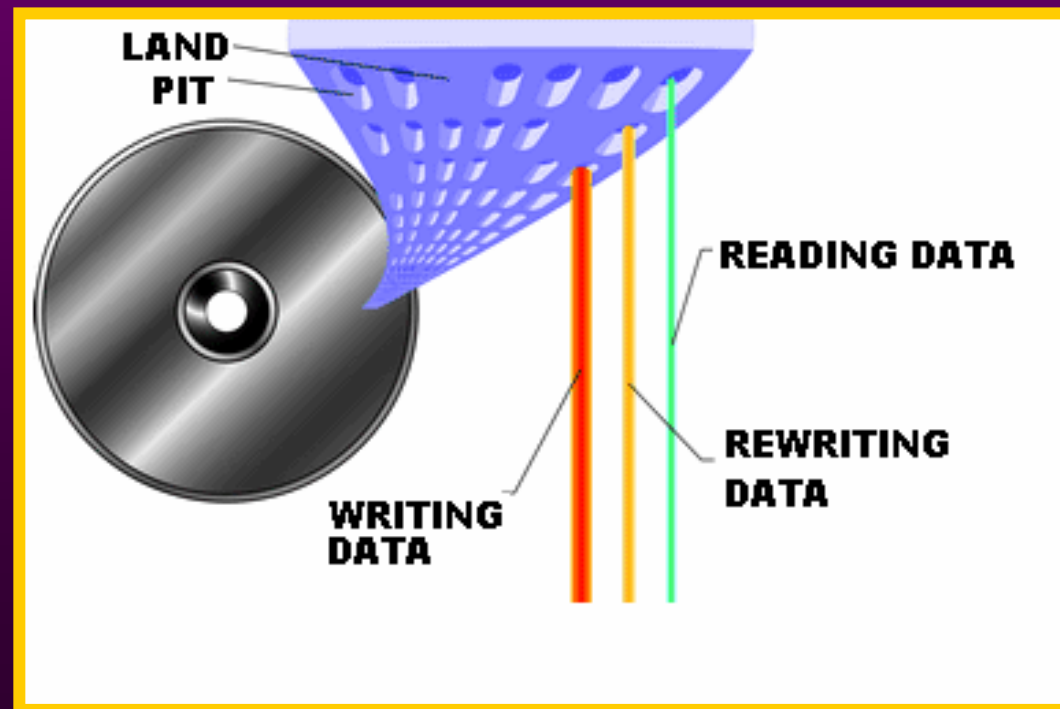
Hard Disks, *cont'd.*

- Hard disk systems for large computer systems
 - May use a system consisting of multiple hard drives; RAID is a recent trend



Optical Discs

- Laser beams write and read data packed at very tight storage densities, several times finer than that of a typical magnetic disk.





CDs

- CDs are permanently etched when data is stored on the disc.
- **Recordable (CD-R)** discs can be written to, but not erased and rewritten.
- **Rewritable (CD-RW) CDs** can be used in the same way as magnetic disks—data can be stored and erased as needed.

DVDs

- DVDs are read-only and may replace VHS as the movie media of choice.
- **Rewritable DVDs (DVD-RAM or DVD+RW)** allow users to record on DVD discs.





Magneto-Optical Discs

- *M-O discs* use a combination of magnetic and optical technologies.
- Can store up to 5.2 GB per disc.



Magnetic Tape Systems

- **Magnetic tape** is used primarily for backup purposes.
- The device that reads tapes is called a *tape drive*.
- Most tape media are in the form of *cartridge tapes*, though *detachable-reel tapes* exist as well.



Online Storage

- Online storage is usually storage on a server accessible over the Internet or another network.
- Online storage can be used as a primary storage medium or for backup or distribution purposes.

FIGURE 4-19
Online storage.

SIGN UP AND LOGIN

The screenshot shows the Xdrive website's sign-up and login interface. On the left, there is a 'registered user login' section with fields for 'user name' and 'password', and a 'Log in' button. Below it is a 'Your FREE Internet Hard Drive (get up to 100MB)' section with a 'Sign Up' button. The main content area is titled 'YOUR INTERNET HARD DRIVE' and features a quote from PC World: "... Xdrive is a superb tool for file transfer and a useful tool for storing backups of essential files." - April 18, 2000. It lists several benefits: Secure (virus-protected servers), Share (access for friends), Store (up to 100MB of files), Access (anytime, anywhere), Desktop (download Xdrive Express Desktop), and Wireless (access via Palm VXi or WAP phone). The page also includes a 'Mobile Access' section and a 'Partners' list with logos for Veritas, Symantec, and CriSign.

ACCESSING FILES

The screenshot shows the Xdrive file explorer interface. At the top, there are navigation tabs: Home, Special Offers, Downloads, Free After Rebate!, and Win \$50,000!. Below the tabs is a toolbar with icons for Upload, Download, New Folder, Move, Rename, View, Delete, and Share. The main content area displays 'Deborah Morley's Xdrive' with '50.00 MB Capacity, 49.93 MB Remaining'. A table lists files and folders:

	Size	Last Modified
[-] /xdrive		
[-] private		02-17-2001 10:56 AM
[-] Neck.jpg	9k	02-17-2001 12:13 PM
[-] Anne.jpg	9k	02-17-2001 12:13 PM
[-] public		02-17-2001 10:56 AM
[-] Spring 2001 schedule.doc	21k	02-17-2001 10:58 AM
[-] Computer standards - draft.doc	22k	02-17-2001 10:58 AM
[-] Backup		02-17-2001 12:15 PM

At the bottom, there is a progress bar showing 'EMPTY' and 'FULL 0%'.



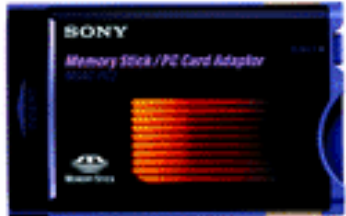
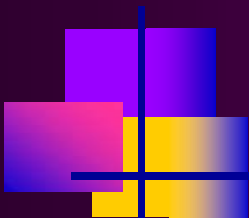
Smart Cards

- **Smart card:** credit-card-sized piece of plastic that contains some type of computer circuitry.
 - Holds less than a few megabytes
 - Commonly used to store prepaid amounts of digital cash, or personal information
- *Smart card readers* are attached to a PC or built into a cell phone, keyboard, or other device.



Flash Memory Devices

- Flash memory sticks
 - Size of a stick of gum; hold from 4 to 512 MB each
- Flash memory cards
 - Standards include CompactFlash, SmartMedia, Secure Digital (SD), and MultiMedia Card (MMC)
- Flash memory drives
 - Have no moving parts—are more shock-proof and portable than conventional drives



FLASH MEMORY STICKS

FLASH MEMORY CARDS



FLASH MEMORY DRIVES





Comparing Storage Alternatives

Speed, expense, portability, and compatibility

- Most PC users require
 - Hard drive
 - CD or DVD drive
 - Floppy drive