Chapter 2

Working Inside a Computer

Reviewing the Basics

1. When taking a computer apart, why is it important to not stack boards on top of each other?

You could accidentally dislodge a chip.

2. Why is it important to remove loose jewelry before working inside a computer case?

Because the jewelry might get caught in cables and components as you work.

3. When assembling a system, which do you install first, the drives or the motherboard?

Drives

4. What is the purpose of raised screw holes or standoffs installed between the motherboard and case?

To prevent a short that might happen if lines on the bottom of the motherboard touch the case when the system is running.

5. When installing the front panel wires to the motherboard front panel header, how do you know which pins to use for each wire if the pins on the header are not labeled?

You can find this information in the motherboard user guide.

6. What are the two major components of a processor cooler assembly?

Heat sink and fan

7. How many pins does the CPU fan header on a motherboard have?

4 pins

8. If the power connector from the CPU fan has only three pins, it can still connect to the 4-pin header, but what functionality is lost?

Adjustable speed control of the fan to lessen the noise in the system

9. How do you determine the wattage capacity needed by a power supply?

Add up all wattage requirements for all devices that will use the power supply and then add an additional 30%

10. Which one component in a high-end gaming computer is likely to draw the most power?

The video card

Thinking Critically

1. You disassemble and reassemble a computer. When you first turn it on, you see no lights and hear no sounds. Nothing appears on the monitor screen. What is the most likely cause of the problem? Explain your answer.

a. A memory module is not seated properly in a memory slot.

b. You forgot to plug up the monitor external power cord.

c. A wire in the case is obstructing a fan.

d. Power cords to the motherboard are not connected.

Answer: d. Power cords to the motherboard are not connected. All the other answers would still cause the system to start the boot even though it might fail. If the motherboard is not getting power, it will not start the boot.

2. How much power is consumed by a load drawing 5 A with 120 V across it?

600 watts

3. What is a reasonable wattage capacity for a power supply to be used with a system that contains a DVD drive, three hard drives, and a high-end video card?

a. 250 watts

b. 1000 watts

c. 700 watts

d. 150 watts

Answer: c. 700 watts

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At a Glance

Instructor's Manual Table of Contents

Lecture Notes

Overview

In this chapter, students will learn how to work inside of a computer case, and how different components are removed or replaced in a case. Cooling methods for computer cases are discussed. Lastly, students will be introduced to factors that influence power supply usage.

Chapter Objectives

After reading this chapter and completing the exercises, the student will learn:

- How to take a computer apart and put it back together
- About the methods and devices for keeping a system cool
- How to select a power supply to meet the power needs of a system

Teaching Tips

How to Work Inside a Computer Case

Step 1: Plan and Organize your Work

1. Discuss basic tips and best practices in planning and ensuring that work inside a case is performed safely.

Step 2: Open the Computer Case and Examine the System

1. Stress the importance of performing backups of critical data on a system prior to working on its components.
2. Give students information on how to properly prepare a computer for maintenance, and provide information on how cases are typically opened.
3. Provide instruction on additional pieces of the case that may need to be removed in order to gain access to internal components.
4. Note that students can clip a ground bracelet onto the side of a metal case to ensure safe handling of components.

Teaching Tip	In really complex systems, taking a picture of the internal parts prior to working inside a case can be helpful in troubleshooting connections later. Smartphone cameras allow for a bit more maneuverability inside of a computer case for this purpose.

Step 3: Remove Expansion Cards

1. Discuss techniques for keeping track of cable connections and placement of parts within a computer case, such as using diagrams.
2. Cover steps required to remove expansion cards from a computer, such as removing screws that hold the card in place.

Step 4: Remove the Motherboard, Power Supply, and Drives

1. List the steps required to remove a hard drive from a case, mainly the removal of power cables and data cables.
2. Detail how to remove a motherboard from a case, and note what cables must be removed, such as the front panel connectors. Explain the role of spacers or standoffs in keeping the motherboard from contacting the metal case and shorting circuits.
3. Show how to remove the power supply from a case, noting where screws that hold the power supply in place are typically located.
4. Demonstrate how to remove drives from the case, and show the removal of screws that keep drives in place.

Steps to put a Computer Back Together

1. Explain the optimal order in which components should be installed into the case, starting with power supply, drives, motherboard, and cards. Note that this order may differ depending on the case involved.
2. Show how a motherboard should line up with the IO shield on the back of the case.
3. Discuss what power cables should be connected to the motherboard. Students should be aware that motherboards with a 20+4 pin connector will need the auxiliary connector for proper functioning.
4. Elaborate on what additional power requirements a motherboard might have, such as on-board 6-pin or 8-pin PCIe power connectors, or Molex and SATA power connectors.
5. The front panel connectors and their respective contact points on the motherboard can usually be identified by markings around the pins on the motherboard. List some of the common connectors:
    a. Power SW
    b. HDD LED
    c. Power LED+
    d. Power LED-
    e. Reset SW
6. Motherboard documentation should be discussed as a way of identifying pins and ports on the motherboard.
7. Explain how to connect ports that exist on the front of the PC (such as USB or sound) to the motherboard.
8. Discuss the installation of a video card or other expansion cards, and demonstrate how to ensure that a card is seated correctly.

9. List other devices that need to be connected to a computer, such as the monitor, keyboard, and mouse. Show where these devices plug in.
10. Cover some additional troubleshooting steps to take in the event the computer does not power on or work properly.

Quick Quiz 1

1. The power button on a case is connected to the motherboard via _____.
   Answer: front panel connectors

2. True or False: An anti-static wrist strap can be clipped to the metal portion of a computer case to discharge static.
   Answer: True

3. Which of the following is used to keep the motherboard from contacting the case, preventing a short?
   A. Standoffs
   B. Headers
   C. Retention screws
   D. Case screws
   Answer: A

4. Some motherboards require an extra power connector for PCIe devices. How many pins is this connector?
   A. 4 or 8 pins
   B. 6 or 12 pins
   C. 6 or 8 pins
   D. 4 or 12 pins
   Answer: C

5. Which of the following is not a typical header for the front panel connectors?
   A. Power SW
   B. Power LED-
   C. Reset SW
   D. Power SW-
   Answer: D

Cooling Methods and Devices

Processor Coolers, Fans, and Heat Sinks

1. Provide information on the role of a cooler, which consists of a fan and a heat sink, and explain that coolers are typically made of aluminum and/or copper.
2. Show students how to apply thermal compound to a processor, and explain how this helps to conduct heat away from the processor onto the cooler heat sink.

3. Note that a cooler's fan has a separate 4-pin connector that connects to the motherboard for power. Students should understand that the proper motherboard header should be used, so that the system can properly control the fan speed.

Case Fans and Other Fans and Heat Sinks

1. Explain that larger fans are often preferable to small fans, in that they produce less noise and greater airflow.
2. Students should be aware of devices that produce the majority of heat in a computer, such as the processor and video card. Discuss options for lessening the impact of heat from these devices.
3. List options for cooling other devices in the computer, such as RAM coolers and expansion slot fans. Hard drive coolers exist as well.

Teaching Tip	Processors often come packaged with approved coolers, but these coolers are not always the best option. Aftermarket coolers and heat sinks can sometimes provide better cooling capabilities than stock coolers.

Liquid Cooling Systems

1. Discuss how a liquid cooling system functions similar to a radiator in a car by circulating liquid and cooling it with fans.
2. Emphasize that while this solution produces less noise than system fans, it is also potentially more risky due to the chance of leaks.

Dealing with Dust

1. Describe the problems caused by a dusty computer, and point out that dust can clog fans and keep them from running properly, causing a computer to overheat.
2. Explain that many motherboards are capable of reporting their temperatures to software for monitoring purposes.

Teaching Tip	Older case fans may start to rattle or create loud buzzing noises. Fortunately, most of these fans can be oiled. See the following link for instructions: http://www.ehow.com/how_7602130_stop-noise-dc-fan-motor.html

Selecting a Power Supply

1. Discuss what options exist for purchasing a power supply, noting that new cases often come with power supplies.

Types and Characteristics of Power Supplies

1. List some of the factors that should be considered when buying a power supply, such as:
    a. Form factor
    b. Wattage ratings
    c. Number and type of connectors
    d. Fans inside the PSU
    e. Extra features (warranty / quality)

How to Calculate Wattage Capacity

1. Explain that video cards draw the most power from a power supply, and that gaming video cards rely on the +12V output of a power supply.
2. Emphasize that a power supply should be rated as much as 30 percent higher than anticipated power usage in order to ensure reliability.
3. Discuss some typical power usage ratings for different computer components, such as hard drives, processors, and graphics cards.

Teaching Tip	Power supply wattage calculators exist online, and can be very helpful in determining potential power use: http://images10.newegg.com/BizIntell/tool/psucalc/index.html

Quick Quiz 2

1. The _____ uses fins to conduct heat away from a processor, and is typically made of copper or aluminum, or both.
   Answer: heat sink

2. True or False: A liquid cooling system can only be used with a processor, it cannot provide cooling for a video card or other components.
   Answer: False

3. High end gaming video cards are particularly reliant on the _____ V rail of a power supply.
   Answer: +12

4. Which of the computer components below will most likely draw more power than the others?
    A. High-end graphics card
    B. SATA drive
    C. PATA drive
    D. High-end processor

Answer: D

5. In order to ensure a power supply is capable of meeting system requirements, how much should a power supply be rated over expected capacity?
   A. 10%
   B. 20%
   C. 30%
   D. 50%

   Answer: C

Class Discussion Topics

1. Liquid cooling systems are typically used by performance enthusiasts and gamers. Have students research the cost of installing a liquid cooling system in a computer (including using a liquid cooling compatible case), and compare costs to a case with traditional cooling methods.

2. Power supplies often come with certifications that indicate features such as power efficiency or ability to run multiple graphics cards. However, instruct students to research individual power supplies and ensure that a certification is valid. For example, some power supplies have been rated at efficiency levels for which they have not been certified.

Additional Projects

1. Provide more information on some of the benefits of a liquid cooled system, and what equipment is typically involved in such a system. For example, since less airflow in and out of the case is needed, the amount of dust pulled into a liquid cooled computer case should also be reduced. Research other methods of liquid cooling, such as submerged oil cooling.

2. Give students information on the different sizes of case fans available, and note how to tell which fans would be more efficient at cooling a case while also producing less noise. Some fans can produce massive amounts of airflow, but can also be as loud as 50 dBA.

Additional Resources

1. 80 Plus power efficiency information: http://en.wikipedia.org/wiki/80_PLUS

2. Example of mineral oil cooled PC

http://www.pugetsystems.com/submerged.php

Key Terms

- **case fan** A fan inside a computer case used to draw air out of or into the case.
- **cooler** A cooling system that sits on top of a processor and consists of a fan and a heat sink.
- **front panel connectors** A group of wires running from the front of the computer case to the motherboard.
- **front panel header** A group of pins on a motherboard that connect to wires that are connected to the front panel of the computer case.
- **overclocking** Running a processor at a higher frequency than is recommended by the manufacturer, which can result in an unstable system, but is a popular thing to do when a computer is used for gaming.
- **spacers** *See* standoffs.
- **standoffs** Round plastic or metal pegs that separate the motherboard from the case, so that components on the back of the motherboard do not touch the case.
- **thermal compound** A creamlike substance that is placed between the bottom of the cooler heat sink and the top of the processor to eliminate air pockets and to help to draw heat off the processor.