Module 1—An Introduction to the Brain and Nervous System

Overview

Summary

This introductory module of the *Brain Power! Challenge* Program is designed to help students learn about the parts of the brain, the functions of these parts, and how the brain communicates with the rest of the body. The process of neurotransmission is described in detail. This module provides a key foundation for the next five modules, which will discuss the impact of specific drugs on the body and the brain.

Students will refer to the information covered in this introductory module throughout the entire *Brain Power!* curriculum. If the students did not participate in the *Brain Power! The NIDA Junior Scientists Program* for grades K–5, the information in this module may need to be covered in greater depth.

Learning Objectives

At the end of this module:

- Students can name the main parts of the brain: the cerebral cortex, hypothalamus, cerebellum, brain stem, and limbic system.
- Students can identify the lobes of the cerebral cortex: frontal, parietal, occipital, and temporal.
- Students can explain the functions of the major brain parts.
- Students can identify the components of a neuron: cell body, dendrites, and axon.
- Students can explain the process of neurotransmission.

Background

MAJOR PARTS OF THE BRAIN

Cerebral Cortex

The cerebral cortex is the largest part of the human brain, making up more than 75 percent of this organ. The cerebral cortex is also the most highly developed part of the brain. It controls thinking, perception, and understanding language.

The cerebral cortex is divided into two hemispheres–the right hemisphere and the left hemisphere.

- The right hemisphere controls the left side of the body and is largely responsible for artistic expression and for understanding relationships in space–tasks such as reading a map.

- The left hemisphere controls the right side of the body. It is largely responsible for mathematical ability, problem solving, and comparing information needed to make decisions. It is also the brain's language center.

The two hemispheres communicate with one another through a bundle of fibers called the corpus callosum. The corpus callosum is the bridge between the two hemispheres.

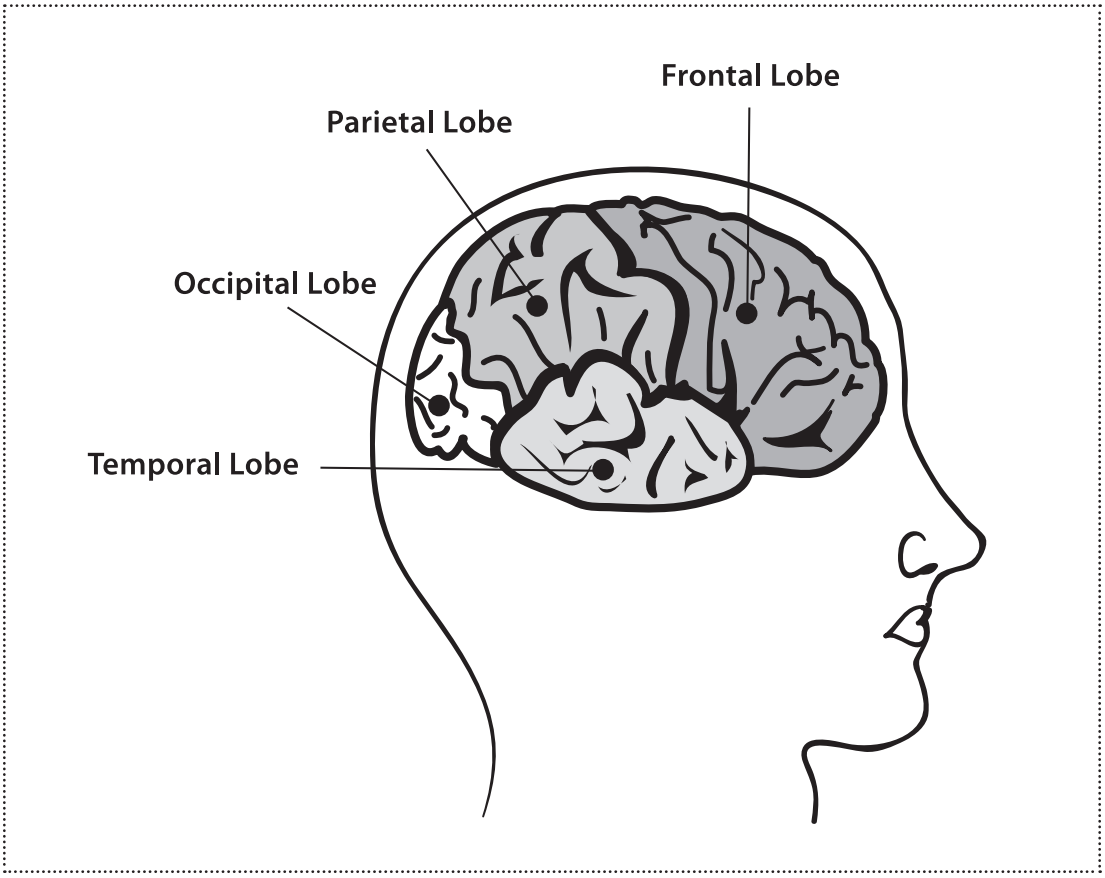
The cortex is specialized. Four specific areas of the cortex, called lobes, are responsible for different tasks:

- The **frontal lobe** is responsible for initiating and coordinating motor movements and higher cognitive skills, such as problem solving and thinking.

- The **parietal lobe** processes sensory information from the whole body–for example, information about pain, touch, and pressure.

- The **occipital lobe** processes visual information coming into the brain.

- The **temporal lobe** is in charge of making sense of the auditory information from the environment.



Hypothalamus

The **hypothalamus** is situated deep inside the center of the brain. The hypothalamus links the nervous system to the endocrine system by producing and releasing hormones. The endocrine system is made up of glands that regulate, coordinate, and control hormones. The hypothalamus regulates body temperature, hunger, and thirst.

Cerebellum

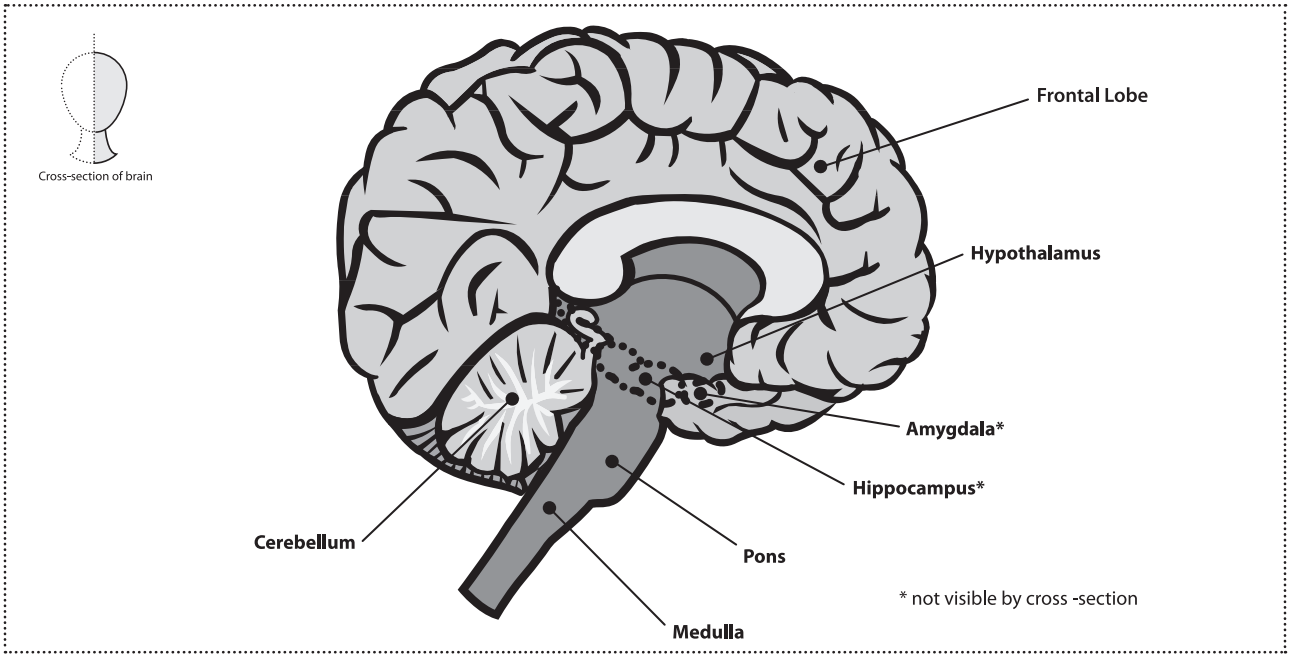
The **cerebellum** is located at the back of the head near the spine. It controls posture, movement, and the sense of balance. Playing ball, picking up objects, and playing musical instruments are among the activities that fall under the control of the cerebellum.

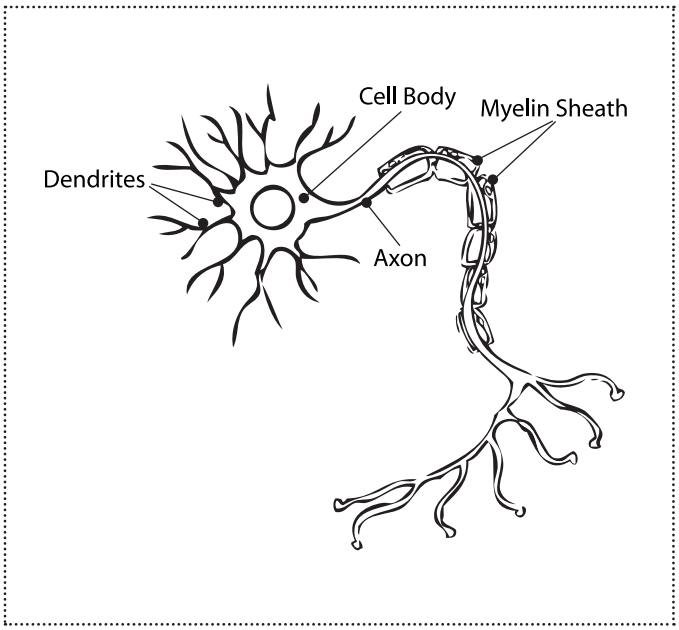
Brain Stem

The **brain stem**, the most primitive part of the brain, connects the brain to the spinal cord. It is located near the cerebellum. The two main parts of the brain stem are the **pons** and the **medulla.** The pons contains nerve fibers that connect the cerebral cortex with the cerebellum and the spinal cord. The pons controls sleep, awakening, and dream onset. The medulla controls heart rate, respiration, and blood pressure. The brain stem also controls simple reflexes, such as coughing and sneezing.

Limbic System

The **limbic system** is located deep inside the brain. It has many parts, but two of the most important are the **hippocampus** and the **amygdala.** The hippocampus is mainly responsible for learning and memory. The amygdala plays an important role in emotional behavior. The limbic system is greatly affected by substances such as nicotine, alcohol, and illegal drugs.





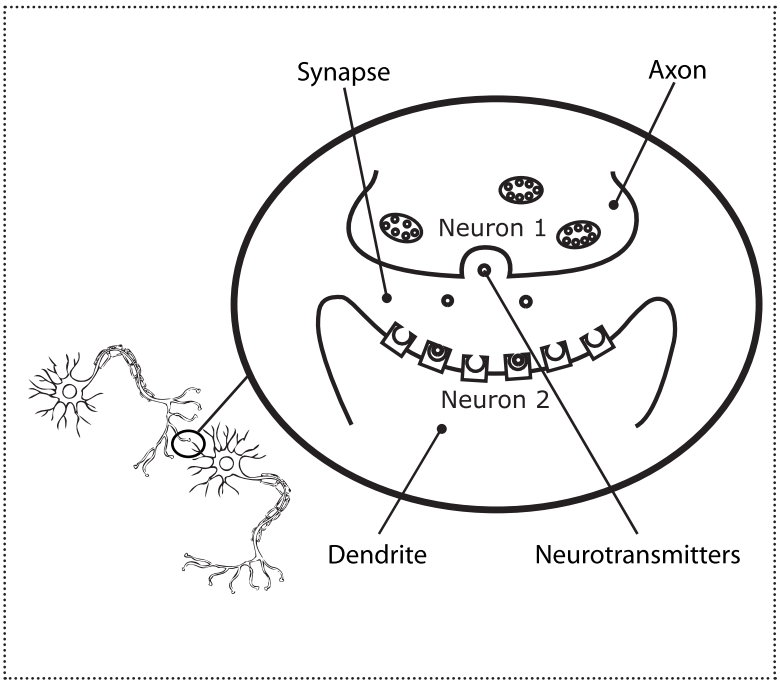
NEURONS

Information is constantly exchanged between the brain and other parts of the body by both electrical and chemical impulses. Cells called neurons are responsible for carrying this information. All of the major brain parts discussed above are composed of neurons—almost 100 billion neurons total!

A neuron has three main parts. The **cell body** directs all the neuron's activities. **Dendrites,** short branches that extend out from the cell body, receive messages from other neurons and pass them on to the cell body. An **axon** is a long fiber that transmits messages from the cell body to the dendrites of other neurons or to other tissues in the body, such as muscles. A protective covering, called the **myelin sheath,** covers the axons of many neurons. Myelin insulates the axons and helps messages from nerve signals travel faster, farther, and more efficiently.

NEUROTRANSMISSION

The exchange of information between the axon of one neuron and the dendrites of another neuron is called neurotransmission. Neurotransmission takes place through the release of chemicals into the space between the axon of the first neuron and the dendrites of the second neuron. These chemicals are called neurotransmitters. The space between the axon and the dendrite is called a **synapse.**



When neurons communicate, an electrical impulse traveling down the axon causes neurotransmitters to be released from the end of the axon into the synapse. The neurotransmitters cross the synapse and bind to special molecules, called receptors, on the dendrite of the second neuron. Receptors are found on the dendrites and cell bodies of all neurons. The receptors convert the information into chemical or electrical signals which are then transmitted to the cell body and eventually to the axon. The axon then carries the signal to another neuron or to body tissues such as muscles.

Once a neurotransmitter binds to a receptor, a series of events follow. First, the message carried by the neurotransmitter is passed on to the receiving neuron. Second, the neurotransmitter is inactivated. It is either broken down by an enzyme or reabsorbed by the axon from which it was released. Other molecules, called transporter molecules, complete this reabsorption process. These molecules are located in the cell membranes of the axon that releases the neurotransmitters. They pick up specific neurotransmitters from the synapse and carry them back across the cell membrane and into the axon, where they are recycled for use at a later time. Note that this process is true for most neurotransmitters, but not for all of them.

The human body produces many different types of neurotransmitters. Each neurotransmitter has a specific role to play in the functioning of the brain. A neurotransmitter binds to a receptor in much the same way that a key fits into a lock; a specific neurotransmitter will bind only to its corresponding receptor.

The process of neurotransmission as described here is shown step-by-step in Module 1 of the CD-ROM in Room 1—*NT 101: An Introduction to Neurotransmission*.

Neurotransmitter messages can be generalized as either excitatory or inhibitory messages. An excitatory neurotransmitter is one that increases the activity of neurons, and an inhibitory neurotransmitter decreases the activity of neurons. Over the course of these modules, several specific neurotransmitters will be discussed, including acetylcholine, GABA, and dopamine.

Neurotransmitter	Brain Function
Acetylcholine (excitatory)	Plays an important role in the function of the hippocampus, which is in charge of learning and memory.
GABA (inhibitory)	A neurotransmitter in the cerebral cortex, which controls thinking, perceiving, and understanding language.
Dopamine (excitatory)	Plays an important role in the pleasure/reward system in the brain.

Preparation

- Read the Background section of this module for more information about the brain and neurotransmission.
- Provide students with the Module 1 magazine *The Brain and Nervous System* for background knowledge.
- Determine which activities you want the class to complete.
- Arrange for computer lab time or prepare the classroom computer for students' Internet and CD-ROM use.
- Photocopy and pass out the Brain Parts Fact Sheet and the Neurotransmission Fact Sheet for students to complete during the lecture.
- Prepare transparencies and photocopies for the lesson.

Introduction

Reading: Begin by giving students adequate time to read the student magazine. Have students pay particular attention to the following sections: Background, Stats and Facts, and Science in the Spotlight.

Discussion: After students have read the magazine, facilitate a discussion about the brain using the following questions. If necessary, review this information with your students, using the diagrams provided.

Time:

15–20 minutes

Supplies:

Transparencies of diagrams if needed

Handouts:

Module 1 magazine

Brain Parts Fact Sheet

Neurotransmission Fact Sheet

The Parts of the Brain

- What does the brain do?
- What are the four lobes of the brain?
- What are the functions of the right and left hemispheres?
- What does the limbic system control?
- What are three functions of the brain stem?

Neurotransmission

- What are the three main parts of a neuron?
- Approximately how many neurons are in the brain?
- What are the steps of neurotransmission?
- What are the definitions of neurotransmitters, synapse, and receptors?

Activity 1: Brain Messages

Time:

45 minutes

Supplies:

One large piece of butcher-block paper per group

Markers/crayons/ pencils

Handouts:

Neurotransmission Fact Sheet

This is the first activity in a series of six. These activities are all part of the *Brain Power! Challenge* competition. Before you begin, go over the competition details that are found on page vii of this guide.

Part 1:

1. Give each group the Neurotransmission Fact Sheet. Make sure students understand the role of the brain and neurons in transmitting messages throughout the body.

2. Give each group a large sheet of butcher-block paper, pencils, and markers. Tell each group to draw the steps involved in neurotransmission. Students should be able to describe the parts of a neuron, how information exchange takes place, and how information is sent throughout the body. They should include a short written explanation of how the process works.

Part 2:

3. Have groups take turns showing the steps of neurotransmission. Encourage students to ask questions in a discussion format in between the presentations.

4. Based on the clarity, information, and creativity in the groups' presentations, you will give each group a score from 0–10. These scores need to be recorded on the Group Scorecard, as each *Challenge* activity for the *Brain Power!* modules involves a similar scoring system. At the end of all the modules, the team with the most points wins the *Brain Power! Challenge* competition.

Activity 2: Scavenger Hunt

Time:

45 minutes

Supplies:

Timer if needed

Pen or pencil

Handouts:

Neurotransmission Scavenger Hunt

In this activity, students will learn about neurotransmission by using the Internet. Have students work together in groups to complete an Internet scavenger hunt.

Ideas for making this activity more suitable for a bigger class: If there are not enough computers for all groups, send groups one at a time while the rest of the class completes other activities. Use a timer to record each group's completion time.

Students should try to find the answers as quickly as possible. You can use the provided Scavenger Hunt handout or develop one of your own. The following Web site contains all the information students need to complete the scavenger hunt:

Prior to this activity, add the Internet resource listed below to the computer's Internet "Favorites" drop-down menu. **http://faculty.washington.edu/chudler/neurok.html**

CD-ROM

The CD-ROM includes games and materials to supplement the information presented in the module. The room labeled "1" contains the following activities and specific information pertaining to this module:

- **Learning Objectives:** these are presented at the beginning of each CD-ROM module
- **Parts of the Brain:** a short film about brain parts
- **Cerebral Cortex:** a short film about the cerebral cortex
- **Hemisphere Quiz:** a personal quiz students can take to determine their own "dominant hemisphere"
- **Harry Human Superguy:** an interactive quiz and cartoon about brain parts and functions
- ***NT 101: An Introduction to Neurotransmission:*** this activity details the process of neurotransmission step-by-step
- **Module Quiz**: this quiz is the final part of the module, intended to assess students' learning

1.  Divide the students into pairs and give each a copy of the Brain Parts Fact Sheet. Assign each pair a part of the brain and have them draw their own original cartoon character or superhero that represents this brain part. For example, students assigned the occipital lobe might draw a character with very large eyes, and students assigned the cerebellum might draw their character playing football or dancing ballet. After drawing the cartoon, each pair should think of a fun name for their character and then introduce him or her to the class.

2.   Have students develop timelines charting the major findings and breakthroughs in brain research. Divide the students into small groups and have each group focus on a specific timeframe (e.g., 0–1700 AD, 1700–1900, 1900–present). Encourage students to highlight key milestones on their timelines. The following Web site is a good starting point:
http://faculty.washington.edu/chudler/hist.html

3.    Have students create a plan for a board game to show the process of neurotransmission. Make sure they cover all the major parts of the process. You can present the activity with the following framework to build motivation.

> The object of the game is for the neurotransmitter to reach the receptors across the synapse. What kind of obstacles would the neurotransmitter face in your game? What pieces would the neuron need to collect before it can send the message? What would the board look like?

Have students create a visual presentation for their games. In this activity, you are the president of a board game company looking to make and sell the best neurotransmission game. Judge the presentations based on creativity and scientific accuracy.

Key to Icons

 Art

 Science

 History

 Business

 Social Studies

 English

 Math

Assessment

As students complete the activities in the module, observe whether they have mastered the following:

1. Do students know the main parts of the brain and the major functions of each part?

2. Do students know the main parts of a neuron? Can they explain the function of the neurotransmitters?

3. Can students explain neurotransmission? Do they have a clear understanding that this is the process through which messages are sent throughout the brain and body?

4. Do students understand the importance of the brain and its many functions?

5. Did students participate in the class activities and discussion? Did they engage in the topics?

Resources

RESOURCES FOR TEACHERS

National Institute on Drug Abuse (NIDA)
www.drugabuse.gov, 301-443-1124
This Web site contains information about drug abuse as well as sections designed specifically for parents, teachers, and students.

National Clearinghouse for Alcohol and Drug Information (NCADI)
http://ncadi.samhsa.gov, 1-800-729-6686
NCADI is the world's largest resource for information and materials concerning substance abuse. Many free publications are available here.

***The Amazing Brain*. Ornstein, R., & Thompson, R. F.** Boston: Houghton Mifflin Company, 1991. This uniquely illustrated, comprehensive presentation of the numerous and complex functions of the brain is an ideal source for health educators and older students.

Brain Basics: Know Your Brain
www.ninds.nih.gov/disorders/brain_basics/know_your_brain.htm
Provides an excellent overview of the architecture and functions of the brain.

RESOURCES FOR STUDENTS

Neuroscience for Kids
http://faculty.washington.edu/chudler/neurok.html
Useful for both adults and children, this Web site contains information on the brain and neurotransmission, activities, experiments, pictures, and other resources.

The Physical Brain. **Byrnie, F.** Woodbridge, CT: Blackbirch Press, Inc., 2001. This book, part of *The Amazing Brain* series, uses a variety of illustrations and pictures to describe the development, functions, and specializations of the brain. The book also contains an overview of neurotransmission.

The Great Brain Book: An Inside Look at the Inside of Your Head. **Newquist, H.P.** New York: Scholastic Reference, 2005. *The Great Brain Book* uses medical illustrations, cartoon illustrations, and interesting photographs to tell the complete story of the brain, from the history of the brain to the future of brain science.

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CHAPTER 15
Our Environment

We have heard the word 'environment' often being used on the television, in newspapers and by people around us. Our elders tell us that the 'environment' is not what it used to be earlier; others say that we should work in a healthy 'environment'; and global summits involving the developed and developing countries are regularly held to discuss 'environmental' issues. In this chapter, we shall be studying how various components in the environment interact with each other and how we impact the environment.

15.1 ECO-SYSTEM — WHAT ARE ITS COMPONENTS?

All organisms such as plants, animals, microorganisms and human beings as well as the physical surroundings interact with each other and maintain a balance in nature. All the interacting organisms in an area together with the non-living constituents of the environment form an ecosystem. Thus, an ecosystem consists of biotic components comprising living organisms and abiotic components comprising physical factors like temperature, rainfall, wind, soil and minerals.

For example, if you visit a garden you will find different plants, such as grasses, trees; flower bearing plants like rose, jasmine, sunflower; and animals like frogs, insects and birds. All these living organisms interact with each other and their growth, reproduction and other activities are affected by the abiotic components of ecosystem. So a garden is an ecosystem. Other types of ecosystems are forests, ponds and lakes. These are natural ecosystems while gardens and crop-fields are human-made (artificial) ecosystems.

Activity 15.1

- You might have seen an aquarium. Let us try to design one.
- What are the things that we need to keep in mind when we create an aquarium? The fish would need a free space for swimming (it could be a large jar), water, oxygen and food.
- We can provide oxygen through an oxygen pump (aerator) and fish food which is available in the market.

- If we add a few aquatic plants and animals it can become a self-sustaining system. Can you think how this happens? An aquarium is an example of a human-made ecosystem.
- Can we leave the aquarium as such after we set it up? Why does it have to be cleaned once in a while? Do we have to clean ponds or lakes in the same manner? Why or why not?

We have seen in earlier classes that organisms can be grouped as producers, consumers and decomposers according to the manner in which they obtain their sustenance from the environment. Let us recall what we have learnt through the self sustaining ecosystem created by us above. Which organisms can make organic compounds like sugar and starch from inorganic substances using the radiant energy of the Sun in the presence of chlorophyll? All green plants and certain bacteria which can produce food by photosynthesis come under this category and are called the producers.

Organisms depend on the producers either directly or indirectly for their sustenance? These organisms which consume the food produced, either directly from producers or indirectly by feeding on other consumers are the consumers. Consumers can be classed variously as herbivores, carnivores, omnivores and parasites. Can you give examples for each of these categories of consumers?

- Imagine the situation where you do not clean the aquarium and some fish and plants have died. Have you ever thought what happens when an organism dies? The microorganisms, comprising bacteria and fungi, break-down the dead remains and waste products of organisms. These microorganisms are the decomposers as they break-down the complex organic substances into simple inorganic substances that go into the soil and are used up once more by the plants. What will happen to the garbage, and dead animals and plants in their absence? Will the natural replenishment of the soil take place, even if decomposers are not there?

Activity 15.2

- While creating an aquarium did you take care not to put an aquatic animal which would eat others? What would have happened otherwise?
- Make groups and discuss how each of the above groups of organisms are dependent on each other.
- Write the aquatic organisms in order of who eats whom and form a chain of at least three steps. [ ] → [ ] → [ ]
- Would you consider any one group of organisms to be of primary importance? Why or why not?

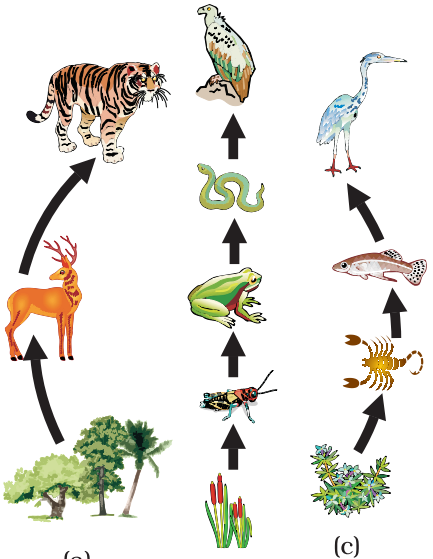

Figure 15.1
Food chain in nature (a) in forest, (b) in grassland and (c) in a pond

15.1.1 Food Chains and Webs

In Activity 15.4 we have formed a series of organisms feeding on one another. This series or organisms taking part at various biotic levels form a food chain (Fig. 15.1).

Each step or level of the food chain forms a trophic level. The autotrophs or the producers are at the first trophic level. They fix up the solar energy and make it available for heterotrophs or the consumers. The herbivores or the primary consumers come at the second, small carnivores or the secondary consumers at the third and larger carnivores or the tertiary consumers form the fourth trophic level (Fig. 15.2).

We know that the food we eat acts as a fuel to provide us energy to do work. Thus the interactions among various components of the environment involves flow of energy from one component of the system to another. As we have studied, the autotrophs capture the energy present in sunlight and convert it into chemical energy. This energy supports all the activities of the living world. From autotrophs, the energy goes to the heterotrophs and decomposers. However, as we saw in the previous Chapter on 'Sources of Energy', when one form of energy is changed to another, some energy is lost to the environment in forms which cannot be used again. The flow of energy between various components of the environment has been extensively studied and it has been found that –

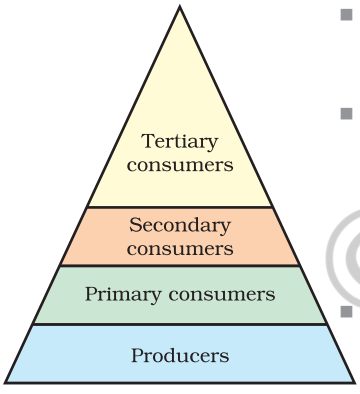

Figure 15.2
Trophic levels

- The green plants in a terrestrial ecosystem capture about 1% of the energy of sunlight that falls on their leaves and convert it into food energy.
- When green plants are eaten by primary consumers, a great deal of energy is lost as heat to the environment, some amount goes into digestion and in doing work and the rest goes towards growth and reproduction. An average of 10% of the food eaten is turned into its own body and made available for the next level of consumers.
- Therefore, 10% can be taken as the average value for the amount of organic matter that is present at each step and reaches the next level of consumers.
- Since so little energy is available for the next level of consumers, food chains generally consist of only three or four steps. The loss of energy at each step is so great that very little usable energy remains after four trophic levels.
- There are generally a greater number of individuals at the lower trophic levels of an ecosystem, the greatest number is of the producers.
- The length and complexity of food chains vary greatly. Each organism is generally eaten by two or more other kinds of organisms which in turn are eaten by several other organisms. So instead of a straight line food chain, the relationship can be shown as a series of branching lines called a food web (Fig. 15.3).

From the energy flow diagram (Fig. 15.4), two things become clear. Firstly, the flow of energy is unidirectional. The energy that is captured by the autotrophs does not revert back to the solar input and the energy which passes to the herbivores does not come back to autotrophs. As it moves progressively through the various trophic levels it is no longer available to the previous level. Secondly, the energy available at each trophic level gets diminished progressively due to loss of energy at each level.

Another interesting aspect of food chain is how unknowingly some harmful chemicals enter our bodies through the food chain. You have read in Class IX how water gets polluted. One of the reasons is the use of several pesticides and other chemicals to protect our crops from diseases and pests. These chemicals are either washed down into the soil or into the water bodies. From the soil, these are absorbed by the plants along with water and minerals, and from the water bodies these are taken up by aquatic plants

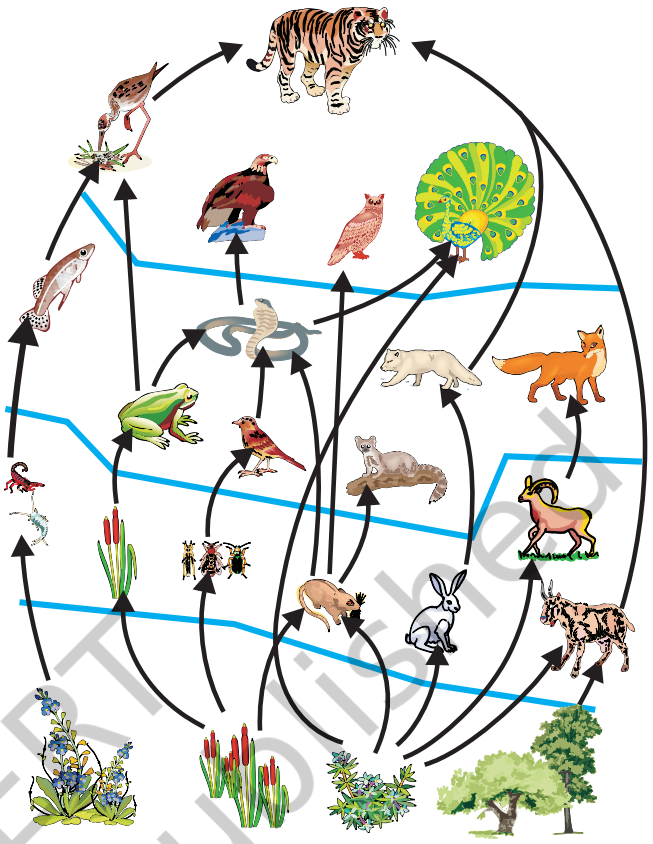

Figure 15.3 *Food web, consisting of many food chains*

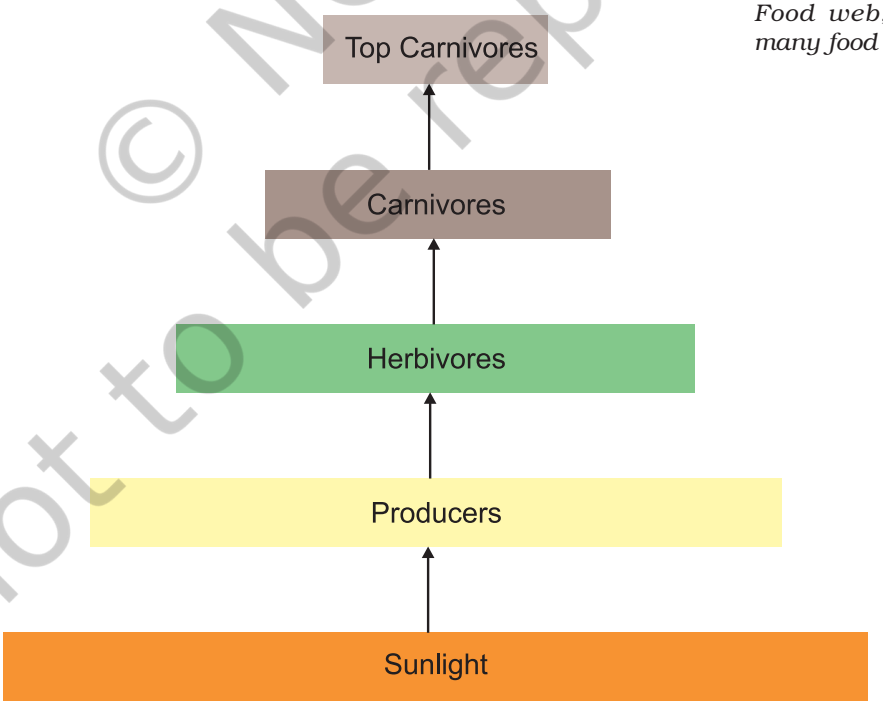

Figure 15.4 *Diagram showing flow of energy in an ecosystem*

and animals. This is one of the ways in which they enter the food chain. As these chemicals are not degradable, these get accumulated progressively at each trophic level. As human beings occupy the top level in any food chain, the maximum concentration of these chemicals get accumulated in our bodies. This phenomenon is known as biological magnification. This is the reason why our food grains such as wheat and rice, vegetables and fruits, and even meat, contain varying amounts of pesticide residues. They cannot always be removed by washing or other means.

Activity 15.3

- Newspaper reports about pesticide levels in ready-made food items are often seen these days and some states have banned these products. Debate in groups the need for such bans.
- What do you think would be the source of pesticides in these food items? Could pesticides get into our bodies from this source through other food products too?
- Discuss what methods could be applied to reduce our intake of pesticides.

QUESTIONS

1. What are trophic levels? Give an example of a food chain and state the different trophic levels in it.
2. What is the role of decomposers in the ecosystem?

15.2 HOW DO OUR ACTIVITIES AFFECT THE ENVIRONMENT?

We are an integral part of the environment. Changes in the environment affect us and our activities change the environment around us. We have already seen in Class IX how our activities pollute the environment. In this chapter, we shall be looking at two of the environmental problems in detail, that is, depletion of the ozone layer and waste disposal.

15.2.1 Ozone Layer and How it is Getting Depleted

Ozone (O_3) is a molecule formed by three atoms of oxygen. While O_2, which we normally refer to as oxygen, is essential for all aerobic forms of life. Ozone, is a deadly poison. However, at the higher levels of the atmosphere, ozone performs an essential function. It shields the surface of the earth from ultraviolet (UV) radiation from the Sun. This radiation

is highly damaging to organisms, for example, it is known to cause skin cancer in human beings.

Ozone at the higher levels of the atmosphere is a product of UV radiation acting on oxygen (O_2) molecule. The higher energy UV radiations split apart some moleculer oxygen (O_2) into free oxygen (O) atoms. These atoms then combine with the molecular oxygen to form ozone as shown—

$$O_2 \xrightarrow{UV} O + O$$

$$O + O_2 \rightarrow O_3$$
(Ozone)

The amount of ozone in the atmosphere began to drop sharply in the 1980s. This decrease has been linked to synthetic chemicals like chlorofluorocarbons (CFCs) which are used as refrigerants and in fire extinguishers. In 1987, the United Nations Environment Programme (UNEP) succeeded in forging an agreement to freeze CFC production at 1986 levels. It is now mandatory for all the manufacturing companies to make CFC-free refrigerators throughout the world.

Activity 15.4

- Find out from the library, internet or newspaper reports, which chemicals are responsible for the depletion of the ozone layer.
- Find out if the regulations put in place to control the emission of these chemicals have succeeded in reducing the damage to the ozone layer. Has the size of the hole in the ozone layer changed in recent years?

15.2.2 Managing the Garbage we Produce

In our daily activities, we generate a lot of material that are thrown away. What are some of these waste materials? What happens after we throw them away? Let us perform an activity to find answers to these questions.

Activity 15.5

- Collect waste material from your homes. This could include all the waste generated during a day, like kitchen waste (spoilt food, vegetable peels, used tea leaves, milk packets and empty cartons), waste paper, empty medicine bottles/strips/bubble packs, old and torn clothes and broken footwear.
- Bury this material in a pit in the school garden or if there is no space available, you can collect the material in an old bucket/ flower pot and cover with at least 15 cm of soil.
- Keep this material moist and observe at 15-day intervals.
- What are the materials that remain unchanged over long periods of time?
- What are the materials which change their form and structure over time?
- Of these materials that are changed, which ones change the fastest?

We have seen in the chapter on 'Life Processes' that the food we eat is digested by various enzymes in our body. Have you ever wondered why the same enzyme does not break-down everything we eat? Enzymes are specific in their action, specific enzymes are needed for the break-down of a particular substance. That is why we will not get any energy if we try to eat coal! Because of this, many human-made materials like plastics will not be broken down by the action of bacteria or other saprophytes. These materials will be acted upon by physical processes like heat and pressure, but under the ambient conditions found in our environment, these persist for a long time.

Substances that are broken down by biological processes are said to be biodegradable. How many of the substances you buried were biodegradable? Substances that are not broken down in this manner are said to be non-biodegradable. These substances may be inert and simply persist in the environment for a long time or may harm the various members of the eco-system.

Activity 15.6

- Use the library or internet to find out more about biodegradable and non-biodegradable substances.
- How long are various non-biodegradable substances expected to last in our environment?
- These days, new types of plastics which are said to be biodegradable are available. Find out more about such materials and whether they do or do not harm the environment.

QUESTIONS

1. Why are some substances biodegradable and some non-biodegradable?
2. Give any two ways in which biodegradable substances would affect the environment.
3. Give any two ways in which non-biodegradable substances would affect the environment.

Visit any town or city, and we are sure to find heaps of garbage all over the place. Visit any place of tourist interest and we are sure to find the place littered with empty food wrappers. In the earlier classes we have talked about this problem of dealing with the garbage that we generate. Let us now look at the problem a bit more deeply.

Activity 15.7

- Find out what happens to the waste generated at home. Is there a system in place to collect this waste?
- Find out how the local body (*panchayat*, municipal corporation, resident welfare association) deals with the waste. Are there mechanisms in place to treat the biodegradable and non-biodegradable wastes separately?
- Calculate how much waste is generated at home in a day.
- How much of this waste is biodegradable?
- Calculate how much waste is generated in the classroom in a day.
- How much of this waste is biodegradable?
- Suggest ways of dealing with this waste.

Activity 15.8

- Find out how the sewage in your locality is treated. Are there mechanisms in place to ensure that local water bodies are not polluted by untreated sewage.
- Find out how the local industries in your locality treat their wastes. Are there mechanisms in place to ensure that the soil and water are not polluted by this waste?

Improvements in our life-style have resulted in greater amounts of waste material generation. Changes in attitude also have a role to play, with more and more things we use becoming disposable. Changes in packaging have resulted in much of our waste becoming non-biodegradable. What do you think will be the impact of these on our environment?

Think it over

Disposable cups in trains

If you ask your parents, they will probably remember a time when tea in trains was served in plastic glasses which had to be returned to the vendor. The introduction of disposable cups was hailed as a step forward for reasons of hygiene. No one at that time perhaps thought about the impact caused by the disposal of millions of these cups on a daily basis. Some time back, *kulhads*, that is, disposable cups made of clay, were suggested as an alternative. But a little thought showed that making these *kulhads* on a large scale would result in the loss of the fertile top-soil. Now disposable paper-cups are being used. What do you think are the advantages of disposable paper-cups over disposable plastic cups?

Activity 15.9

- Search the internet or library to find out what hazardous materials have to be dealt with while disposing of electronic items. How would these materials affect the environment?
- Find out how plastics are recycled. Does the recycling process have any impact on the environment?

QUESTIONS

1. What is ozone and how does it affect any ecosystem?
2. How can you help in reducing the problem of waste disposal? Give any two methods.

What you have learnt

- The various components of an ecosystem are interdependent.
- The producers make the energy from sunlight available to the rest of the ecosystem.
- There is a loss of energy as we go from one trophic level to the next, this limits the number of trophic levels in a food-chain.
- Human activities have an impact on the environment.
- The use of chemicals like CFCs has endangered the ozone layer. Since the ozone layer protects against the ultraviolet radiation from the Sun, this could damage the environment.
- The waste we generate may be biodegradable or non-biodegradable.
- The disposal of the waste we generate is causing serious environmental problems.

EXERCISES

1. Which of the following groups contain only biodegradable items?
   (a) Grass, flowers and leather
   (b) Grass, wood and plastic
   (c) Fruit-peels, cake and lime-juice
   (d) Cake, wood and grass
2. Which of the following constitute a food-chain?
   (a) Grass, wheat and mango
   (b) Grass, goat and human

(c) Goat, cow and elephant

(d) Grass, fish and goat

3. Which of the following are environment-friendly practices?

(a) Carrying cloth-bags to put purchases in while shopping

(b) Switching off unnecessary lights and fans

(c) Walking to school instead of getting your mother to drop you on her scooter

(d) All of the above

4. What will happen if we kill all the organisms in one trophic level?
5. Will the impact of removing all the organisms in a trophic level be different for different trophic levels? Can the organisms of any trophic level be removed without causing any damage to the ecosystem?
6. What is biological magnification? Will the levels of this magnification be different at different levels of the ecosystem?
7. What are the problems caused by the non-biodegradable wastes that we generate?
8. If all the waste we generate is biodegradable, will this have no impact on the environment?
9. Why is damage to the ozone layer a cause for concern? What steps are being taken to limit this damage?