Module Overview

Students of all ages, but particularly those of middle school age, have a natural curiosity about their bodies and how they work. *Human Body Systems* taps this curiosity by helping students clarify what they already know about their bodies and giving them an opportunity to perform a series of engaging hands-on activities through which they extend and enrich this knowledge.

Each lesson builds on skills and concepts presented in previous lessons. As students progress through the module, they take greater responsibility for their own learning, eventually planning and conducting their own procedures, devising their own data tables, and analyzing the results they obtain. Therefore, the module should be taught as a complete unit. It should not be used as a sourcebook of occasional experiments.

Human Body Systems is divided into three parts: The Digestive System, The Respiratory and Circulatory Systems, and the Musculoskeletal System. A lesson sequence chart for the module appears on page xxviii.

PART 1 THE DIGESTIVE SYSTEM

Lesson 1 is a preassessment for the module. It gives students an opportunity to share what they already know about human body systems and the organs of which they are composed. Students begin constructing a human body systems poster that they will revisit and revise in subsequent lessons. On the basis of their current knowledge, students construct definitions of "organ" and "body system."

Lesson 2 serves as an introduction to the digestive system. Students measure and mark the length of the organs of the digestive tract on a long piece of polyvinyl tubing. Working in groups of four, they then simulate peristalsis by taking turns squeezing an oiled tennis ball through the tubing. (The tennis ball represents food traveling through the digestive tract.) In Lesson 3, students use Benedict's solution and Lugol solution to perform chemical tests for sugar and starch, an activity that prepares them for exploring chemical digestion in the mouth.

Lessons 4 through 7 cover in detail the digestive processes that occur in the mouth, stomach, and intestines. During this sequence of lessons, students explore the digestion of carbohydrates, proteins, and fats and examine how the structure of the inner layer of the small intestine facilitates the absorption of digested nutrients into the bloodstream. Students also explore two mechanisms of absorption—diffusion and active transport. Lesson 4 marks the beginning of a "weaning" process that moves students from a point where they are provided with all the components of a scientific inquiry to one where they must design part or all of an inquiry themselves.

Lesson 8, the first of three formal assessments, has two parts. The first part is a performance assessment in which students are presented with a problem that involves chemical testing of foods and are challenged to design and conduct an inquiry to solve it. Working in pairs, students choose their materials, design a procedure and data table, conduct the inquiry, record their results, and state their conclusions. In the second part of the assessment, students work individually to complete a series of selected-response items, many of which involve analyzing illustrations of processes or concepts introduced in Lessons 1 through 7. Students also update and revise their human body systems posters.

PART 2 THE RESPIRATORY AND CIRCULATORY SYSTEMS

Lesson 9 introduces the *Human Body Systems* Anchor Activity, which is entitled Diseases and Health Careers. The Anchor Activity is a research project during which students work in pairs to gather information about a disease or health care career, organize their findings, and display them in poster form. When their work is complete, each pair shares its poster with the class in a brief oral presentation. Students are encouraged to use a variety of print, audiovisual, and on-line resources to research the topic they have selected for their Anchor Activity.

By this point in the module, students have become familiar with the processes of digestion. They are aware that digested nutrients pass through the walls of the small intestine into the bloodstream, which transports them to body cells. In Lessons 10 and 11, students explore how their bodies obtain another substance needed by the cells—oxygen. They explore the mechanisms of breathing and gas exchange as well as the capacity of the lungs to hold large quantities of air.

The logical next step is to explore what happens to oxygen and digested nutrients when they reach the body cells. Thus, in Lesson 12, students explore cellular respiration, the process whereby oxygen reacts with nutrients to release energy for life activities. First, students explore combustion by observing the burning of a candle. This experience familiarizes them with the raw materials and end products of oxidation. Students then perform a series of short inquiries during which they examine the raw materials and waste products of cellular respiration. When these investigations are complete, students compare and contrast the processes of combustion and cellular respiration.

In Lesson 13, students explore the nature of calories by comparing the relative amounts of heat released by two different foods—marshmallows (representing carbohydrates) and walnuts (representing proteins and fats). This inquiry vividly illustrates the energy potential in various foods.

Lessons 14 through 16 concern the heart and the circulatory system. These lessons focus on how oxygen and nutrients are transported to the body cells and how wastes are carried away for eventual elimination. In Lesson 14, students use a siphon-pump to explore the double-pump action of the heart. Heart rate and the factors that affect it are investigated in Lesson 15. Narrowed arteries and the burden they place on the heart are investigated in Lesson 16.

Lesson 17 is the second formal assessment in the module. It concerns the respiratory and circulatory systems. In the first part of this assessment, students design and carry out an inquiry that explores the effect of exercise on breathing rate. In the second part, they respond to a series of selected-response items and put the finishing touches on their human body systems posters.

PART 3 THE MUSCULOSKELETAL SYSTEM

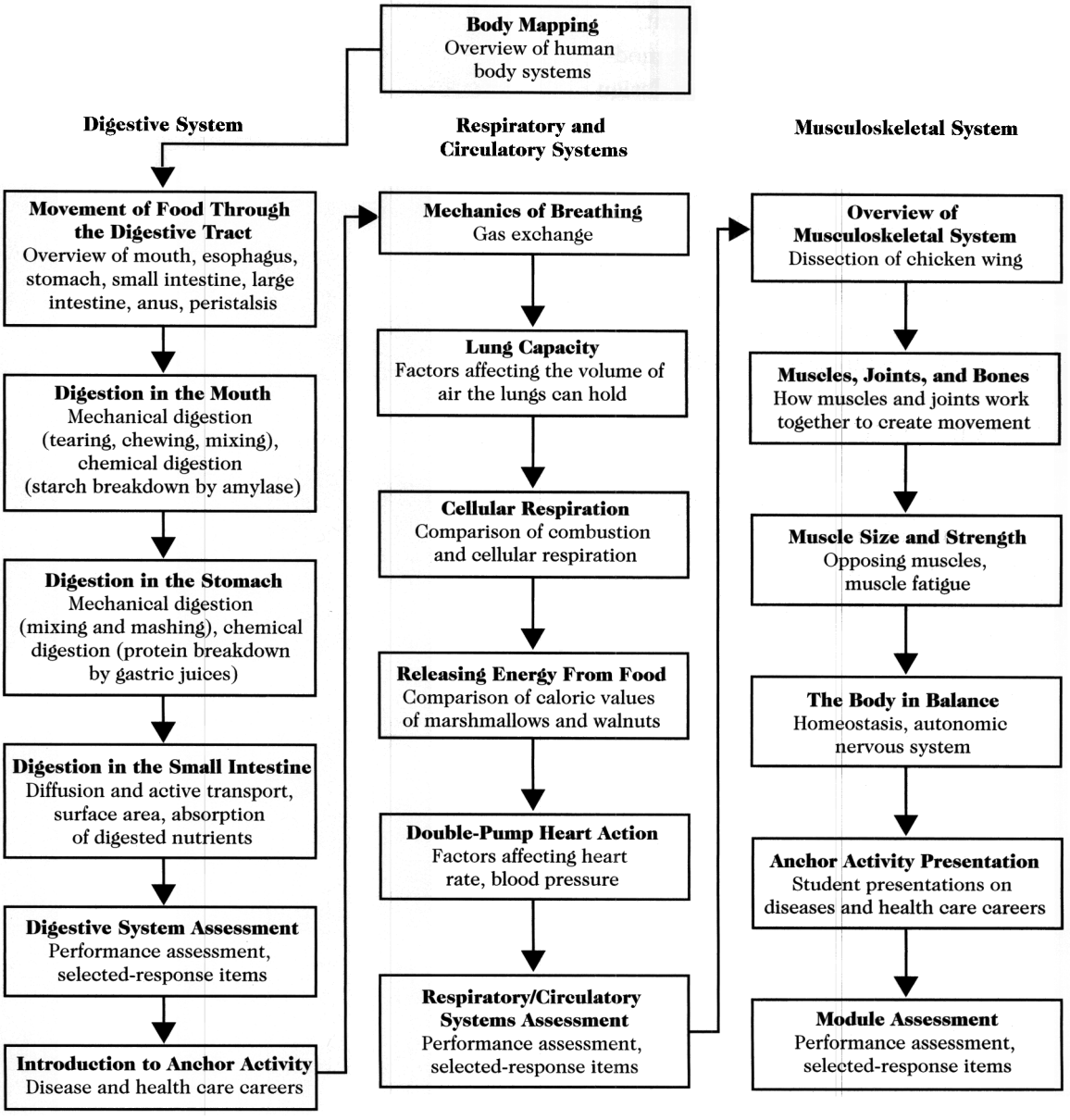
Part 3 of *Human Body Systems*, The Musculoskeletal System, deals with how the body uses the energy released by cellular respiration. Lesson 18, during which students dissect a chicken wing, serves as an overview of the musculoskeletal system. In Lesson 19, students explore the nature of joints, with an emphasis on how muscles, bones, and nerves work together to produce movement. Students examine the relationship between muscle size and strength in Lesson 20, and in Lesson 21, they focus on muscle fatigue. In the culminating inquiry in Lesson 22, students investigate homeostasis as they try to maintain a small quantity of water at average human body temperature for a short period of time.

Following Lesson 22, students have two or three periods to practice their anchor activity and to present it to the class. They can also use this time to study for their final assessment.

Lesson 23 is a comprehensive, two-part module assessment. In the first part, students design and carry out an inquiry to determine how practice affects their reaction time to a visual stimulus. The second part contains selected-response questions that cover the entire module.

Human Body Systems is a rigorous, engaging, life science module appropriate for students of middle school age. It addresses the skills and concepts deemed appropriate for grades 5 through 8 by the National Science Education Standards (see Appendix B in this volume). It helps students become more acquainted with something that is near and dear to them and that will be with them their entire lives—their body and the systems that keep it alive and healthy.

Lesson Sequence for *Human Body Systems*



Module Structure

Human Body Systems includes a Teacher's Guide, a Student Guide, and a materials and equipment kit. Following are brief descriptions of the major components in the Teacher's Guide and in the Student Guide. The master list of materials and equipment for the module begins on page xxxvi.

TEACHER'S GUIDE

The Teacher's Guide for *Human Body Systems* is organized in 23 lessons of varied lengths. The shortest lessons can be completed in a 45-minute class period, and the longest takes three such periods. A lesson may be taught in a 45-minute class period, or in back-to-back periods to accommodate block scheduling. Block scheduling requires less time for materials management and allows more time for class discussion and work on the extensions. For lessons that are more than 45 minutes long, suggestions for appropriate breaking points are made.

The Teacher's Guide contains general information on teaching the module. It also includes information about the science concepts that apply to each lesson, materials and their management, assessments, homework assignments, and extension activities. It also contains information about the Anchor Activity, a major research project that students begin in Lesson 9 and continue to work on throughout the module.

The following components appear in each lesson of the Teacher's Guide:

Lesson Number and Title

Number of Inquiries and Periods in the Lesson

One period is assumed to be 45 minutes.

Overview A brief introduction that puts the lesson in context. It provides a link between the current lesson and those that precede and follow it and outlines what students do in the lesson.

Concepts A list of the major concepts covered by the lesson. Many of the concepts are based on those in the National Science Education Standards.

Student Objectives A list of the things students are expected to accomplish in the lesson.

Background Detailed information relating to the content of the lesson. This section is intended to provide teachers who are unfamiliar with the lesson's content a foundation for answering student questions and facilitating inquiry. The Background section may also contain information about common student misconceptions that relate to the content of the lesson.

Materials A list of materials, presented under appropriate subheadings depending on the nature of the inquiry to be performed. The subheadings for lists of student materials include For Each Student, For Each Pair of Students, and For Each Group of 4 Students. Each materials list may also include a subsection entitled For the Teacher.

Preparation A list of steps explaining what the teacher must do prior to the lesson. Preparation may include photocopying student sheets, preparing transparencies or newsprint, collecting additional items of equipment not included in the kit, mixing solutions, assembling lab equipment, or setting up audiovisual equipment. It is assumed that the teacher will refill chemical containers and replace other consumables when necessary.

Getting Started A brief exercise or activity that introduces students to or provides the context for the lesson. In some cases, they first brainstorm what they already know about the topic. This encourages students to begin thinking about the topic of the lesson and allows the teacher to assess their pre-existing ideas.

Inquiry Number and Title Lessons may contain more than one inquiry. Each inquiry has its own number, title, and procedure.

Procedure A step-by-step guide for facilitating the inquiry. This section provides a carefully planned route through the lesson and complements the Procedure in the Student Guide.

Reflections A list of steps presenting guidance on how to provide closure for the lesson. Students may be asked to reflect on their inquiry results and discuss how the concepts encountered in the lesson can be applied to situations outside the classroom.

Homework Suggestions for independent student study related to the current or upcoming lesson. Many of the homework assignments involve the reading selections that appear in the Student Guide. Additional homework can be assigned from the extensions (see below).

Extensions Activities designed to extend students' experience of the topic into other fields of science and other content areas. These activities provide the opportunity for science teachers to collaborate with colleagues from other content areas to ensure a more integrated curriculum.

Assessment A section describing in detail the concepts and skills upon which the student should be assessed for the lesson. Teachers may wish to assign point values in keeping with their customary grading schemes. When a lesson itself is designed as an assessment, scoring rubrics are suggested.

Preparation for [a subsequent lesson] Brief mention of preparation or materials needed for an upcoming inquiry when they must be prepared by the teacher in advance. It is suggested that teachers check materials requirements before each lesson is to be taught.

Inquiry Masters Reproducible sheets that include keys to the types of answers students may give in response to questions posed in an inquiry, transparency masters, illustrations, and scoring rubrics. These are generally for teacher use only. (See Appendix A for a complete list of inquiry masters.)

Student Sheets Reproducible worksheets that students use to record their ideas and interpret their data and to answer questions about the concepts covered in the inquiries. Student sheets may also be used for homework assignments, reviews, and assessments. Most lessons have at least one student sheet; some have several. Masters for these sheets appear at the end of each lesson in the Teacher's Guide. Teachers must photocopy sufficient quantities of them before each lesson. (See Appendix A for a complete list of student sheets.)

STUDENT GUIDE

The Student Guide is intended to be used in conjunction with the Teacher's Guide. The components in the Student Guide complement those in the Teacher's Guide. For example, both guides contain lists of student objectives, but the wording may differ slightly between the two volumes, as appropriate for teachers and for students. The materials lists are less detailed in

the Student Guide than in the Teacher's Guide. Some sections are unique to each guide; for example, Homework and Extensions are not included in the Student Guide, while reading selections do not appear in the Teacher's Guide. The two volumes are designed to be complementary, and the teacher needs both guides to facilitate inquiry.

Each lesson in the Student Guide contains the following sections:

Lesson Number and Title

Introduction A brief section of text that places the concepts included in the lesson in context with those that have preceded it and with the students' own experiences. It may also provide a brief preview of the lesson. Some introductions include background information to draw students into the topic to be investigated.

Objectives for This Lesson A list that outlines what the students are expected to accomplish by the end of the lesson.

Materials A list that specifies the size of the group in which the students will be working as well as the materials they will require.

Getting Started A brief exercise or activity that introduces students to the topic of the lesson. It may include a brainstorming session on what students already know about the topic or a series of questions or experiences that form the basis for a brief group or class discussion.

Number and Title of Inquiry

Procedure Step-by-step instructions that students follow to complete an inquiry or to explore the concepts of a lesson more fully. This section often contains questions that students discuss in their groups, answer on their student sheets or in their science notebooks, and discuss with the class.

Reflecting on What You've Done A closing section that provides students an opportunity to think about and discuss what they have learned in the lesson and to begin to apply what they have learned to new situations.

Reading Selections Readers—frequently accompanied by photographs and illustrations—that pertain to the content of the module or, more specifically, to that of the lesson. All lessons in this module have one or more reading selections. A reading selection may provide background information that helps apply the concepts addressed in the lesson or it may introduce additional concepts from other areas of the National Science Education Standards. Most reading selections develop these concepts in the context of the world outside the laboratory. They are also intended to increase students' awareness of the history of science and technology.

Also included in this module is "Spies," an illustrated serial that provides important background information students need as they progress through the module. Although "Spies" episodes read like science fiction, the information they present about the human body is based on facts. The selections in the serial follow the adventures of two "spies," Peppi and Bollo, sent to planet Earth by a group of scientists in another galaxy. These scientists want to learn everything they can about the human body. Their goal is to gather enough information so that they can design the "perfect" human. Peppi and Bollo, who have the ability to make themselves very small, travel through the different body systems and collect information to take back to their leaders.