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AUTHOR Jacobs, Cecelia; And Others
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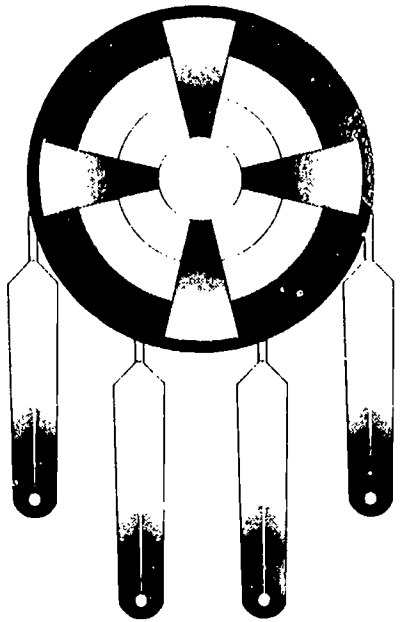
ABSTRACT

The Science of Alcohol Curriculum for American Indians uses the Medicine Circle and the "new science paradigm" to study the science of alcohol through a culturally relevant holistic approach. Intended for teachers and other educational personnel involved with American Indians, this curriculum presents a framework for alcohol education that integrates physical, spiritual, mental, and emotional perspectives. The rubric of science alone will not alter the impact that alcohol and alcohol abuse have had on the lives of some American Indian students. This unit of the curriculum focuses on the digestion and metabolism of alcohol. It discusses: (1) the concept of holism; (2) the four basic processes of the alimentary canal; (3) the value of the machine model of the body; (4) physical and chemical actions of digestion in the mouth; (5) peristalsis in the esophagus; (6) roles of the stomach, intestines, liver, and pancreas in digestion; (7) disruption of the stomach's normal functions by alcohol; (8) alcohol metabolism in the liver; (9) damage to the liver and pancreas by alcohol; (10) digestion of food compared to that of alcohol in the mouth, esophagus, and small intestines; and (11) effects of alcohol on the urinary tract. This unit contains a participant's handbook, 21 references, a glossary, 24 handouts and accompanying overhead transparencies, tips for a successful training session, and an evaluation form. (SV)

Science of Alcohol Curriculum for American Indians (SACAI)



Training Unit

The Digestive System and Alcohol Use

AMERICAN INDIAN SCIENCE & ENGINEERING SOCIETY

SCIENCE OF ALCOHOL CURRICULUM FOR AMERICAN INDIANS: (SACAI)

THE DIGESTIVE SYSTEM AND ALCOHOL USE

TRAINING UNIT

AUTHORS: CECELIA JACOBS
HEATHER DUFFY
CAROLYNA SMILEY-MARQUEZ, PH.D.

AMERICAN INDIAN SCIENCE AND ENGINEERING SOCIETY
1085 FOURTEENTH STREET
SUITE 1506
BOULDER, CO 80302

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American Indian Science and Engineering Society developed SACAI in an effort to address the devastating effects of alcohol among Indian populations. The SACAI approach is based on the belief that all things are connected and that successful prevention and intervention programs for American Indian students must start with this philosophical base. This connectedness is consistent with the new science paradigm and is symbolized in the curriculum by the Medicine Circle.

Many concerned and dedicated people played a part in the development and completion of this project. The content of the Teacher Training units was developed with the insight and dedication of three SACAI site coordinators: Ruth Bradford from the Pine Ridge Reservation in South Dakota; Artley Skenandore from the Oneida Reservation in Wisconsin; and Mark St. John from Isleta Pueblo in New Mexico.

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Cecelia Jacobs
SACAI Project Director

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CONTENTS

USING THE SACAI UNIT

SACAI has been developed for use by trainers who have a background in biological science. The material provided in each unit is based on current research; however, the field of alcohol studies is rapidly changing and trainers should be aware of new theories and developments published regularly. The bibliography at the end of each unit provides information that can be helpful in staying current in alcohol studies. Although SACAI is targeted to teachers from grades 4 through 12, the training audience can include anyone interested in how alcohol affects the normal functions of the digestive and central nervous systems. This can include counselors, school health professionals, administrators, parents, and community members. SACAI emphasizes information of particular interest to teachers of American Indian students and includes a culturally relevant approach to presentation methods and explanations based on the concept of the Medicine Circle.

The SACAI materials include Training Units and accompanying Participant Booklets. The following units are currently available:

Bridging American Indian Culture and the New Science Paradigm
The Digestive System and Alcohol Use
The Central Nervous System and Alcohol Use

It is strongly suggested that Bridging American Indian Culture and the New Science Paradigm precede the use of other units. This first unit provides a grounding in alcohol issues and discussion of the Medicine Circle which is used throughout the curriculum. The remaining units can be studied in any order.

Each Training Unit includes presentation material, handouts, overheads (paper and transparent copies), activities and a bibliography. A Participant Booklet also accompanies each Training Unit. (Additional booklets are available from AISES.)

Training Unit

The Training Unit is presented in two columns. The left column, Presentation Background, contains the concepts and ideas to be presented. The right column, Presentation Notes, offers a variety of suggestions for engaging participants in the material. The Presentation Notes indicate when to use overheads, handouts, activities, or supplemental readings. These refer to and are associated with preceding paragraphs in the left column (Presentation Background). The Training Unit is designed so

the user may easily follow the text from top to bottom on each page, alternating from column to column. The space provided throughout the unit may be used for your notes and comments.

Presentation Notes contain the following items:

1) Supplementary Readings: These suggested materials can be used to expand and enhance your understanding of the subject. They are listed in Presentation Notes with a full reference in the bibliography at the end of the unit. Depending on the time available and the size and interest of your class, you can make the readings optional, assign various material to small groups, request summaries--written or oral--from individual participants, ask for contrasts and comparisons of selected readings, assign cooperative learning activities, etc.

2) Overheads: Following specific text, overheads are provided to facilitate the training. Many of these are included in the Participant Booklet as "handouts". When an overhead is included in the booklet as a handout for participants, it is indicated in the Presentation Notes. Paper copies of the overheads are provided in the Training Unit along with transparencies.

3) Stories: Some units include stories written by American Indian authors or adapted from traditional stories. Participants should be encouraged to learn the stories common to the communities in which they work and to include them when appropriate in the learning process. The text of the stories is located after the handouts and overheads in this unit and the accompanying Participant Booklet.

4) Notes: Notes are used to offer information related to the text or to provide cultural perspective or background.

5) Discussion: Throughout the curriculum, open-ended questions are offered as a means to explore the material or its implications more fully. Trainers are encouraged to use the space provided to add questions of their own.

6) Activities: Ideas for class participation are offered, particularly at the beginning and end of the units, as warm-up and closing or review exercises. Many of these activities can be adapted for use in participants' classrooms. (Additional activities adaptable to classroom settings are listed in the Participant Booklets at the end of each section).

Participant Booklet

Accompanying the Training Unit is a Participant Booklet. Each participant should be given a booklet to facilitate the training. The booklet is divided into sections with discussion questions and activities following each section. The booklet also has pages for notes, a glossary of terms (when appropriate), and a bibliography. The content in the Participant Booklet is identical to that found in the Training Unit and it follows the same sequence. In addition to the activities and suggested readings found in the Training Unit, the Participant Booklet contains summary questions and training activities. These are designed to be used at the discretion of the trainer in conjunction with the activities found throughout the Training Unit in the Presentation Notes column.

Tips for a Successful Training Session

The following items are suggestions to consider in order to facilitate a successful training session. These ideas reflect effective strategies found over many years of research and experience in providing in-service training to educators. Suggestions are made specific to this unit.

1. Adequate preparation includes familiarity with the content, overheads, handouts and other materials.

2. If possible, participants should be provided the Participant Booklet prior to the training so they may familiarize themselves with the content.

3. The more interaction participants have with each other, the more involved in the training they will become.

4. Take adequate time to complete discussions and activities to ensure that all participants understand the content. The time needed will vary across training situations.

5. Provide culturally relevant examples and/or experiences whenever possible and encourage the participants to share their related experiences.

6. Allow participants the opportunity to discuss how the unit's content may be applied to the classroom setting when teaching students about the effects of alcohol.

THE DIGESTIVE SYSTEM AND ALCOHOL USE

Presentation Background

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I. The Digestive System

Our human body, like the natural, social, and familial environment, has highly interrelated and interdependent parts. When one part is weak, ill, or injured, the entire body is affected.

"Learning from Grandmother" emphasizes the importance of respecting all parts of nature, community, and self. It discusses discipline and moderation in using resources, in this case nature. Individuals are not independent of the systems and environment in which they live.

Learning from Grandmother
by Carolyna Smiley-Marquez

When I was young, I spent many early morning and evening hours gathering herbs - leaves, stems, roots, and flowers of desert plants - with my great-grandmother in the pinon-covered hills of northern New Mexico.

Those long slow walks together, always in the direction of the rising or setting sun, were filled with much silence which I interpreted to be determination on her part. The old woman's eyes would dart ahead of us along the ground. Like invisible fingers, they would turn and examine plants - leaves, stems, and flowers - almost indistinguishable to her twelve-year-old apprentice.

I suspected that she herself was no longer aware of the long accustomed greetings of "Aye, oh," she offered to certain plants, small animals, insects, and to occasional spirits for which she had warning or opportunity. The desert floor puffed little

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pillows of dust at her shuffling feet, always three or four steps in front of me as the flour sack, filled with medicine plants that would be used to make teas and pastes for those with uneasinesses, swung rhythmically from a string tied around her waist.

The walk took us a long distance. Only a few leaves, stems or roots could be taken from any one area. In sentences that seemed inevitably to rise in pitch at their seeming ends - like small melodic chants - she reminded me of my responsibility to respect the balance which nature had established. This was my duty in this and in all relationships. "They are like clan members, family, just as you are with your sisters, mothers and grandmothers; they are just as members of your own body" she urged in a near whisper designed to assure my care in listening. To treat any part with disregard would be to harm the whole in some inexplicable way. I sensed her appreciation of the cycles and of the balance of natural life even though she rarely responded to my pulsing, "But why, grandmother?"

Our digestive system is most efficient when it is healthy and functions in a cooperative manner within a healthy body. One amazing thing about this system is that it is active all of the time, even when we are sleeping. Whenever we eat food (food is defined here as solid and/or liquid) it responds immediately to begin the digestive process and it continues for several hours. We are fortunate that this system works so naturally as a part of the body.

This expression of gratefulness for something that is generally taken for granted is compatible with Indian way, whether or not it is done verbally in

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day-to-day activities. For, in the traditional mind, all things in nature are believed to exist and function within an encompassing spiritual reality which binds all things. To be unceremoniously grateful for the part is to be respectful of the whole.

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Handout 1: "Charlie"

Activity: Ask participants to form small groups. Give each group enough handouts of "Charlie" so each member has one and so there is one extra per group. Ask participants to help each other fill in the outline with the digestive system including the pancreas, liver, kidneys and bladder. When they have completed their drawings, ask them to work as a team filling out the extra handout with their collective knowledge. When participants have completed their aggregate drawing, show the overhead "Charlie" so they can make any needed corrections. Note that the outline is not truncated and is placed in a particular setting. When teachers do this type of activity they can adapt the figure, name, and setting to fit the community they are teaching. The purpose of this activity is to determine how much background the group needs about the digestive system. Your presentation can then be adapted to the specific needs of the group. This activity can be done with a large cooperative group. An outline of a person is drawn on the chalk board with background. Volunteers fill in the

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digestive system as the group offers suggestions and discussion. The interaction of participants will provide information about their level of understanding of the digestive system.

Overhead 1a,b,c: "Charlie" (3 parts)

Handout 2: "Charlie"

Note: Non-Indian science regularly includes dissection of animal and human bodies as a part of studying their anatomy. Indian scientists in today's world also follow these procedures. However, traditional Indian science is based on studies of the living organism in its natural environment. These scientific observations result in gaining intimate knowledge of the animal and its behaviors, an understanding of its natural patterns and natural relationships, and an intuitive appreciation for the spiritual interconnectedness of human, earth, and animal. Such native studies result in an education which is embedded in its context. This engenders an appreciation of ecology and interdependence of being, world, and, to many American Indians, spirit.

To disaggregate or separate, to dissect, then, is to deny the sacred whole. Charlie, and Charlie's digestive system, therefore, should remain complete and should become the primary reference.

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We are also fortunate that our digestive organs and other human parts work together in a cooperative and harmonious way when they are given nutrition-rich foods and protected from harmful stresses that can result in illness, injury, or death.

While Charlie's digestive system is "inside" his body, it is like a tunnel or tube that only has two

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As much as possible, Charlie remains intact throughout the lessons, even though his "parts" are examined individually. This is an acknowledgement that American Indian people have cultural values and that those values can be honored in the context of education. Yet, today's Indians also live a bicultural life--being citizens of two cultures. They become researchers, doctors, nurses, and other medical professionals who can function effectively with both traditional and non-traditional practices. This acknowledges the versatility of the Indian mind, and it provides a symbolic integration of the two cultural perspectives which is mutually acceptable and respectful.

Discussion: The superintendent of Porterville Schools (California) said he would take a high school junior to court for refusing to participate in the dissection lessons in biology. What does this say about public school policies and values?

Overhead 2/Handout 3: "Digest Pass"

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openings, one where the food goes in and one where the waste product comes out. In a way, like the tunnel walls which surround the passageway through which a train can pass through a hill or mountain, the tunnel can be considered to be "outside" the body, even though it does not seem that way to us. Like the train tunnel, the alimentary canal (the name given for the digestive tunnel) twists and turns, narrows and widens through the mountain's belly. One end of the human body's digestive tunnel, of course, is the end where things get to be tasted--the mouth. The other end, where what is left of the food after digestion ends up for disposal, is the anus.

The idea that the alimentary canal is "outside" the body is supported by the fact that the same type of epithelial cells that make up our skin also make up the lining of the canal. Of course, these cells function differently than skin cells.

Cells similar in structure, function, and embryonic origin are grouped together to form tissue. Epithelial cells are situated especially closely together with very little intercellular material between them. Cells of a tissue are held together by a basement membrane and intercellular fibers.

In fact, they are joined so tightly that they are like a smooth, cloth-like sheet. This intimate bonding of cells that also forms our outer skin provides a special protection by keeping out harmful substances that do not belong inside the body. The cell membrane that surrounds the cell determines which substances enter and leave the cell.

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Overhead 3/Handout 4: "Charlie's Epithelial Cells"

THE DIGESTIVE SYSTEM AND ALCOHOL USE

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Because some substances can pass freely through the membrane and others cannot, the membrane is said to be semi-permeable.

Alcohol has the unique molecular structure that allows it to cross that membrane, unlike liquid and solid food which must be broken down into simpler molecules by the digestive process before nutrients can be absorbed by the digestive system.

Charlie's digestive system has four basic processes:

1) ingestion of food and movement through the alimentary canal;
2) mechanical breakdown of food;
3) chemical breakdown of food; and
4) elimination of waste products and undigestible substances.

Food is ingested through the mouth and passes through the alimentary canal. The breakdown of foods occurs through mechanical processes (chewing and movement) which cause physical changes, and chemical processes of mixing food with enzymes (such as saliva) or acids (such as hydrochloric acid) which cause molecular changes. Once food has

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Overhead 4/Handout 5: "Food and Alcohol Molecules" This overhead associates American Indians with the molecule which represents health and nutrition.

Overhead 5/Handout 6: "Processes of Charlie's Digestive System"

Overhead 6/Handout 7: "Charlie's Alimentary Canal"

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been digested, it's essential nutrients can pass through the intestine walls to the blood stream where it is transported to the cells where these are transformed into energy for growth, activity and healing.

Every cell in the body requires a constant source of energy which it extracts from oxygen and digested foods which are broken down to essential molecules -- carbohydrates, fats, and/or proteins--and transformed into usable forms--glucose (from carbo-hydrates), fatty acids (from fats), and amino acids (from proteins).

Science has been able to demonstrate a great deal about how this process occurs, but there are still many opportunities for research. For example, despite our knowledge about the mechanical and chemical activities which take place in the alimentary canal, there is much we do not know about many of the interrelationships of the digestive system with other systems and parts of the body.

One reason for this lack of data may be due to the model or framework of the world that guided researchers and scientists for so long. Biologists and physiologists, like physicists, defined the world with mechanistic models. Primary organs of digestion, respiration, blood circulation, and brain-body communication (the nervous and endocrine

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Discussion: Why might the interrelationships among various parts of the body be less well understood than the parts themselves? How does this question relate to the concept illustrated by the Medicine Circle?

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systems) were grouped in systems having sequential operations. These systems were routinely presented as self-contained. You may recognize language relating to the industrial economy of the time. This mechanical model can be represented by an assembly line--as food passes through the alimentary canal, different pieces were added, or different processes are affected, with the final product being energy and growth and the by-product being waste.

While this model adequately demonstrates the pathway and process of food digestion, it is incomplete in that it neglects the interrelationships within the entire organism. It fails to appreciate the subtle interaction of systems inside and outside the digestive tract and the person as a whole during the on-going activity of metabolism.

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Discussion: How does this view of our bodies affect our understanding of our place in nature? How does it affect our behavior, our communities?

Supplementary Reading: "The Relativity of Wrong" by Isaac Asimov, in the Skeptical Inquirer, 1989.

Note: Albert Einstein's theory of relativity completely altered the manner in which mathematicians and scientists understood dimensions that had, until then, been explained by Euclidian geometry. Time and space became inextricably included as the fourth dimension and pathways of discovery became open that had not been dreamed of before.

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Similarly, in the field of the biological sciences, there have been paradigm shifts which have forever altered the way we understand the human being. Prior to the discovery of germ theory, illness was seen to have been caused by a lack of righteousness. New medicine and new diseases have affected our understanding of our bodies and their relationship to the environment, and of wellness and illness.

American Indians, having originally developed cultures independent of euro-ethnic thought, evolved with their own unique interpretation of nature. This interpretation is characterized by an embeddedness in the context of circumstances or experiences (which contrasts with the euro-ethnic tendency to segregate and analyze content separately from context). It was not until recently, for example, that scientists considered the effect of a researcher or investigator upon her scientific investigation. It was accepted that experimentation could occur unaffected or "uncontaminated" by the researcher or investigator. The traditional American Indian paradigm assumes dependence and influence among all the elements which exist in any circumstance. Health and harmony of individual, community, and environment are intrinsically related.

The new science addresses the limits of current knowledge and questions the

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The digestive process of the human body is highly interrelated with the whole body, the whole person, the community, and the environment. For us in the 1990's, this lesson of interdependence has become evident as a part of our scientific understanding and as a survival imperative.

II. The Ingestion of Food and Alcohol

In mammals, digestion begins in the mouth, or oral cavity, which holds the openings of the salivary glands, the teeth, and the tongue. As the teeth mechanically break down food, bacteria in the mouth thrive on sugar products (glucose, maltose, dextrose, fructose) and starch (which is broken down into sugar). Individuals who become highly dependent on sugar-type foods, including alcohol which is high in carbohydrates and sugars, are susceptible to tooth decay. This is because carbohydrate-rich alcohol may become a primary food

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rational progression of linear, analytic thought. An example is The Tao of Physics (Capra, 1983). Fritjof Capra discusses the limits of scientific knowledge and, in looking beyond the current "edge", considers what eastern mystics and what American Indians have long accepted: that there is chaos in order and order in chaos and that all experience exists in highly contextualized circumstances.

Discussion: How can a person's attitude, culture or environment affect her digestion? How does the way we think about our body affect the way we behave?

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source, being regularly in the mouth, thereby providing fertile ground for bacterial reproduction and tooth decay. In addition, individuals addicted to alcohol tend to neglect nutrient-rich foods which assure the healthy maintenance of teeth and gums.

The mouth grinds and mixes food and saliva. While the food is pulverized by molars and ripped and torn by the incisors, it is moistened by thousands of mucous glands embedded in the mucous membrane lining of the mouth, and by salivary glands whose

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Note: Interestingly, certain groups seem exempt from cavities--the Eskimo and African natives. Theorists suggest that this could be genetic (an inherited immunity) or it could be related to diets.

Overhead 7: "Commodities Replace Traditional Food Gathering"
Among many tribes, a generation of Indian people grew up with commodities, which were provided when relationships with the federal government moved hunter and gatherer tribes off their lands, or isolated them on reservations, or prohibited them from continuing their traditional food gathering. Use of these commodities, finely ground white flour, white sugar, powdered milk, lard, and canned meats, literally changed the diet of a generation of people and may be responsible for the abrupt shift in eating and preference patterns of American Indians throughout the United States.

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ducts open into the mouth. Saliva lubricates the food and buffers ingested acid or alkaline foods. When saliva mixes with the food, it dilutes and dissolves the food so that it can move easily through the tract and be absorbed.

Saliva is primarily enzymes and water. The enzyme present in saliva, alpha amylase, initiates the digestion of starch (from vegetables and grains). The digestion of starch is accomplished by inserting water molecules between the glucose units so that they become detached from one another. If starch and water are simply mixed together, this process occurs very slowly. In order for digestion to proceed at a useful rate, alpha amylase is required.

Enzymes are complex proteins that accelerate biochemical reactions. All enzymes are proteins,

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Overhead 8/Handout 8: "How Charlie's Enzymes Work"
Food is made up of many molecules bound together. A molecule that can be acted upon by an enzyme is called a substrate molecule. The enzyme in salva, like many enzymes, acts by temporarily binding with the substrate. This binding causes the substate to "bend" or otherwise change shape. Once the shape of the substrate is changed, it breaks connections with other substrate molecules. This means that where there was one large piece of food with many substrtate molecules all bound together, there are now many smaller pieces that are easier for the body to digest.

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and each has a specific chemical action which it catalyzes. The enzyme in saliva, for example, readily breaks down starch, but is incapable of breaking down other substances. The specificity of action of enzymes is a function of their particular structure. Each enzyme must be shaped in such a way that it can form a close fit with its substrate molecule. Not a single chemical reaction has yet been found in a living organism that is not accelerated by an enzyme. It is only through the catalytic powers of enzymes that biochemical reactions take place at a rate.

No nutrients are absorbed in the mouth, however, the alcohol molecule is so small, it can pass through the moist skin within the mouth (and other parts of the alimentary canal as well) into the blood system's capillaries which provide nutrition to the tissue in the mouth. Since blood in these capillaries returns through the circulatory systems's veins back to the heart and then, within a few heartbeats, to the brain, the effects of drinking alcohol can be felt by the drinker very quickly. Subtle changes in the physiology and behavior of the drinker occur almost immediately because of the rapid absorption.

An observant person who knows the drinker's physiology and behavior will recognize the changes that occur. This happens even as small amounts of alcohol enter the blood stream through the walls of the mouth because alcohol acts as a dilator (enlarger) on the capillaries. More blood flows through, warming and even reddening the muscles and skin in

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Discussion: How might the children of alcoholics react when they observe these subtle changes?

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the surrounding area. It is not uncommon for the face to change hue or color and temperature, however slight, even during the early phases of drinking. The alcohol molecule, then, is different from food in that it enters the bloodstream prior to digestion -- even while in our mouths.

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Note: Although absorption of other dangerous drugs (such as glue, paint thinner, certain paints, gasoline, cocaine, etc.) can take place through the respiratory system, the principles of absorption are also true of alcohol-type and other drug-type products which are sniffed. Since sniffing of dangerous products is an issue for Indians and for non-Indians, pointing out the similarity among drugs encourages students to generalize the knowledge they are gaining.

Injection of drugs directly into the bloodstream is another way in which dangerous drugs can be introduced into the body's systems.

Note: Many drinkers, including Indian drinkers, do not believe that others can tell when they have been drinking (except perhaps from the smell associated with alcoholic beverages). Children have often learned many of the symptoms of drinking in the grown-ups and teenagers in their circle of family or relations (i.e., talkativeness, or increased silence, more gestures, trips to bathroom, temper explosions, etc.). However, part of the dysfunction that

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often accompanies the abuse of alcohol in the family is the denial (the pretending by both the family and the drinker) that is also present. Since the pretending becomes so habitual and is a survival strategy, it can occur on a totally unconscious level. The result is often that people who are affected by alcoholism cannot recognize the alcoholic behavior and symptoms at a conscious level and therefore become a part of an intimate system that psychologists have labeled codependent. That is, the relations don't even know that they are pretending along with the drinker.

It is not surprising that children who are raised in this environment may assume that their senses are unreliable since what they see and hear is not validated and may be overtly denied.

Discussion: How can learning the science of alcohol help students to begin to trust their perceptions? How can a teacher facilitate this growth?

Note: The sense of smell is a powerful ally for animals and for human beings (also animals). Along with our eyes and ears, it warns us of danger (the "smell of danger") and it provides us with sensory joy when smelling the things and people we love. The nose can serve as an early warning system for families of alcoholics and can stimulate alternative behavioral choices regarding the

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use of drugs and alcohol or other ethanol-type substances which are sniffed.

The sense of smell provides us, like all animals, with information about our world and our experiences. We all can remember the sensations of hunger when we smell delicious foods or of comfort when we enter the home of a person special to us and recognize familiar smells. Olfactory associated memory is perhaps the strongest sense-related memory humans have. We have learned that babies can identify and bond to the smells of their primary caretaker and that we can recognize smells which tell us of danger and smells which tell us of opportunity.

A Cheyenne or Mandan hunter recognizes the black bear's odor long before he sees and often before he hears the animal. When the hunter is stalking the bear, he becomes hyperalert and is very conscious of this smell--its direction, its potency, whether or not it is sweet, harsh or acrid which tells him about the sex of the bear and often its state of calm or agitation, and its location (if the odor alternately intensifies or diminishes, the bear is moving). The hunter clans of Indian groups became very conscious about smells; but for most of us, this communication between our environment and our brain occurs at an unconscious level. In the euro-ethnic culture, we

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have "de-odorized" ourselves and our environment.

Consider the emphasis in this culture on use of body products that serve that purpose. Our grocery stores do not smell like food, our foods are packaged in tin and aluminum and plastic. This is part of contemporary civilization.

Discussion: Can you think of other cultures or subcultures where the sense of smell provides important survival information? Some answers may include: 1) desert Indians like the Hopi, Papago, and the Mohave smell coming rain; 2) Menorah and Potawatomi have learned to smell approaching storms on the Great Lakes; 3) Choctaw, Houma, and Seminole smell hurricanes brewing; 4) Paiute, Sac and Fox and Sioux on the plains are alert to prairie fires; 5) the Colville know the smell of a forest fire; 6) Aleuts and Eskimos smell the incoming walrus colony; and 7) the Salish and Yakima smell the salmon as they move upstream to spawn. Ask for non-Indian examples also.

Story 1/Handout 23: "Swims Long Way and the Squall Pot", by Carolyna Smiley-Marquez, 1990.
This story is set in Ottawa country where, years ago, clans lived on both eastern and western sides of the northern end of Lake Michigan. Travel and settlement by some families across the narrow of the great lake for food

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gathering may have been the reason for this separation.

The smell and feel of an impending squall is very distinct. Those who depend on and travel the lakes know how that smell serves as a warning of danger for small and large crafts used for crossing and for fishing.

This story is a metaphor for alcohol use and abuse. Alcohol abusers are swallowed up by their own unwise desires to overuse it. It's smell, one of danger, is housed in a container like Swims Long Way's clay pot, and that smell, as the smell of a squall, can permeate the atmosphere as an alert.

The story implies that Swims Long Way could have been lost forever; but because he learned a good lesson and gave a gift, he was saved. In this way he became a man and, in using his gifts of experience and of recognizing the smell of danger, he became a warrior.

Storytellers are very respected among Indian people as they are the creators of the stories which give lessons for living. Here, the teller's gift is a lifesaving story about taking unwise risks. The same lesson may be taught through a number of stories depending on the teller and on the context. The Indian teller knows that the lessons of life are abstracts; their forms, then, are amorphous. It is the gift of the

THE DIGESTIVE SYSTEM AND ALCOHOL USE

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The tongue, a powerful muscle, moves the food around in the mouth to assure proper grinding. It is covered by a mucous membrane and many tiny extensions of papillae which give it a rough texture. Touch receptors and specialized taste buds are present in the papillae. When the ball (called

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teller to make these abstract lessons tangible through stories.

Stories may change with each telling and may take on different characteristics when told by a different person. Indian tellers (as well as tellers from other cultures with a rich folkloric history) create stories rich with their own unique symbols. This is what gives a story its characteristics and binds it to a group. Yet the structure, the intent, and meaning of the story may be truly cross-cultural.

Activity: Read "Swims Long Way and the Squall Pot", and discuss the following questions:
1)What are some of the traditional "American" stories? 2)To what extent is abstraction and metaphor used? 3)What cultural values are informed and supported by these stories?

Supplementary Reading: Keepers of the Earth: Native American Stories and Environmental Activities for Children by Michael J. Caduto and Joseph Bruchac, 1989 is an example of American Indian stories used in the teaching of science.

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a bolus) of food has been chewed and lubricated, it is rolled backward on the tongue and pushed or flipped down into the cavity of the pharynx.

The pharynx or throat is a small chamber that is shared by the respiratory (trachea) and the digestive (esophagus) tracts. It is the juncture where these passages cross. Occasionally, there are "traffic jams" in this area. A person might breathe food down the wrong pipe and have to choke up the matter or swallow air down the wrong pipe and have to belch it up. Vomiting may be caused by mechanical irritation to the pharynx, such as sticking a finger down the throat or swallowing something highly irritating.

The esophagus is a flattened, muscular tube about 10 inches long which extends between the lungs, behind the heart, and through the diaphragm to reach the stomach. It is primarily a transport tube and does nothing to accelerate the digestive process specifically. Food is pushed down the esophagus by a series of waves of contraction. These waves, called peristalsis, occur because of the contractions of circular muscles in its walls. The actions of these muscles are powerful, involuntary, and independent of gravity. That is why we do not have to remember to swallow or think about our food on its way to the stomach. In fact, we can swallow even when we are standing on our heads! A circular muscle, the cardiac sphincter, connects the esophagus to the stomach. It relaxes to allow food to enter and closes to prevent regurgitation. An irritant, such as alcohol, can cause reverse peristalsis resulting in vomiting. Vomiting irritates the esophageal lining and

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Overhead 9/Handout 9: "Charlie's Esophagus"

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increases the likelihood of reverse-peristalsis. Continuous reverse-peristalsis leads to damage of the esophagus walls which can cause esophageal hemorrhaging and often death.

The effects of alcohol on the movement of food increases in severity with chronic alcohol users. Studies have revealed that primary and secondary peristalsis (in the upper two-thirds of the esophagus) can deteriorate (become weaker), while there is an increase in the non-peristaltic contractions following deglutition (the emptying of the esophagus into the stomach). In addition to the weakening of peristalsis, the frequency of primary peristalsis is reduced as a result of alcohol use. This means that swallowing food becomes more difficult and, because the non-peristaltic contractions increase, stomach contents and acid are forced to come back up the esophagus. This discomfort caused by eating combined with a dependence on the calories in alcohol is one reason why many alcoholics avoid food and, eventually, become malnourished.

Often heavy users of alcohol also smoke. Such a combination significantly increases the risk of developing esophageal cancer. Although it is unclear whether it is the alcohol or its enhancement of the carcinogenic affect of tobacco, cancer risks increase. This may be because there is direct damage by alcohol on the esophagus. When smoke enters the esophagus it affects the already damaged cells. Or it may be taht the nutritional deficiencies associated with chronic alcoholism may induce cell damage in the mucous, making them more sensitive to carcinogens.

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Overhead 10: "Deadly Combination"

THE DIGESTIVE SYSTEM AND ALCOHOL USE

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The functions of the body are regulated by two major control systems: 1)the nervous system, and 2)the hormonal, or endocrine, system. The hormonal system is concerned principly with control of the metabolic functions of the body, controlling the initiation or suspension of chemical reactions in the cells, the transport of substances through cell membranes, or other aspects of cellular metabolism such as growth and secretion. Some hormonal effects occur in seconds, while others require several days simply to start, and then they continue for weeks, months or even years. Many interrelationships exist between the hormonal and nervous systems. Milk production in mammary glands, reactions to danger, and sexual and reproductive functions are all examples of this interaction.

The presence of food triggers responses by the nervous system, which notifies endocrine glands to produce hormones. The hormone gastrin is released into the blod in response to the food. Each hormone has a specific personality, or characteristic, and a specific destination and purpose. Many hormones may be present and moving through the bloodstream

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Note: When a lactating mother hears the sound of a crying baby, even when her own child is far away, her brain responds to the cries as if it were her child. The response is to send a chemical signal (hormone) to the glands that produce milk in breasts, stimulating them so the crying child can be fed.

Discussion: What are other examples of hormone stimulation?

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at once, each with a specific task. The hormones that are released signal other organs, such as the stomach and liver, as well as cell membranes throughout the body to prepare to process and accept nutrients. Some recent studies suggest that the presence of alcohol in the bloodstream may alter the production of hormones.

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Story 2/Handout 24: "Night Flyer and the Trickster" by Carolyna Smiley-Marquez, 1990. Raven is often represented, like Coyote, as a trickster. Raven is full of mischief and, occasionally, as in this encounter with Night Flyer (bat), his curiosity runs away with his good sense. Raven is a reminder to all of us not to take life too seriously, and, in this story, to think about the consequences of making a trade of one good sense for one that we know very little about.

This analogy of trading away one's "good sense" for something that looks like it might empower us, is like using alcohol without thinking about the consequences of making such a bargain. This is an opportunity to discuss how Raven's trade of his excellent eye is like using alcohol.

Activity: Read "Night Flyer and the Trickster". Ask participants to imagine that they are Night Flyer who has played that exquisite trick on raven. Night Flyer now has the facility to map movement with both her eyes and her supersonic ears. If we, as night flyer,

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The hormones that are released signal other organs, such as the stomach and liver, as well as cell membranes throughout the body to prepare to process and accept nutrients.

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fly high above the ceremony with our dual mapping tools, we could look down and watch the dancers, and, using our bioradar, we also can trace the movements of small insects.

Imagine that we do this for a period of time, and we record or make a map of all the movements of each human dancer, drummer, singer, of each other human present in the shadows of the ceremony, and of each of the insects. Our map may be made of lines, or dots of light, or may appear to be neon blurs; and as we study our map we might also notice that each participant in the event had a pattern to his or her movements. Lacking a mapping record, the movement seemed chaotic. However, a pattern emerges when we, as night flyer, now study our map of the night's action.

Note: The discreet nature of the body's nervous, endocrine and communication systems can be related to the preparation for ceremonies. While there may be some talk about the coming event, most of the initiation of a ceremony in Indian country, occurs with little overt planning or discussion. Particularly nonpublic Indian rituals and ceremonies, like those of many individual tribes, have occurred for so many

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III-A. METABOLISM OF FOOD AND ALCOHOL

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generations, that the preparation begins without heralding.

Who knows what serves as the announcer? The smell of fish smoking, of mutton boiling, of pine fires--the silent transference of ceremonial items or clothing from niches, from boxes--the gathering of the medicine people who talk in low voices with each other -- the melting of the snow, the passage of migrating birds, the birthing of antelope -- something invisible, perhaps intuitive, motivates the beginning of preparation among the people.

Of course, occasionally a caller will notify the people, but usually this notice serves only to validate the preparations being made by men and women of the community. Each part of the activity, essentially silent, intimately interwoven and interdependent, stimulates other actions and activities. The choreographer is the culture, the history, the seemingly innate script, that directs the replication of events as old as Indian time. Perhaps the message is passed by invisible calls, like those of Night Flyer, which are heard only by those who have the ears to hear. Perhaps.

Overhead 11/Handout 10: "Charlie's Stomach"

THE DIGESTIVE SYSTEM AND ALCOHOL USE

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The Stomach

The stomach holds about two and one-half quarts of food (recall that food is defined here as solid and/or liquid). It is unique in that it is a storage organ, a digestive organ, and a hormone producing organ. Once food enters the stomach from the esophagus, the stomach begins to move with rhythmic contractions. This movement helps to continue the breakdown of food. It also causes the cells in the stomach to produce enzymes. These enzymes break down food.

Hydrochloric Acid (HCl) is also produced at this time. HCl is an aqueous solution of hydrogen chloride. It is a highly corrosive strong mineral acid commonly used in laboratories. It is produced by the gastric cells in response to gastrin, histamine, and nerve stimulation. The presence of hydrochloric acid reduces the pH to less than 2.0 which is highly acidic. Neutral pH is 7, anything above 7.0 is more alkaline, everything below, more acidic. HCl causes the food to corrode. It is, in fact, so corrosive that it is difficult to find containers that will hold it. Mucous membranes protect the lining of the stomach from the effects of HCl by producing mucous which neutralizes the acid.

After food has turned into a fluid-like mass known as chyme, which is the consistency of oat-meal, it leaves the stomach and goes to the small intestine. Food usually spends about 4 hours in the stomach. Normally there is no absorption of any substance in the stomach, only the breakdown of food, large particles to small.

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On the other hand, while alcohol is absorbed in the stomach some of it is absorbed through the stomach walls and goes to the bloodstream. The rate of absorption of alcohol determines the alcohol's effect on the rest of the body. Two factors influence the speed and amount of absorption and resultant intoxication: the type of alcoholic beverage and the amount of food in the stomach upon ingestion. The higher the concentration of alcohol in a drink (up to 50% or 100 proof), the more potent the quantity that is ingested and the more quickly it is absorbed. Distilled spirits, such as whiskey and vodka, effect the body more dramatically as a result of this rapid absorption. Beer effects the body in the same way, but contains food substances such as sugars which slow the absorption.

Because food absorbs and disperses the alcohol, the amount of food in the stomach determines how quickly alcohol affects the rest of the body. Food acts to slow absorption because it allows for the alcohol to be distributed throughout the stomach area rather than be pooled against stomach walls. Food must be in the stomach before the alcohol in order to have this effect.

Alcohol has two effects on human tissue, including the stomach walls--it sedates and it irritates. It slows digestion, absorption, and movement of impulses along the nerves, and it relaxes the vascular system. The continuous presence of alcohol in the stomach acts to irritate and inflame the mucous membrane. This irritation, called gastritis, causes the stomach to contract and squeeze out the maximum amount of hydrochloric acid which then results in a dual irritation effect, both from the alcohol on the lining of the stomach itself, and from the increase in the output of hydrochloric

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acid. The result is often the development of raw sores, or ulcers.

Alcohol dependent individuals often experience high levels of nervousness when they have not had a drink. Such nervousness may cause indigestion since the secretion of digestive juices of the stomach (pepsin, mucous, HCl) are responses to nervous stimuli. Alcohol as an irritant disturbs the integrity of the epitheliums (lining cells) of the stomach by creating wound-like breaks and cyst-like lesions. In addition, alcohol's presence may alter the acidic secretions and may effect movement of the gastric muscles.

An ulcer may hemorrhage which can cause severe retching and vomiting. Hemorrhages can result from inflammation. In fact, bleeding can occur even in the absence of an ulcer simply from a seriously inflamed stomach lining. If a large blood vessel happens to be in the area of the ulcer, bleeding can be profuse. Hematemesis (vomiting of blood) and black tarry (digested blood) stool are symptoms of bleeding.

Another threat of ulcers is that they might perforate and release the stomach's contents into the abdominal cavity where the food, filled with bacteria and acid can cause infection and even death. This circumstance is a serious emergency and can

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Note: If ulcers are in the stomach, they are called gastric ulcers; in the esophagus, esophageal ulcers; and if in the duodenum, duodenal ulcers. Duodenum ulcers are the most common.

Overhead 12: "Ouch!"

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only be treated by immediate surgery. Ulcers can be healed with proper nutrition, medicine, and removal of the irritant.

When a healthy stomach receives food, the stomach muscles begin almost immediately to contract and expand in a rhythmic manner. This continues the breakdown of food begun in the mouth. When this process is complete, chyme enters the small intestine by going through the pyloric sphincter.

Similar information to the cardiac sphincter which allows food to enter the stomach, the pyloric sphincter allows food to move from the stomach to the small intestine. It is sensitive to the presence of alcohol. With large concentrations, it tends to get "stuck" in the closed position. When this pylorospasm happens, the alcohol trapped in the stomach may cause sufficient irritation to induce vomiting. This "stuck" pylorus may serve as a self-protective mechanism by preventing the passage into the small intestine of what might otherwise be life-threatening doses of alcohol.

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Note: Remember Raven's eye socket? He gave away his eye in exchange for an ear that served him no useful purpose because he did not have the shrill voice to send out signals for his new radar detector. A discussion about Raven's loss and how it is like an esophageal, stomach, or duodenal ulcer could emphasize the seriousness of the damage.

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The Small Intestine

Overhead 13/Handout 11: "Charlie's Small Intestine"

The highly convoluted small intestine begins at the pyloric sphincter and ends at the cecum of the large intestine. It fills the abdominal cavity within the frame of the large intestine. The small intestine, 3 to 5 meters in length and about three centimeters in diameter, is roughly divided into three parts: the duodenum at the top, the jejunum in the middle portion, and the ilium at the bottom. Typically, food spends about 12 hours in the small intestine. As in the esophagus, peristalsis moves food through the intestines. The major portion of the absorption of nutrients occurs here. The partially digested food is highly acidic in the stomach but due to the mucous of the small intestine, the pH is alkaline in the intestine.

Overhead 14/Handout 12: "Close up of Charlie's Small Intestine"

Food digested in the small intestine is ready to be used by the body cells. To do the body any good, food cannot stay in the small intestine. It must be carried by the blood to all the cells of the body. Food gets out of the small intestine and into the blood by absorption, the movement of chemicals or water into or out of an organ.

In the duodenum, the chyme is blended with enzymes from the pancreas and bile from the gall bladder. The chyme is them moved to the jejunum where most nutrients are absorbed. Enzymes from the stomach and the pancreas break food down into nutrients, amino acids and small proteins. It is these very

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small particles that cross the lining of the small intestine to enter the bloodstream and become valuable to the body as fuel.

Overhead 15/Handout 13: "One of Charlie's Villi"

Nutrients are absorbed by the epithelial cells that line the small intestine in finger-like extensions called villi. Nutrients diffuse through the cell walls and into the villi. Inside each of the villi is a central lymphatic capillary called the lacteal. The lacteal is responsible for the absorption of fat from the nutrients. The remaining nutrients are absorbed into the bloodstream by a network of blood capillaries which surround the lacteal. These capillaries then dump into larger blood vessels which carry the nutrients to the rest of the body.

Overhead 16/Handout 14: "Outside to Inside"

Nutrients diffuse directly through the surface membrane of the epithelium and into the cell. Water, which is constantly diffusing along with the nutrients, creates a flow of fluid which assists the movement of nutrients in and out of the cell. The nutrients diffuse out through the sides of the cell into the area between the cells, known as the intracellular space. From the intracellular space, they continue to diffuse through the basement membrane of the epithelium and finally into the circulating blood of the villi. Fats are absorbed in a slightly different manner. Digested fats are dissolved before entering the cell. Once inside the cell, the fats are "reassembled" into forms which can be more easily absorbed by the lacteal. The

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newly "reassembled" fatty substances are excreted into the intracellular space, and through the basement membrane. When the substances are within the villi they are ready to be absorbed by the lacteal.

The microscopic journey of nutrients from the intestine to the blood stream is an example of nature's ability to bring together several systems. While in the intestine the nutrients blend with enzymes from the pancreas and bile from the liver. When they are broken down enough, they are absorbed into the epithelial cells which have small openings on the intestine side. When the nutrients are inside the cell, they go through another process in which they are broken down even further and then recombined with lipids (fats) before they pass through the other side into the lacteals. Although the nutrients are larger than they were when they entered the epithelial cells, they are able to move through the epithelial cell wall because the lacteal side of the epithelial cell has larger openings than the intestine side. The nutrients can easily move through, now ready to be transported by the blood system and used by the body.

Alcohol behaves differently from food in the small intestine just as it does in other parts of the body. Because of the structure of the alcohol molecule, it can easily slip through the epithelial cells without undergoing the digestive process. It moves directly into the blood from the small intestines. Remember that because of its molecular structure, alcohol begins entering the bloodstream in the mouth and continues to diffuse unmetabolized into the bloodstream throughout the digestive journey.

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The Large Intestine and Anus

The large intestine also has villi or folds. It does not produce digestive enzymes and is not involved in the chemical digestion of chyme. Instead, it absorbs water, vitamins, and minerals, thus creating feces from the more fluid-like chyme. The total length of the large intestine is only about five feet. It is organized in the body in the shape of an upside down U, from the site of the appendix, extending up to near the diaphragm, across the left side below the diaphragm and downward. Neither digestion nor food absorption occurs from the large intestine. The primary activity is the reabsorption of water from the waste material back into the blood. Wastes, as a result, are concentrated.

In the colon, various bacteria live upon the residue of digestible material in the chyme. In the process of this interaction, chemical changes convert the waste materials into fecal material. From the lowermost part of the large intestine, the rectum, this fecal material is transferred out of the body through the anus.

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Overhead 17/Handout 15: "Charlie's Large Intestine and Anus"

Note: The large and small intestines do not join end to end. Rather, the small intestine enters the large intestine several inches above its "blind" end. This is known as the cecum. An outgrowth, the vermiform appendix, extends downward from the cecum.

THE DIGESTIVE SYSTEM AND ALCOHOL USE

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Very little alcohol stays in the alimentary canal past the small intestine. The body does not eliminate alcohol in this way. An examination of some of the organs that support digestion reveals more about this process.

III-B. METABOLISM OF FOOD AND ALCOHOL

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Overhead 18/Handout 16: "Charlie's Pancreas"

The Pancreas

The pancreas produces enzymes needed to break down food as well as the hormones needed to balance blood sugars. The pancreas produces the digestive enzymes and releases these into the small intestine just below the duodenum. It is these enzymes that take the chyme and break it into particles small enough to cross the lining of the small intestine so that they can enter the body.

The hormones of the pancreas are mainly related to regulating blood sugar levels in the body. The only fuel that our body uses to produce energy is a particular sugar molecule, glucose. All other nutrients, such as amino acids and fats, are used as building blocks but not as energy. The regulation of glucose in the blood is very important. If it gets too high some might be discarded as waste. If it gets too low the body stops functioning. There are two hormones that are primarily involved in controlling blood sugar levels, insulin and glucagon. Insulin is released when blood sugar levels are high. It stimulates the cells of the body to allow glucose to enter by increasing the permeability of the cell membrane to glucose. One of the primary cell types that this occurs in is

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liver cells. This way, when blood sugar levels are high (a condition known as hyperglycemia), the liver cells will take up a large amount of glucose and store it as glycogen for later use. Other cells of the body will take up glucose and use it to make Adenosine Triphosphate (ATP) which is the energy currency of the body. Glucagon is released by the pancreas when blood sugar levels are low (a condition known as hypoglycemia). Glucagon stimulates the cells of the liver to turn the stored glycogen back into glucose and dump it into the bloodstream. This increases blood sugar levels to a point where the body can keep using glucose for fuel.

Overuse of alcohol changes the secretions of the pancreas to the point that the canals become swollen and plugged. The cells themselves begin to swell creating a condition called acute hemorrhagic pancreatitis. This condition is a very painful disorder requiring large amounts of sedation and pain-killing medication. Many people die in their first attack, and of those who survive, many experience chronic recurring pancreatitis. The reoccurrence is due to a breakdown of tissue in the pancreas and the formation of large vacuoles or tumors filled with fluid (called pseudocysts). These tumors are also painful and degrade the pancreatic function.

Presentation Notes

Note: An enzyme acts as a chemical compound to change the structure of the material with which it is interacting. A hormone acts on a body cell or organ to alter its function.

Supplementary Reading: "University of Colorado Creates First Artificial Enzyme" by Joseph E. Verrengia, 1990 this article contains the following

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The Liver

The liver is a large organ that is of vital importance for the metabolism of all ingested substances, particularly toxins such as alcohol. The liver is responsible for a host of tasks. It breaks down wastes and toxic substances. It manufactures essential blood components, including clotting factors. It stores certain vitamins, such as B12 which is essential for red blood cells. It helps regulate the blood-sugar (glucose) level, a very critical task, because glucose is the only food the brain can use.

The presence of alcohol disturbs the metabolic function of the liver. Metabolizing alcohol is always a very high-priority liver function. Therefore, whenever alcohol is present, the liver is

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statements, "We can put together amino acids in a way that nature can't" and "The real motivation was to show that we could do it." Discuss this article in reference to the differences in perception of Indian and non-Indian thought regarding the role of humans in nature.

Overhead 19/Handout 17: "Charlie's Liver"

Supplementary Readings: "Liver Is Main Pathway for Alcohol" by Robert Nystrom, 1990; "Alcohol the Chemical: How it Works" by James Milam and Katherine Ketcham, 1981; "Alcohol's Acute Effects on the Body" by Jean Kinney and Gwen Kinney, 1987.

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"distracted" from other normal and necessary functions. For the alcoholic, this can be frequent.

The liver is composed of many tiny compartments called liver lobules. These lobules are circular and consist of rows of liver cells called liver plates. Each of these liver plates is separated by small veins, called sinusoids, which carry both oxygen and nutrients to the cells.

The liver receives blood from two sources: the hepatic artery, which supplies oxygenated blood from the heart, and the hepatic portal vein, which carries blood from the digestive tract. Blood transported in the hepatic portal vein comes from the small intestine and contains a high concentration of dissolved nutrients, but a relatively low amount of oxygen. Oxygen-rich blood is supplied by the hepatic artery. Both the hepatic artery and the hepatic portal vein empty into sinusoids, which run between each of the liver plates. The walls of the sinusoids are very permeable and allow substances absorbed into the blood from the intestines, along with oxygen from the heart, to leave the blood freely and enter the liver cells. Once diffused into the liver cells, the nutrients are metabolized into simpler forms which can be used by the rest of the body. After the cell processes these nutrients, it dumps them back into the blood which then goes to the central vein. The central vein then directs

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Discussion: "What are the eating habits of persons you know who drink? Are there any patterns?"

Overhead 20/Handout 18: Liver and Liver Lobule

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the blood back to the heart for more oxygen, and then to the rest of the body.

The liver cells have another function. Blood arriving from the intestines may contain toxins which are dangerous to the body. As the blood passes through the liver, these toxins diffuse, along with the nutrients and oxygen, into the cells. Once toxins are in the liver cells, they stop whatever they are doing and work to detoxify the ingested poison. Within each of the liver plates lie tiny canals called bile canaliculi into which the liver cells secrete bile. These canals carry the bile into a large duct called the hepatic duct, which directs the bile into either the gallbladder or the duodenum of the small intestine, depending on where it is needed. Bile is secreted continuously by the liver cells, and is normally diverted into the gallbladder and temporarily stored. Once in the gallbladder, bile is concentrated about fivefold, and as much as 12 hours of bile secretion can be stored. The most abundant substance secreted in the bile is bile salts. These salts have two important functions in the intestinal tract. First, they have a detergent action on the fat particles in the food, which decreases the surface tension of the particles and allows the mechanical agitation (peristalsis) in the intestinal tract to break fat globules into small sizes. Second, the salts help in the absorption of fatty acids, and other substances, from the small intestines into the blood.

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Note: Bile is an example of the ecological actions of the human body. It is composed of materials which have been recycled for this digestive act before they are discarded with the waste products of the digestive system.

THE DIGESTIVE SYSTEM AND ALCOHOL USE

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The principle pathway for normal alcohol metabolism is the liver. Small amounts of alcohol are eliminated in urine, sweat, and breath, but the primary site of elimination is the liver. As soon as the blood carrying the alcohol enters the liver, an enzyme called alcohol dehydrongenase (ADH) attacks the alcohol molecule, quickly removing two hydrogen atoms to create a new substance called acetaldehyde. Since acetaldehyde is a highly toxic agent which can produce nausea, rapid heartbeat, dizziness, headache, and mental confusion if present in the body in large quantities, the liver quickly initiates the second step in the elimination process. It employs another enzyme with a similar name, aldehyde dehydrogenase (ALDH), to transform acetaldehyde into acetate. Acetate is then converted to carbon dioxide and water and eventually eliminated from the body.

During these two steps in alcohol metabolism, a great deal of energy is required. Alcohol, as a sugar, does release energy. In fact, it can release enough energy to run the liver. Since the liver is functioning to metabolize alcohol instead of food, the drinker gets no nutrient value other than sugar. None of the building blocks needed for the body are available, only sugar. Drinking alcohol will give a drinker a feeling of energy so many drinkers will not eat, sometimes for weeks at a

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Indian hunters and fishers know the value of using all the resources of the hunt and of recycling. It is interesting to notice that this is a part of our own biology as well.

Overhead 21/Handout 19: "Metabolism of Alcohol"

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time. Since there is no nutrient value in the energy produced by alcohol, the drinker becomes malnourished. Since alcohol is sugar, recovering alcoholics often crave sugary foods to replace the sugar that their body is used to having. This only feeds the addiction. The best thing for the recovering alcoholic to eat is carbohydrates, like bread and potatoes, which provide some sugars, but also provide building blocks. Since these are digested differently from plain sugar, the addiction is not being fed, but the relief may be the same.

The liver of an average person takes approximately one to two hours to convert an ounce of alcohol. Factors such as weight and nutritional status affect the conversion rate for each person. Alcohol that is not metabolized is transported by the blood throughout the rest of the body and returns to the liver on the next cycle where more of the alcohol can be metabolized. Some of the acetaldehyde produced from alcohol in the liver is broken down into non-toxic substances. What is not metabolized is transported in the blood in the same manner as the alcohol.

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Note: Acetaldehyde is a powerful toxin. Normally, it is quickly removed by the enzyme ALDH during the second step in the reaction. Drugs such as disulfiram (Antabuse), which are used to create psychophysiological barriers to alcohol intake, work by inhibiting ALDH. The result is the rapid buildup of acetaldehyde and the severe physical reactions of nausea, flushing, and shortness of breath.

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Several forms of liver disease are associated with alcohol abuse. Acute fatty liver may develop in anyone who has been drinking heavily, even for relatively brief periods of time. Fatty liver gets its name from the deposits of fat that build up in normal liver cells. This occurs because of a decrease in the breakdown of fatty acids and an increase in the synthesis of fats by the liver. The latter is a result of the "distracting" metabolic effects of alcohol. Acute fatty liver occurs whenever 30% or more of the dietary calories are in the form of alcohol. This is true even if the diet is otherwise adequate. Acute fatty liver is a reversible condition if alcohol use is stopped.

Alcoholic hepatitis is a more serious form of liver disease that often follows a severe or prolonged bout of heavy drinking. Although more commonly seen in alcoholics, hepatitis may occur in nonalcoholics as well. In hepatitis there is inflammation of the liver and damage to liver cells. Also, liver metabolism is often seriously disturbed. Jaundice is a usual sign of hepatitis. Jaundice refers to the yellowish cast of the skin and the whites of the eyes. The yellow color comes from the pigment found in bile, a digestive juice made by the liver. The bile is being handled improperly and is therefore

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the molecular structure and function of ADH and ALDH in an effort to explain genetic variations that may account for individual or racial differences in alcohol sensitivity and susceptibility to alcoholism. (Nystrom, 1990).

Supplementary Readings: "Metabolic Adaptations" by Dr. James R. Milam and Katherine Ketcham, 1981.

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bile is being handled improperly and is therefore circulating in the bloodstream in excessive amounts. Other symptoms of alcoholic hepatitis may include weakness, easy fatigue, loss of appetite, occasional nausea and vomiting, low-grade fever, mild weight loss, increasing ascites, dark urine, and light stools.

Although in some patients hepatitis is completely reversible with abstinence from alcohol, in others it may be fatal or go on to become a smoldering chronic disease. Among patients who stop drinking, only 1 in 5 will go on to develop alcoholic cirrhosis. But 50% to 80% of those who continue drinking will develop cirrhosis. Alcoholic hepatitis is in many cases clearly a forerunner of alcoholic cirrhosis, but it is thought that alcoholic cirrhosis can also appear without the prior occurrence of alcoholic hepatitis.

Cirrhosis of the liver is a condition in which there is widespread destruction of liver cells. These are replaced by nonfunctional scar tissue. In fact, the word cirrhosis simply means scarring. There are many different types and causes of cirrhosis, but long-term heavy alcohol use is the cause in the vast majority (80%) of cases. It is estimated that about 1 in 10 long-term heavy drinkers will eventually develop alcoholic cirrhosis. It is accompanied by very serious and often irreversible metabolic and physiological abnormalities. In fact, more than half of the patients who continue to drink after the diagnosis of alcoholic cirrhosis has been made are dead within 5 years. In alcoholic cirrhosis the liver is simply unable to perform its work properly. Toxic substances, normally removed by the liver, circulate in the bloodstream, creating problems elsewhere in the body. This is partic-

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Presentation Background

Presentation Notes

ularly true of the brain, as we shall see later. The liver normally detoxifies most of the blood from the intestinal tract as it returns to the heart. The cirrhotic liver, now a mass of scar tissue, is unable to handle the usual blood flow. The blood, unable to move through the portal vein (the route from the blood vessels around the intestines to the liver), is forced to seek alternative return routes to the heart. This leads to pressure and "back-up" in these alternative vessels. It is this pressure that causes the veins in the esophagus to become distended, producing esophageal varices and inviting hemorrhaging. The same pressure accounts for hemorrhoids.

Hepatic coma can be one result of cirrhosis. In this case, the damage comes from toxins circulating in the bloodstream. In essence, the brain is poisoned by these wastes and its ability to function seriously impaired, leading to coma. Cancer of the liver is another complication of long-standing cirrhosis. Of the people who developcirrhosis, as many as 50% will also have pancreatitis. Still other complications may include GI bleeding, salt and water retention, and renal failure. The main elements of treatment for cirrhosis are abstinence from alcohol, multivitamins, a nutritionally balanced adequate diet, and bed rest. Even with such treatment, the prognosis of cirrhosis is not good and many of the complications just described may occur (Kinney and Leaton, 1987).

Another phenomenon associated with cirrhosis is ascites. Here the liver "weeps" tissue fluid directly into the abdominal cavity. Again, this is caused by the back pressure. This fluid would normally be taken up and transported back to the heart by the hepatic veins and lymphatic system.

Presentation Background

Large amounts of fluid can collect and distend the abdomen. If you were to gently tap the side of a person with ascites, you would see a wavelike motion in response, as fluid sloshes around.

Alcoholic liver disease can diminish the ability of the liver to store glucose as glycogen, the body's storage form of sugar. There is also less ability to release glucose from storage. This can lead to low blood sugar levels. Insufficient amounts of blood sugar may cause coma, essentially because the brain is without enough of a fuel supply to function. Intravenous glucose may be necessary to prevent irreversible brain damage. On the other hand, alcohol and alcoholic liver damage may lead to states of diabetes-like, higher than normal blood-glucose levels. This occurs in large part because of the effects of alcohol and alcoholic liver disease on glucose-regulating hormones in the body.

The Kidneys

The kidneys are part of the excretory or fluid waste system. Blood enters the kidney by the renal artery and is cycled throughout the kidneys, which remove wastes and function in adjusting the concentrations of various salts in the blood. After the blood has been cleaned and is free of wastes, it leaves the kidney by way of the renal vein and circulates back to the heart. The remaining waste fluid, or urine, exits the kidney through a duct called a ureter, and drains into the urinary bladder.

Presentation Notes

Overhead 22/Handout 20: "Charlie's Kidney"

THE DIGESTIVE SYSTEM AND ALCOHOL USE

Presentation Background

Nephrons are tiny filter units within the kidney. There are about 1,000,000 nephrons in each kidney. When the blood passes by the entrance of each nephron, it passes into smaller and smaller vessels. This causes an increase in pressure inside the vessel. This pressure squeezes most of the fluid out of the vessel and into the tube-like nephron. What is left in the blood vessel is the red and white blood cells and enough fluid to move them along.

After the fluid is moved out of the blood vessels and into the nephron, the blood vessels weave around the nephron tubes and reabsorb needed proteins, sugars and salts. What is left in the nephron tubes is moved to the collecting duct where water that was squeezed out of the blood vessel is reabsorbed through the collecting duct. The rest of the contents of the nephron is waste and is stored with the waste from the other nephrons in the renal pelvis before it goes to the bladder. The renal pelvis is an area in the kidneys into which collecting tubes drain. Wastes leave the kidneys through tubes, called ureters, that empty into the urinary bladder.

Water is the most important substance to our bodies. We can go without food for a much longer period of time than we can go without water. Water is kept inside the body by being absorbed across the collecting duct wall of the nephron and back into the body. Alcohol, even small amounts, causes the collecting duct to become impermeable to water. This means that the water removed from the blood in the nephrons is not reabsorbed by the body and is excreted rather than reused.

Presentation Notes

Overhead 23/Handout 21: "One of Charlie's Nephrons"

Presentation Background

The impermeability of the collecting duct makes the bathroom a popular place in a bar. It also causes dehydration of all of the cells of the body. As any one who has ever had a hangover knows, the water is sucked out of the tissues, like the tongue and the lips, and taken to the rest of the body to keep vital tissue such as the heart and brain functioning. Dehydration is a serious problem in alcoholics, even though they are drinking all the time. It can cause dementia and heart failure and ultimately death.

The urinary bladder is a hollow muscular organ where the urine is stored until it is time to expel it. This expulsion is called voiding.

When approximately 300 ml of urine has accumulated in the bladder, its wall is stretched to the extent that sensory nerves are stimulated and transmit this information to the brain indicating that it is time to void the bladder. Normally people can control the bladder so that voiding only occurs under proper social conditions.

Although only a small percentage of ingested alcohol makes it to the bladder, it can still do damage there. When alcohol is in the urine it irritates the lining of the bladder and makes the control of

Presentation Notes

Discussion: If water is squeezed from the blood vessels into the nephron, why isn't alcohol? The alcohol molecule is too larg so only a very few are removed in the kidneys.

Overhead 24/Handout 22: "Charlie's Bladder"

Presentation Background

chronic alcoholics is that the tissue can swell so much that it is impossible to void the bladder. This leads to infection and can lead to a bursting of the bladder. Bladder infections are common in the alcoholic and can be painful as well as extremely dangerous.

In discussing the digestive process, functions and organs have been presented as well as various reactions of the body to alcohol. Although presented in fairly typical euro-ethnic science fashion, there has been an attempt to infuse an Indian world view as a way of "seeing" wholeness, connections, interdependence, harmony and lack there of.

Presentation Notes

Supplementary Reading: "Hey, What's in This Stuff Anyway?" by Harvey Milkman and Stanley Sunderwirth, 1987.

Activity: Use Handout 1 "Charlie" to review the process of digestion. Discuss normal digestion processes and adaptations the body makes to the presence of alcohol.

Activity: Ask participants to draw a Medicine Circle. Discuss how the concepts of balance and interrelatedness are reflected in the considerations of this unit. Paula Gunn Allen quotes her mother as saying "Life is a circle, and everything has its place in it." Explore applications and extensions of this thought in the context of the cycles of digestion.

GLOSSARY

THE DIGESTIVE SYSTEM AND ALCOHOL USE

Acetaldehyde	A toxic agent produced by the liver in the initial stages of alcohol metabolism.
Acid Foods	Foods of a high acid level, having a pH maximum of 6 and a minimum of 0.
Fatty Liver	Degenerative changes in liver cells due to fat deposits in the cells.
ADH	(Alcohol dehydrogenase) An enzyme that creates acetaldehyde when reacting with alcohol.
Alcoholic Hepatitis	Inflammation of the liver due to alcohol consumption. Accompanied by systematic signs including fever, jaundice, and an enlarged liver.
ALDH	(Aldehyde dehydrogenase) An enzyme that creates acetate out of the highly toxic acetaldehyde.
Alimentary Canal	The digestive tube from the mouth to anus, including mouth, pharynx, esophagus, stomach, small and large intestines, and rectum.
Alkaline Foods	Foods containing a strong base, having a pH minimum of 8 and a maximum of 14.
Alpha Amylase	The class of enzymes that split or hydrolyze starch.

Amino Acid	The building blocks of which proteins are constructed and the end-products of protein digestion.
Ascites	The accumulation of fluid in the abdomen.
Bile	A secretion of the liver which facilitates the digestion of fats in the intestines.
Bile Salts	Alkali salts of bile.
Blood Sugar	Sugar in the form of glucose.
Carbohydrate	A group of chemical substances including sugars and starches that contain only carbon, oxygen and hydrogen.
Carbon Dioxide	A colorless gas heavier than air. It is the final metabolic product of carbon compounds present in food.
Cardiac Sphincter	Muscle at the juncture of the esophagus and the stomach. Also known as the Pyloric Sphincter.
Cirrhosis	A chronic disease of the liver, characterized by scarring.
Collecting Ducts	Small ducts that receive urine from several renal tubules. Several tubules join together to provide a passage for the urine to larger straight collecting tubules (papillary ducts of Bellini) that open into the pelvis of the kidney.
Dextrose	A simple sugar formed in the digestive tract by the action of enzymes on carbohydrates.
Disulfiram/ Antabuse	A drug administered orally to treat alcoholism. Trade name is Antabuse.

Duodenum	The first part of the small intestine, connecting with the pylorus of the stomach and extending to the jejunum.
Endocrine System	A system of ductless glands that produce an internal secretion discharged into the blood or lymph and circulated to all parts of the body. Hormones, the active principles of the glands, produce effects on tissues more or less remote from their place of origin. In addition to their endocrine function, some glands produce an external secretion.
Epithelial Cells	Cells that are irregular in shape, having a single nucleus. Frequently two or three are joined together.
Fatty Acid	A hydrocarbon in which one of the hydrogen atoms has been replaced by a carboxyl (COOH) group; a monobasic aliphatic acid made up of an alkyl radical attached to a carboxyl group.
Fructose	A sugar found in corn syrup, honey, and fruit juices. May be used in the body the in the same manner as glucose or may be converted to glycogen and stored.
Gallbladder	A pear shaped sac on the underside of the liver that stores bile from the liver.
Gastrin	Hormones released by the stomach that aid in the stimulation of gastric acid secretion necessary for digestion.
Glucose	The most important carbohydrate in body metabolism. This sugar can be used as energy or stored as glycogen in the body.
Hepatic Duct	The canal that receives bile from the liver.
Hormonal System	See Endocrine System.

Hydrochloric Acid	A highly corrosive stomach acid that aids in the digestive process
Ileum	The lower three-fifths of the small intestine located between the jejunum and the large intestine.
Jaundice	A condition characterized by yellowness of the skin and eyes caused by the body's inability to process bile properly.
Jejunum	The second portion of the small intestine, extending from the duodenum to the ileum.
Lacteal	An intestinal lymphatic that aids in the digestive process.
Lipid	Any of a group of fats or fat-like substances characterized by their insolubility in water and solubility in fat solvents such as alcohol, ether and chloroform.
Liver Lobule	Structural unit consisting of hepatic cells and sinusoids surrounding a central vein.
Maltose	A disaccharide that is converted to glucose in the body.
Nephron	The structural and functional unit of the kidney. There are approximately one million nephrons in each kidney.
Papillae	A small protuberance or elevation.
Peristalsis	A progressive wave-like movement that occurs involuntarily in hollow tubes in the body, especially the alimentary canal.
pH	The degree of acidity or alkalinity of a substance are expressed in pH values. The neutral point, where a solution would be neither acid or alkaline, is pH 7.

Protein	One of a class of complex compounds that occur naturally in plants and animals. Proteins provide the amino acids necessary for the growth and repair of animal tissue.
Pyloric Sphincter	See Cardiac Sphincter.
Salivary Glands	The glands of the oral cavity that secrete saliva to aid in the breakdown of food.
Sinusoid	A minute blood vessel found in such organs as the liver and spleen.
Substrate Molecule	A substance acted upon by an enzyme.
Ulcer	An open sore or legion of the skin or mucous membrane.
Ureter	The tube that carries urine from the kidney to the bladder.

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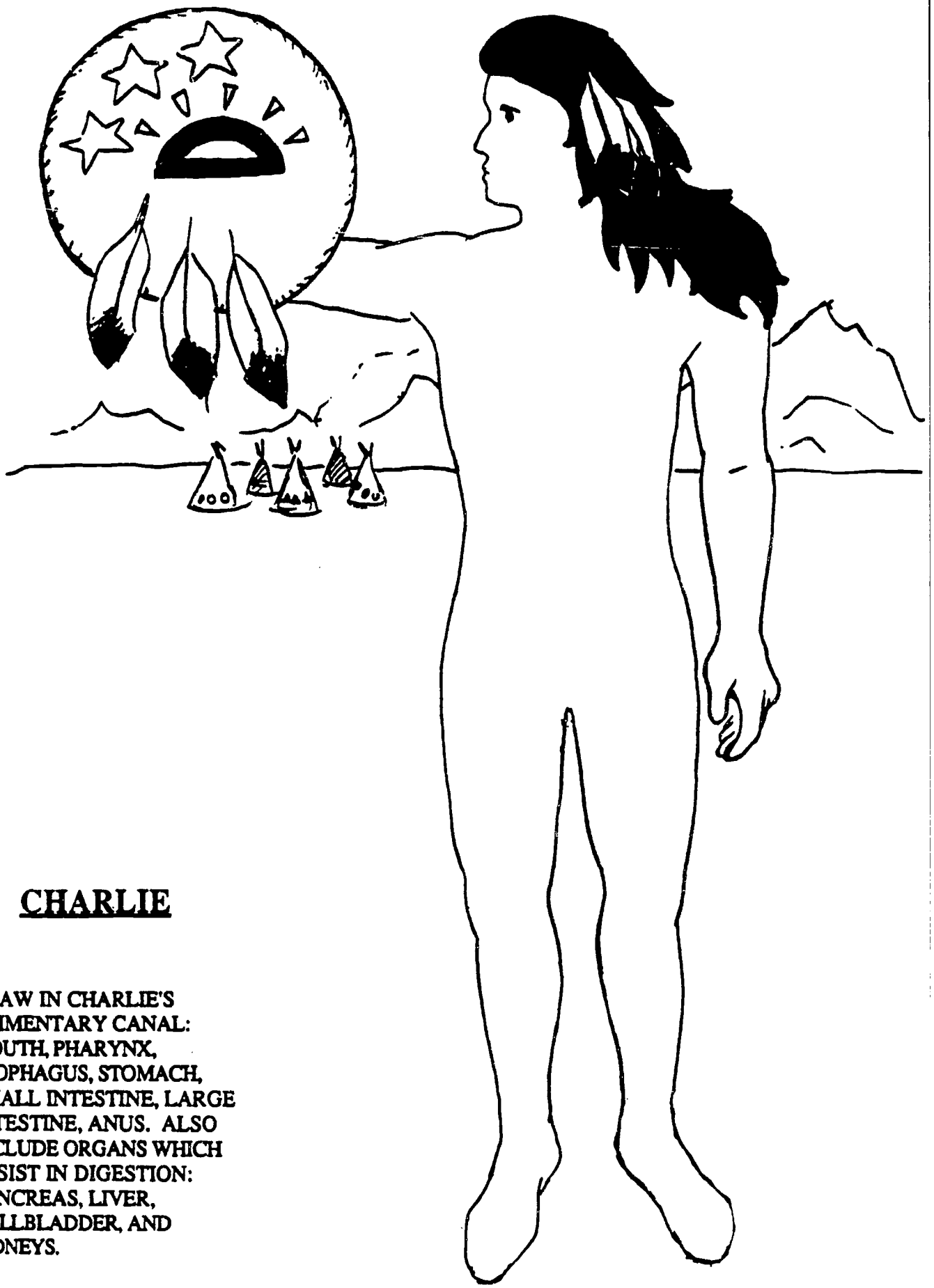
Unit Handouts/Overheads

Handout 1	Charlie
Overhead 1a	Charlie (without parts)
Overheads 1b and 1c	Charlie's Separate Parts
Handout 2	Charlie (with parts)
Overhead 2/ Handout 3	Digest Pass
Overhead 3/ Handout 4	Charlie's Epithelial Cells
Overhead 4/ Handout 5	Food and Alcohol Molecules
Overhead 5/ Handout 6	Processes of Charlie's Digestive System
Overhead 6/ Handout 7	Charlie's Alimentary Canal
Overhead 7	Commodities Replace Traditional Food Gathering
Overhead 8/ Handout 8	How Charlie's Enzymes Work
Overhead 9/ Handout 9	Charlie's Esophagus
Overhead 10	Deadly Combination
Overhead 11/ Handout 10	Charlie's Stomach
Overhead 12	Ouch!
Overhead 13/ Handout 11	Charlie's Small Intestine
Overhead 14/ Handout 12	Close Up of Charlie's Small Intestine
Overhead 15/ Handout 13	One of Charlie's Villi
Overhead 16/ Handout 14	Outside to Inside
Overhead 17/ Handout 15	Charlie's Large Intestine and Anus
Overhead 18/ Handout 16	Charlie's Pancreas
Overhead 19/ Handout 17	Charlie's Liver
Overhead 20/ Handout 18	Liver and Liver Lobule
Overhead 21/ Handout 19	Metabolism of Alcohol
Overhead 22/ Handout 20	Charlie's Kidney

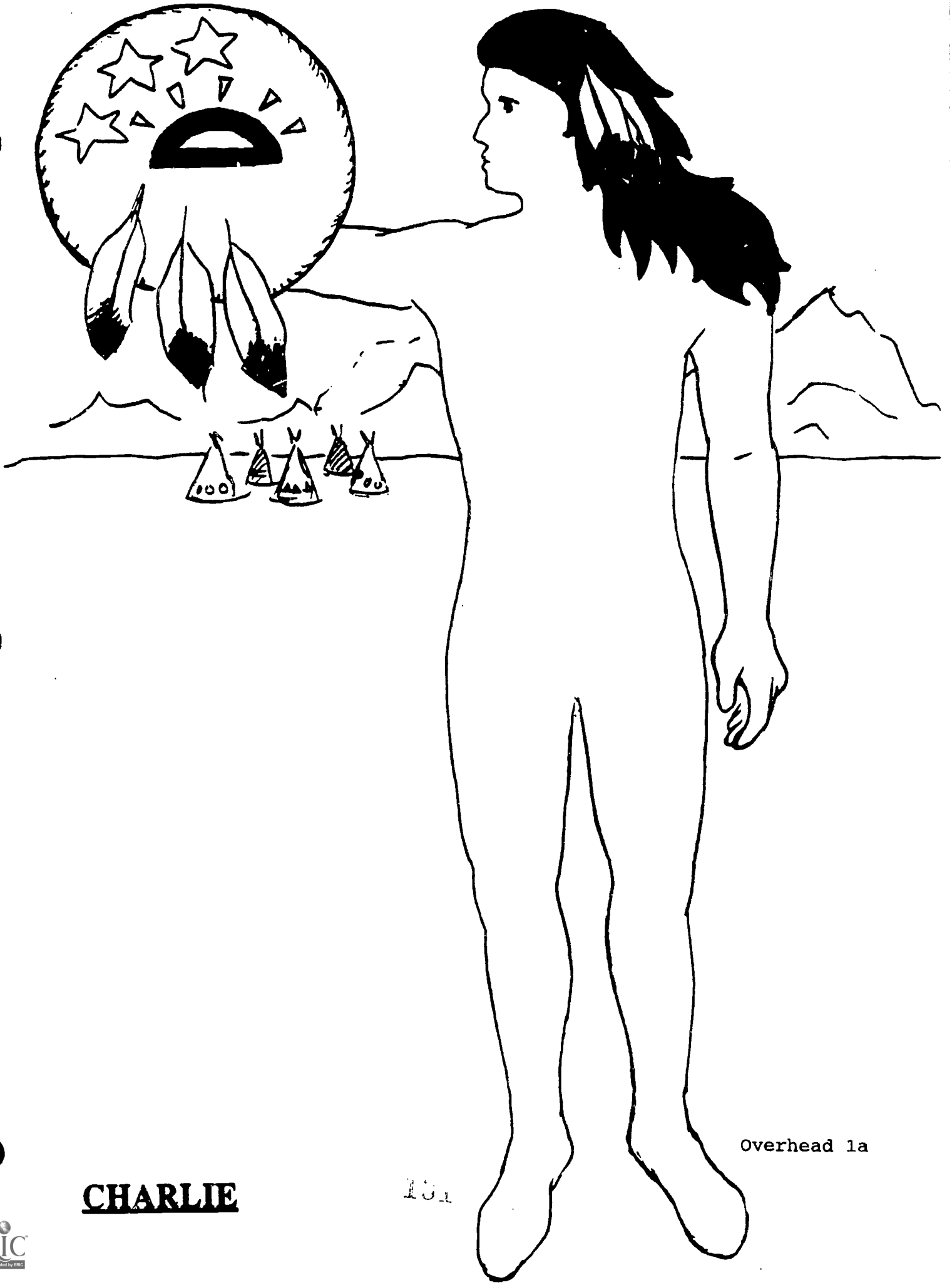
Overhead 23/ Handout 21	One of Charlie's Nephrons
Overhead 24/ Handout 22	Charlie's Bladder
Story 1/ Handout 23	Swims Long Way and the Squall Pot
Story 2/ Handout 24	Night Flyer and the Trickster



CHARLIE

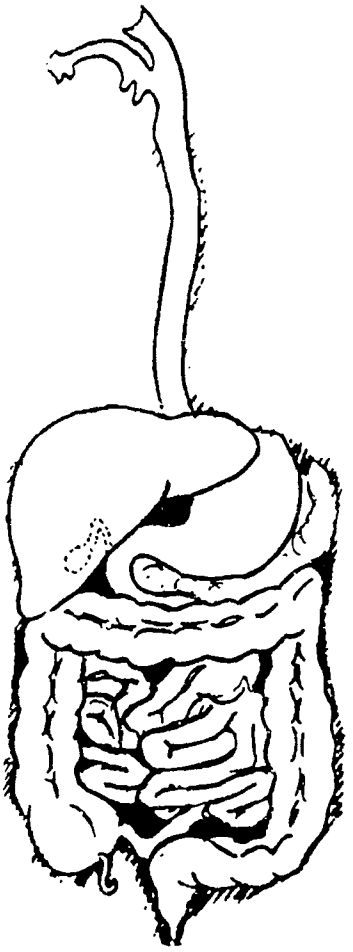
DRAW IN CHARLIE'S ALIMENTARY CANAL: MOUTH, PHARYNX, ESOPHAGUS, STOMACH, SMALL INTESTINE, LARGE INTESTINE, ANUS. ALSO INCLUDE ORGANS WHICH ASSIST IN DIGESTION: PANCREAS, LIVER, GALLBLADDER, AND KIDNEYS.

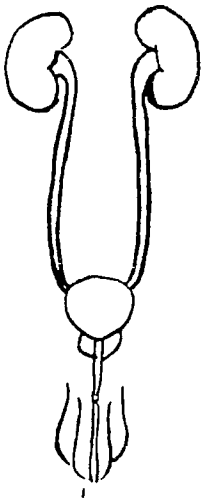
Handout 1



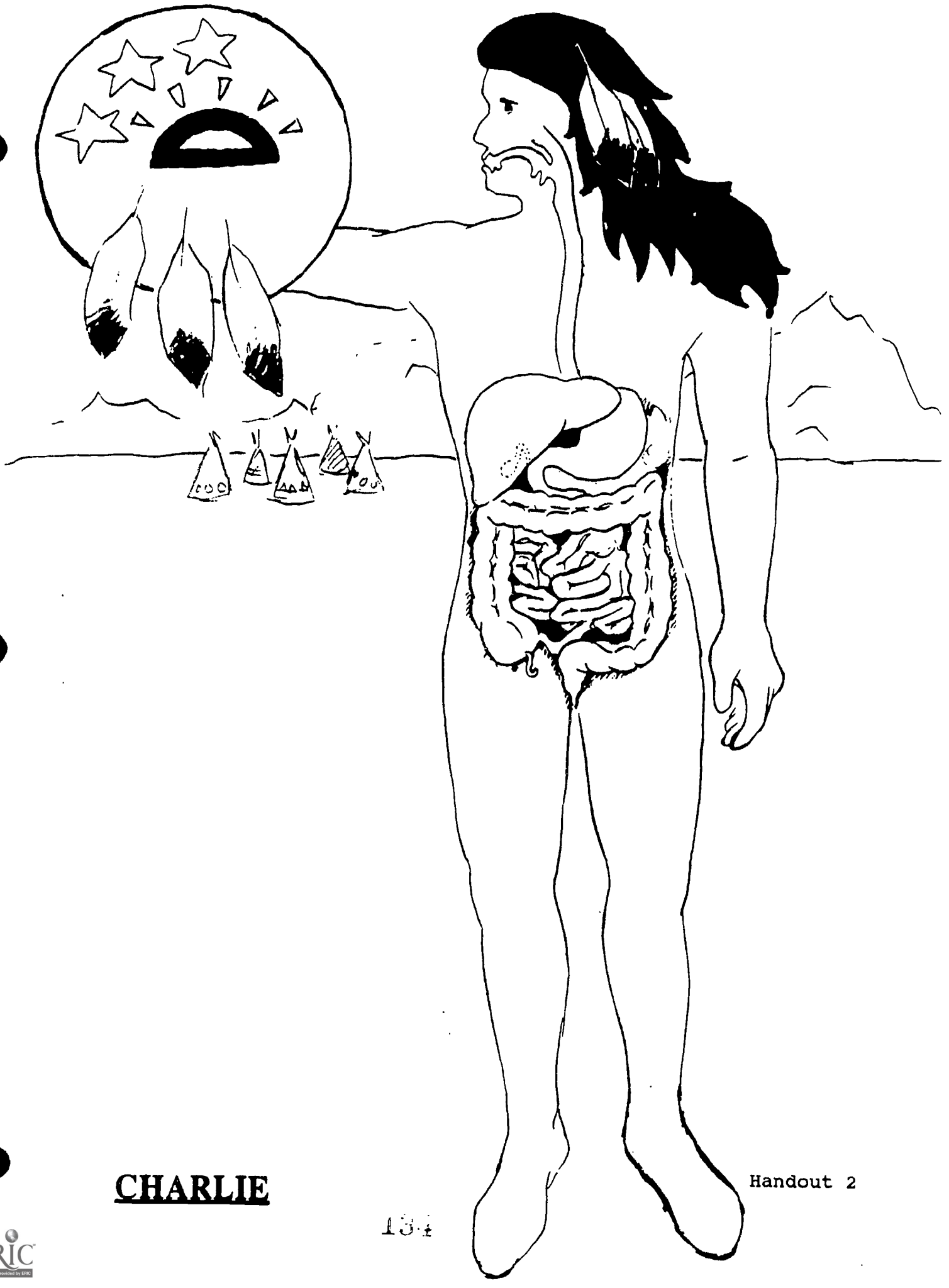
Overhead 1a

CHARLIE





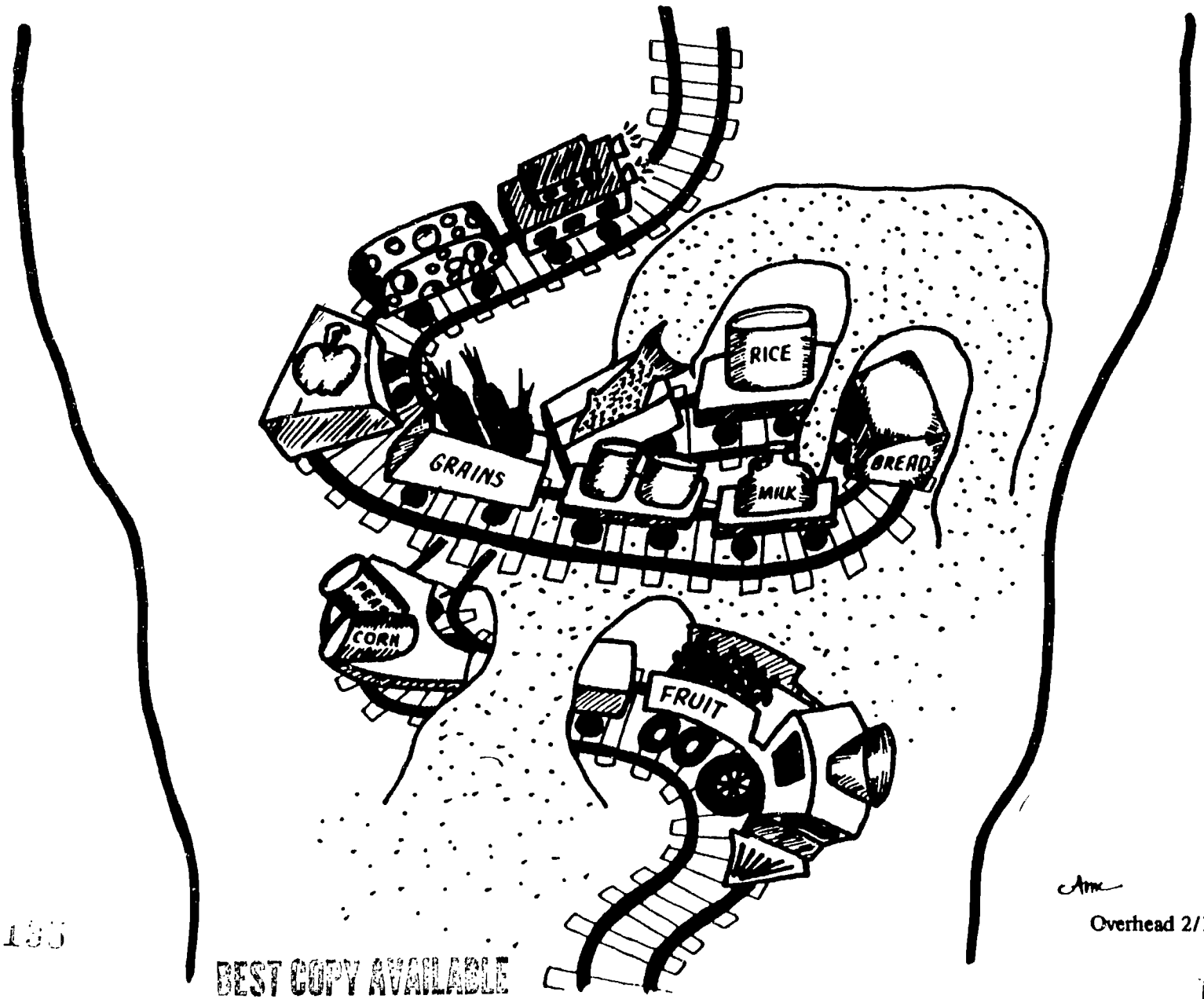
Overhead 1c



CHARLIE

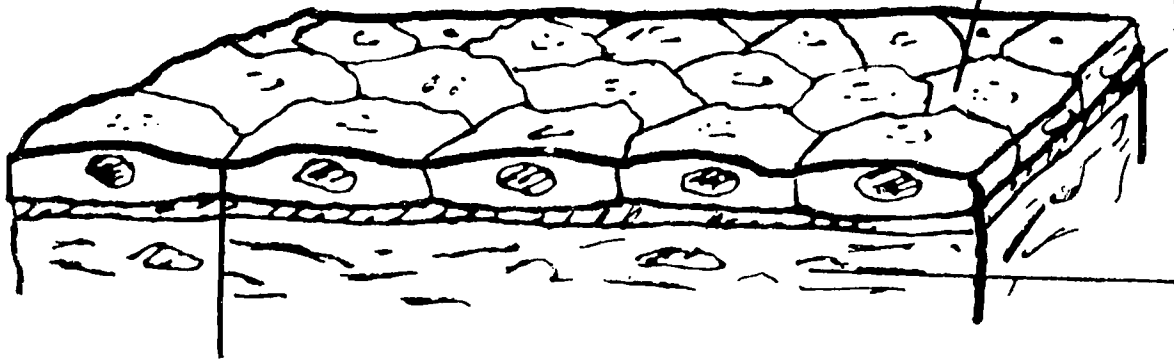
Handout 2

DIGEST PASS



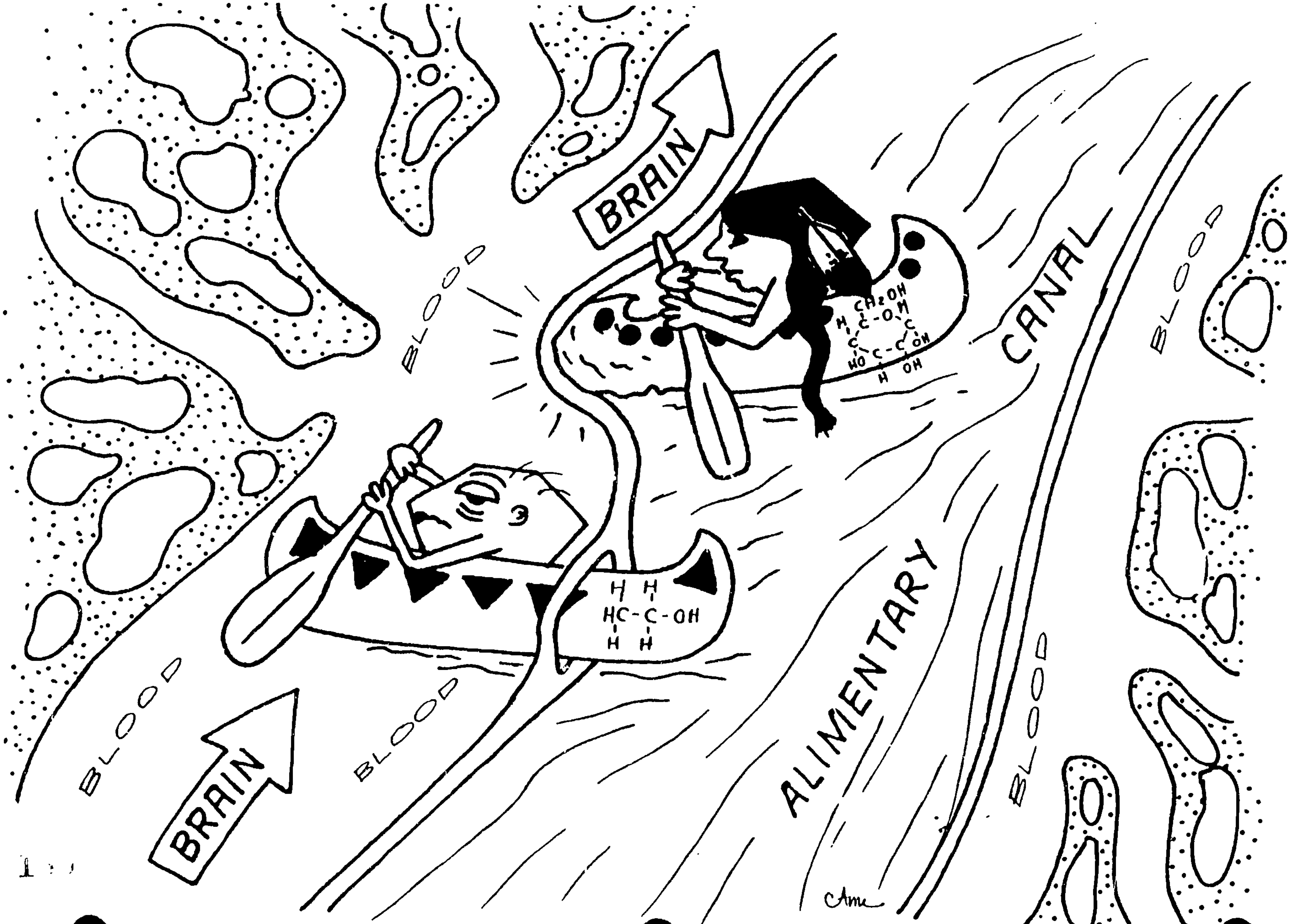
Overhead 2/Handout 3

CHARLIE'S EPITHELIAL CELLS



EPITHELIAL TISSUES LINE ALL INNER AND OUTER SURFACES OF THE BODY. CELLS OF A TISSUE ARE HELD TOGETHER BY THE BASEMENT MEMBRANE AND INTRACELLULAR FIBERS.

FOOD AND ALCOHOL MOLECULES



PROCESSES OF CHARLIE'S DIGESTIVE SYSTEM

1) INGESTION OF FOOD AND MOVEMENT THROUGH THE ALIMENTARY CANAL

2) MECHANICAL BREAKDOWN OF FOOD

3) CHEMICAL BREAKDOWN OF FOOD

4) ELIMINATION OF WASTE PRODUCTS AND UNDIGESTIBLE SUBSTANCES

Overhead 5/Handout 6

CHARLIE'S ALIMENTARY CANAL

MOUTH AND PHARYNX

ESOPHAGUS

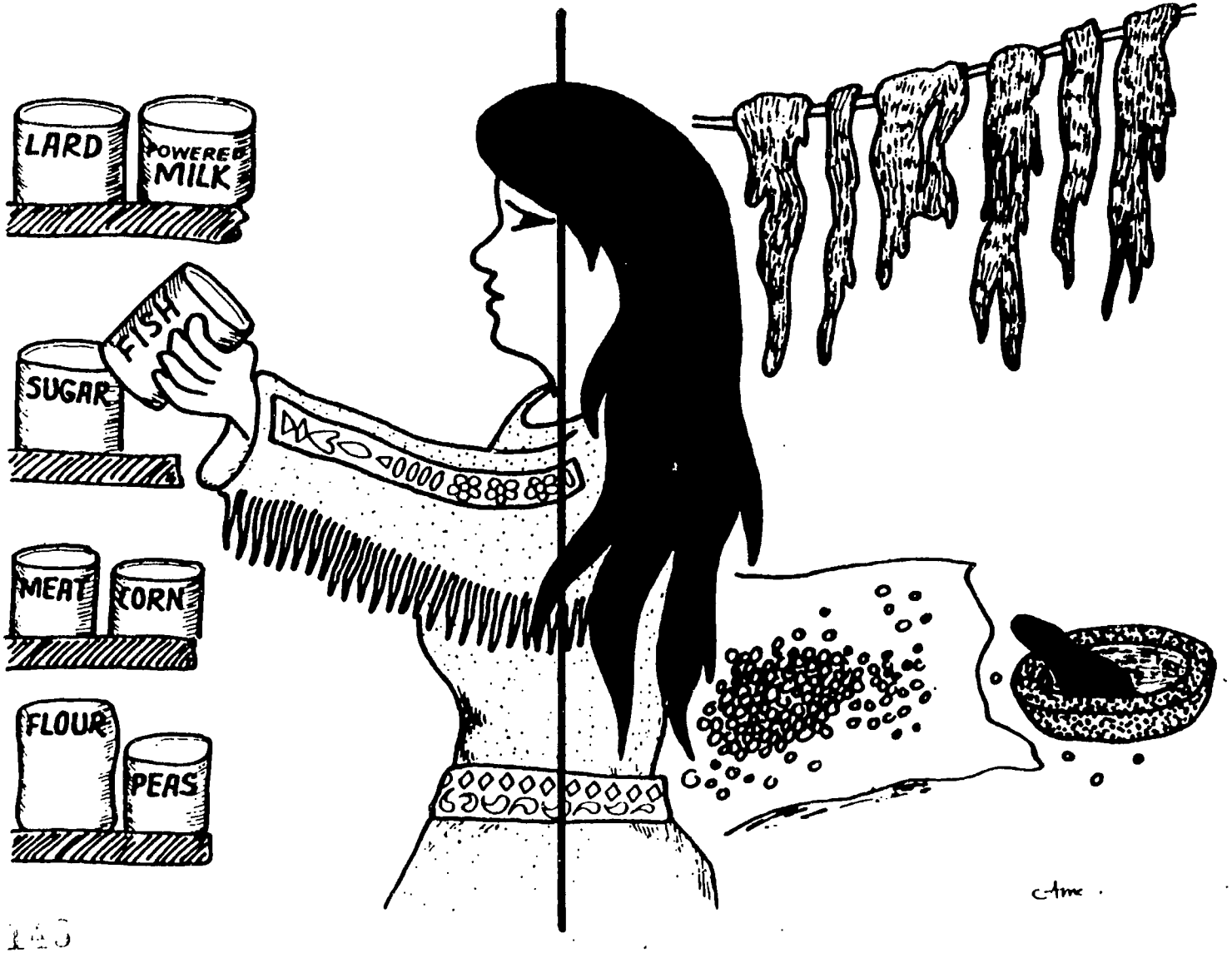
STOMACH

SMALL INTESTINE

LARGE INTESTINE

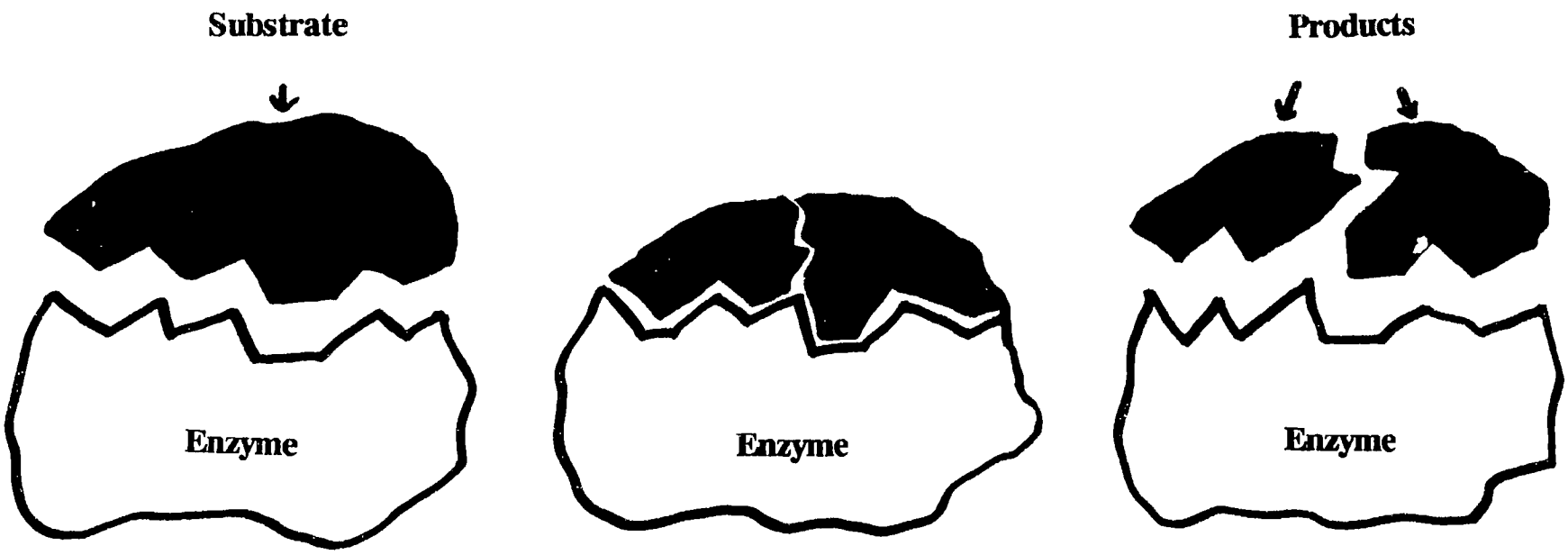
ANUS

COMMODITIES REPLACE TRADITIONAL FOOD GATHERING



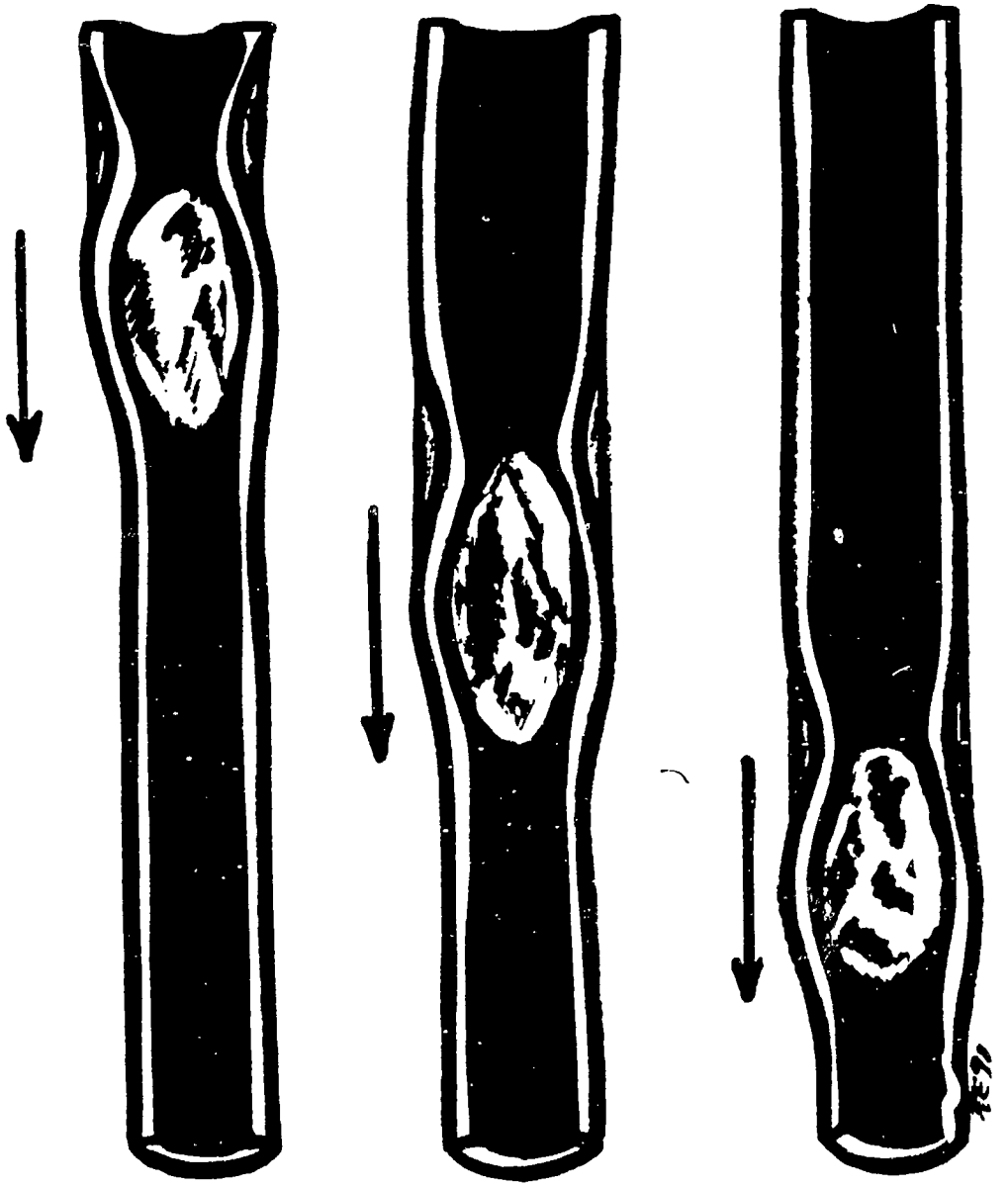
Overhead 7

HOW CHARLIE'S ENZYMES WORK



In order to bring about a chemical change, the enzyme must unite temporarily with the molecule (substrate) participating in the chemical action.

CHARLIE'S ESOPHAGUS



THE ESOPHAGUS IS A MUSCULAR TUBE THAT CONNECTS THE PHARYNX WITH THE STOMACH. FOOD IS MOVED THROUGH THE ESOPHAGUS BY PERISTALSIS, CONTRACTIONS OF THE MUSCLE WALL.

Overhead 9/Handout 9

Evaluation Form - Trainer

Name of Unit:_____

Number of Participants:_____

Date of Training:_____

Location of Training:_____

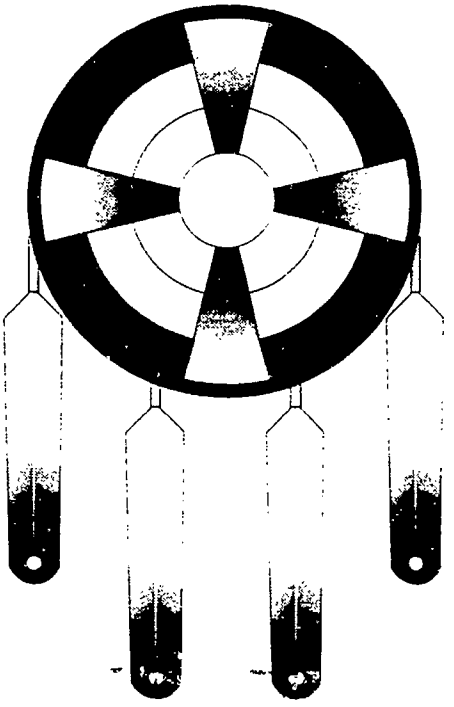
Instructions: Please complete this form and mail along with participant evaluation forms after the training session.

		strongly disagree		no opinion		strongly agree	comments
1.	The unit was easy to use during the training	1	2	3	4	5	
2.	The unit contains useful and appropriate overheads	1	2	3	4	5	
3.	The unit contains useful and appropriate handouts	1	2	3	4	5	
4.	The unit contains useful and appropriate supplemental readings	1	2	3	4	5	
5.	The content in the unit was easy to understand	1	2	3	4	5	
6.	The suggested activities and discussion issues in the unit were valuable to the training session	1	2	3	4	5	
7.	The questions in the "Participant Booklet" assisted in the overall training	1	2	3	4	5	
8.	The classroom application issues in the "Participant Booklet" were useful in the training	1	2	3	4	5	

9. The unit's strengths are:

(over)

Science of Alcohol Curriculum for American Indians (SACAI)



Participant Booklet

The Digestive System and Alcohol Use

AMERICAN INDIAN
SCIENCE & ENGINEERING SOCIETY

10. Recommended improvements for the unit are:

11. Additional Comments:

IMPORTANT: Please return the completed trainer and participant evaluation forms to the address below:

Director, SACAI Program
AISES
1085 14th Street
Suite 1506
Boulder, CO 80302

Science of Alcohol Curriculum for American Indians: (SACAI)

The Digestive System and Alcohol Use

Participant Booklet

Authors: Cecelia Jacobs
Heather Duffy
Carolyna Smiley-Marquez, Ph.D.

American Indian Science and Engineering Society
1085 14th Street, Suite 1506
Boulder, CO 80302

This booklet accompanies the SACAI Training Unit developed by a grant from the Fund for the Improvement of Post Secondary Education (Grant # G008730452-89).

Contents

Preface

People generally learn best and retain more information when it is presented to them in a framework or context which makes cultural and social sense, which is relevant to them. In other words, learning is culturally specific. We retain and use information which reaffirms those things which we have already learned from our families, communities, and cultural and social heritage. If the content of a curriculum is culturally or racially biased, or rooted solely in the history, heritage, and language of a particular group, to the exclusion of others, then those outside of the system become crippled and disadvantaged in the process of learning. (Manning Marable, 1990; Baca and Cervantes, 1989; Collier and Hoover, 1987)

SACAI uses the Medicine Circle as means of addressing this issue. Although not all American Indian groups include the specific model of the Medicine Circle, the concepts of wholeness, interconnectedness and balance which it represents are consistent with most American Indian traditional ideals. Although distinctions in the symbol are made with lines, an understanding of interdependence and co-existing realities blurs these distinctions which are artificially imposed by the lines.

The four aspects of the Medicine Circle as studied in SACAI are physical, spiritual, mental and emotional. They are examined as they relate to individuals, families, communities and the world.
These aspects can be described as follows:

Physical	the tangible world we perceive with our senses;
Spiritual	the interconnectedness and interdependence of all of nature and the creator;
Mental	the experience of perceiving and processing information;
Emotional	the feelings generated in reaction to perceptions.

Most American Indian cultures are congruent with and reflective of what is being called the new science paradigm. This new framework for science observation includes the understanding that the parts do not reveal the whole; the part is merely a pattern in an inseparable web of relationships. Another aspect of the new paradigm is the perception that everything is dynamic. The focus is on the processes through which structures interact rather than on the structures themselves. The observer is part of the universe which he or she observes and not an objective separate entity. And instead of arranging nature in a hierarchy of building blocks, the new paradigm describes a network of interrelationships in which nothing is more important than anything else. Mankind does not stand at the top of the pyramid of nature charged with "dominion over it", but is instead linked to all the elements of nature as in a web.

In both the new science paradigm and the Medicine Circle, the focus is on relationships and connections. The science of alcohol is studied from the integrative perspective of physical, spiritual, mental and emotional views in conjunction with the values of the new paradigm in order to explore a scientifically sound and culturally relevant understanding of the topic and issues.

Alcohol can be a difficult issue for both teachers and students to pursue. There are important physical, spiritual, mental and emotional components to this topic. Teachers need to address these various aspects from their own personal lives and be aware of their own issues before asking students to consider theirs. SACAI explores ways of doing this.

Teaching the science of alcohol to any group of students can be a delicate situation. American Indian communities, and therefore, American Indian children, suffer more from alcohol abuse than any other group in the United States. Many of them come from alcoholic families and alcoholic communities. In discussing

alcoholism, the teacher is often talking about people these students know and love. Given this situation, it is important to realize that the rubric of science will not erase the impact that alcohol has had on their lives. Looking at this concern from the perspective of science gives teachers the opportunity to teach about the effects of alcohol on the physical body. However, the other areas of the Medicine Circle cannot be ignored. And the concentric circles within the Circle representing the family, community and world can all be included in the science of alcohol because all things are related.

No two people perceive the world in exactly the same way, so no two cultural groups describe and experience the world in the same way. These differences are experienced as advantageous only if both are accepted and valued. In teaching the Medicine Circle and the new science paradigm, the current paradigm and formal reductionist science are not scorned; they are built upon, expanded upon and included in a wholistic framework. Application of SACAI in the classroom can be effective from this framework. Respect for a variety of points of view, including holism, is a way to share ideal traditional values that have never been incorporated in the formal educational process.

The Digestive System and Alcohol Use reviews the normal functions and process of digestion. In the course of this review, the metabolism and effects of alcohol on the digestive system are discussed. These effects are not limited to the digestive system, however. When significant quantities of alcohol are consumed, every system and cell in the body is irritated and sedated to some extent. The impact of the abuse of alcohol reaches beyond the physiology to the mind, emotions, and spirit of the drinker. It also extends to the family and community in which he lives. These ramifications are important considerations for teachers whose students cope with alcohol abuse in various areas of their lives.

Upon completion of this SACAI training unit, participants will have:

- reviewed the components and functions of the digestive system
- examined the digestive system as it is integrated with other systems and organs in the body
- contrasted the metabolism of alcohol and food in the digestive system
- explored ways of integrating American Indian cultural values and concepts in the teaching of physiology

Section I

The Digestive System

Overview

An Indian perspective of science will typically put more emphasis on a subject as integrated into its context than on the breakdown of the subject into its components. A central theme in many Indian cosmologies is that all things are related. Later in this unit this concept is emphasized as section Three explores the basic processes of the digestive system. The limitations of viewing the body as a machine are considered and the general purpose of the digestive system is reviewed.

Outcomes

Upon completion of this section, participants will have:

- explored the concept of holism through an American Indian story
- reviewed the four basic processes of the alimentary canal
- considered the value of the machine model for the body

Digestive Process

Our human body, like the natural, social, and familial environment, has highly interrelated and interdependent parts. When one part of the body is weak, ill, or injured, the entire body is affected.

"Learning from Grandmother" emphasizes the importance of respecting all parts of nature, community, and self. It discusses discipline and moderation in using resources, in this case natural medicines. It suggests that individuals exist as members of groups, i.e., family, community and nature. Individuals are not independent of the systems and environment in which they live.

Learning from Grandmother
by Carolyna Smiley-Marquez

When I was young, I spent many early morning and evening hours gathering herbs - leaves, stems, roots, and flowers of desert plants - with my great-grandmother in the pinon-covered hills of northern New Mexico.

Those long slow walks together, always in the direction of the rising or setting sun, were filled with much silence which I interpreted to be determination on her part. The old woman's eyes would dart ahead of us along the ground. Like invisible fingers, they would turn and examine plants - leaves, stems, and flowers - almost indistinguishable to her twelve-year-old apprentice.

I suspected that she herself was no longer aware of the long accustomed greetings of "Aye, oh," she offered to certain plants, small animals, insects, and to occasional spirits for which she had warning or opportunity. The desert floor puffed little pillows of dust at her shuffling feet, always three or four steps in front of me as the flour sack, filled with medicine plants that would be used to make teas and pastes for those with uneasinesses, swung rhythmically from a string tied around her waist.

The walk took us a long distance. Only a few leaves, stems or roots could be taken from any one area. In sentences that seemed inevitably to rise in pitch at their seeming ends - like small melodic chants - she reminded me of my responsibility to respect the balance which nature had established. This was my duty in this and in all relationships. "They are like clan members, family, just as you are with your sisters, mothers and grandmothers; they are just as members of your own body" she urged in a near whisper designed to assure my care in listening. To treat any part with disregard would be to harm the whole in some inexplicable way. I sensed her appreciation of the cycles and of the balance of natural life even though she rarely responded to my pulsing, "But why, grandmother?"

Our digestive system, as all parts of the body, is most efficient when it is healthy and functions in a cooperative manner within a healthy body. One amazing thing about this system is that it is active all of the time, even when we are sleeping. Whenever we eat food ("food" is defined here as solid and/or liquid), it immediately becomes subject to the digestive process. We are fortunate that this system works so naturally as a part of the body. (See Handout 1.)

This expression of gratefulness for something that is generally taken for granted is compatible with Indian way, whether or not it is done verbally in day-to-day activities. For, in the traditional mind, all things in nature are believed to exist and function within an encompassing spiritual reality which binds all things. To be unceremoniously grateful for the part is to be respectful of the whole.

Non-Indian science regularly includes dissection of animal and human bodies as a part of studying anatomy. Indian scientists in today's world also follow these procedures. However, traditional Indian science is based on studies of the living organism in its natural environment. These scientific observations result in gaining intimate knowledge of the animal and its behaviors, an understanding of its natural patterns and natural relationships, and an intuitive appreciation for the spiritual interconnectedness of human, earth, and animal. Such native studies result in an education which is embedded in its context. This engenders an appreciation of the ecology and interdependence of being, world, and, to many American Indians, spirit. To disaggregate or separate, to dissect, is to deny the sacred whole.

To the extent possible in this curriculum, "parts" are examined as elements of the whole. This acknowledges traditional American Indian cultural values in the context of education. Yet, today's Indians also live a bicultural life--being citizens of two cultures. They become researchers, doctors, nurses, and other medical professionals who can function effectively with both traditional and non-traditional practices. This curriculum also acknowledges the versatility of the Indian mind, and it provides a symbolic integration of the two cultural perspectives which can be mutually acceptable and respectful. (See Handout 2.)

The digestive system can be seen as "inside" the body. It is like a tunnel or tube that only has two openings, one where the food goes in and one where the waste products come out. In a way, like the tunnel walls which surround the passageway through which a train can pass through a hill or mountain, the tunnel can be considered to be "outside" the body, even though it does not seem that way to us. Like the train tunnel, the alimentary canal (the name given for the digestive tunnel) twists and turns, narrows and widens through the mountain's belly. One end of the human body's digestive tunnel, of course, is the end where things get to be tasted--the mouth. The other end, where what is left of the food after digestion ends up for disposal, is the anus. (See Handout 3.)

The idea that the alimentary canal is "outside" the body is supported by the fact that the same type of epithelial cells that make up our skin also make up the lining of the canal. Of course, these cells function differently from skin cells. (See Handout 4.)

Cells similar in structure, function, and embryonic origin are grouped together to form tissue. Epithelial cells are situated especially closely together with very little intercellular material between them. Cells of a tissue are held together by a basement membrane and intercellular fibers. In fact, they are joined so tightly that they are like a smooth, cloth-like sheet. This intimate bonding of cells that also forms our outer skin provides a special protection by keeping out harmful substances that do not belong inside the body.

The cell membrane that surrounds the cell determines which substances enter and leave the cell. Because some substances can pass freely through the membrane and others cannot, the membrane is said to be semi-permeable. Alcohol has the unique molecular structure that allows it to cross that membrane, unlike liquid and solid food which must be broken down into simpler molecules by the digestive process before nutrients can be absorbed by the digestive system. (See Handout 5.)

The digestive system has four basic processes:

1) ingestion of food and movement through the alimentary canal;
2) mechanical breakdown of food;
3) chemical breakdown of food; and
4) elimination of waste products and undigestible substances. (See Handouts 6 and 7.)

Food is ingested through the mouth and passes through the alimentary canal. The breakdown of foods occurs through mechanical processes (chewing and movement) which cause physical changes, and chemical processes of mixing food with enzymes (such as saliva) or acids (such as hydrochloric acid) which cause molecular changes. Once food has been digested, its essential nutrients can pass through the intestine walls

to the blood stream. In the blood stream the nutrients are transported to the cells where they are transformed into energy for growth, activity and healing.

Each cell in the body requires a constant source of energy. This is extracted from oxygen and digested foods which have been broken down to essential molecules--carbohydrates, fats, and/or proteins--and transformed into usable forms--glucose (from carbohydrates), fatty acids (from fats), and amino acids (from proteins).

Science has been able to demonstrate a great deal about how this process occurs, but there are still many opportunities for research. For example, despite our knowledge about the mechanical and chemical activities which take place in the alimentary canal, there is much we do not know about many of the interrelationships of the digestive system with other systems and parts of the body.

One reason for this lack of data may be due to the model or framework of the world that guided researchers and scientists for so long. Biologists and physiologists, like physicists, defined the world with mechanistic models. Primary organs of digestion, respiration, blood circulation, and brain-body communication (the nervous and endocrine systems) are grouped in systems having sequential operations. These systems are routinely presented as self-contained. The interdependence of one system with another is not as thoroughly explored.

You may recognize language relating to the industrial economy. This mechanical model can be represented by an assembly line--as food passes through the alimentary canal, different pieces are added, or different processes are affected, with the final product being energy and growth and the by-product being waste.

While this model adequately demonstrates the pathway and process of food digestion, it is incomplete in that it neglects the interrelationships within the entire organism. It fails to appreciate the subtle interaction of systems inside and outside the digestive tract and the body and person as a whole during the on-going activity of metabolism.

American Indians, having developed cultures independent of euro-ethnic thought, evolved their own unique interpretation of nature. This interpretation is characterized by an embeddedness in the context of circumstances or experiences (which contrasts with the ethno-European tendency to segregate and analyze content separately from context). It was not until recently, for example, that scientists considered the effect of a researcher or investigator upon her scientific investigation. It was accepted that experimentation could occur unaffected or "uncontaminated" by the researcher or investigator. The traditional American Indian paradigm assumes high dependence and influence among all the elements which exist in any circumstance. Health and harmony of individual, community, and environment are intrinsically related, as implied by the story "Learning From Grandmother". The "new" science addresses the limits of current knowledge and questions the rational progression of linear, analytic thought.

The digestive process of the human body is highly interrelated with the whole body, the whole person, the community, and the environment. For us in the 1990's, this lesson of interdependence has become evident as a part of our scientific understanding and as a survival imperative.

Questions

1. How can the alimentary canal be considered to be outside the body?

2. What are the basic functions of the digestive process?

3. How does the digestive process contribute to the body's need for energy?

4. What are the advantages and disadvantages to comparing the body to a machine?

5. Why might the interdependence of various parts of the body be less well-understood than the parts themselves? How does this question relate to the Medicine Circle?

Training Activities

These training activities assist participants to understand and apply the content of this section. These may easily be adapted for classroom application with students.

1. Ask participants to form small groups. Ask participants to help each other fill in the outline of "Charlie" (Handout 1) with the digestive system including the pancreas, liver, kidneys, and bladder. When they have completed their drawings, ask them to work as a team filling out an extra handout with their collective knowledge. When participants have completed their aggregate drawing, ask them to compare it to Handout 2 and make any needed corrections. (Note that the outline is not truncated and is placed in a particular setting. When teachers do this type of activity they can adapt the handout, name, and setting to fit the community they are teaching). The purpose of this activity is to determine how much background the group needs about the digestive system. The presentation can then be adapted to the specific needs of the group. This activity can also be done with a large, cooperative group.

2. Compare "Charlie" to a map. Discuss how a map is very simplified and does not really show interactions of those in the community it represents. How might the digestive system be more sophisticated than the "map" of "Charlie" shows? How is the Medicine Circle less sophisticated than the world it represents.

3. Draw an outline of a person on the chalk board with background. Ask volunteers to fill in the digestive system as the group offers suggestions and discussion. The interaction of participants will provide information about their level of understanding of the digestive system.

4. Ask participants to draw a Medicine Circle and illustrate the four aspects as they could relate to a healthy digestive system.

Notes - Section I

Section II

The Ingestion of Food and Alcohol

Overview

Grinding and chemical action in the mouth begin the digestive process for food. Alcohol, however, is not subject to the normal process of digestion. Because the alcohol molecule is so small, it can be absorbed through the alimentary canal lining directly into the blood. The esophagus transports food from the mouth to the stomach. It is susceptible to degeneration and disease caused by alcohol. Both enzymes and hormones contribute to this initial stage of the digestive process.

Outcomes

Upon completion of this section, participants will have:

- examined the physical and chemical action of digestion in the mouth
- discussed the function of peristalsis in the esophagus
- compared the reactions of food and alcohol to the digestive process in the mouth and esophagus

The Ingestion of Food and Alcohol

In mammals, digestion begins in the mouth, or oral cavity, which holds the openings of the salivary glands, the teeth, and the tongue. As the teeth mechanically break down food, bacteria in the mouth thrive on sugar products (glucose, maltose, dextrose, fructose) and starch (which is broken down into sugar). Individuals who become highly dependent on sugar-type foods, including alcohol which is high in carbohydrates and sugars, are more susceptible to tooth decay. This is because carbohydrate-rich alcohol provides fertile ground for bacterial reproduction and tooth decay. In addition, individuals addicted to alcohol tend to neglect nutrient-rich foods which assure the healthy maintenance of teeth and gums.

The mouth grinds and mixes food and saliva. While the food is pulverized by molars and ripped and torn by the incisors, it is moistened by thousands of mucous glands embedded in the mucous membrane lining of the mouth, and by salivary glands whose ducts open into the mouth. Saliva lubricates the food and buffers ingested acid or alkaline foods. When saliva mixes with the food, it dilutes and dissolves the food so that it can move easily through the tract and be absorbed.

Saliva is primarily enzymes and water. The enzyme present in saliva, alpha amylase, initiates the digestion of starch (from vegetables and grains). The digestion of starch is accomplished by inserting water molecules between the glucose units so that they become detached from one another. If starch and water are simply mixed together, this process occurs very slowly. In order for digestion to proceed at a useful rate, alpha amylase is required.

Food is made up of many molecules bound together. A molecule that can be acted upon by an enzyme is called a substrate molecule. The enzyme in saliva, like many enzymes, acts by temporarily binding with the substrate. This binding causes the substrate to "bend" or otherwise change shape. Once the shape of the substrate is changed, it breaks connections with other substrate molecules. This means that where there was one large piece of food with many substrate molecules all bound together, there are now many smaller pieces that are easier for the body to digest.

Enzymes are complex proteins that accelerate biochemical reactions. All enzymes are proteins, and each has a specific chemical action which it accelerates. The enzymes in saliva, for example, readily break down starch, but are incapable of breaking down other substances. Each enzyme must be shaped in such a way that it can form a close fit with its substrate molecule. Not a single chemical reaction has yet been found in a living organism that is not accelerated by an enzyme. It is only through the catalytic powers of enzymes that biochemical reactions take place at a useful rate. (See Handout 8.)

No nutrients are absorbed in the mouth; however, the alcohol molecule is so small, it can pass through the moist skin within the mouth (and other parts of the alimentary canal as well) into the blood system's capillaries which provide nutrition to the tissue in the mouth. Since blood in these capillaries returns through the circulatory systems's veins back to the heart and then, within a few heartbeats, to the brain, the effects of drinking alcohol can be felt by the drinker very quickly. Subtle changes in the physiology and behavior of the drinker occur almost immediately because of the rapid absorption.

An observant person who knows a drinker's physiology and behavior will recognize the changes that occur. This happens even as small amounts of alcohol enter the blood stream through the walls of the mouth because ethanol acts as a dilator (enlarger) on the capillaries. More blood flows through, warming and even reddening the muscles and skin in the surrounding area. It is not uncommon for the face to change hue or color and temperature, however slight, even during the early phases of drinking. The alcohol molecule, then, is different from food in that it enters the bloodstream prior to digestion--even while in our mouths.

The tongue, a powerful muscle, moves the food around in the mouth to assure proper grinding. It is covered by a mucous membrane and many tiny extensions called papillae which give it a rough texture. Touch

receptors and specialized taste buds are present in the papillae, small protuberances on the upper surface of the tongue. When the ball (called a bolus) of food has been chewed and lubricated, it is rolled backward on the tongue and pushed down into the cavity of the pharynx.

The pharynx or throat is a small chamber that is shared by the respiratory (trachea) and the digestive (esophagus) tracts. It is the juncture where these passages cross. Occasionally, there are "traffic jams" in this area. A person might breathe food down the wrong pipe and have to choke up the matter or swallow air down the wrong pipe and have to belch it up. Vomiting may be caused by mechanical irritation to the pharynx, such as sticking a finger down the throat or swallowing something highly irritating.

The esophagus is a flattened, muscular tube about 10 inches long which extends between the lungs, behind the heart, and through the diaphragm to reach the stomach. It is primarily a transport tube and does nothing to accelerate the digestive process specifically. Food is pushed down the esophagus by a series of waves of contraction. These waves, called peristalsis, occur because of the contractions of circular muscles in its walls. The actions of these muscles are powerful, involuntary, and independent of gravity. That is why we do not have to remember to swallow or think about our food on its way to the stomach. In fact, we can swallow even when we are standing on our heads! Another circular muscle, the cardiac sphincter, connects the esophagus to the stomach. It relaxes to allow food to enter and closes to prevent regurgitation. An irritant, such as alcohol, can cause reverse peristalsis resulting in vomiting. Vomiting irritates the esophageal lining and increases the likelihood of reverse-peristalsis. Continuous reverse-peristalsis leads to damage of the esophagus walls which can cause esophageal hemorrhaging and often death. (See Handout 9.)

The effects of alcohol on the movement of food through the esophagus increases in severity with chronic alcohol users. Studies have revealed that peristalsis (in the upper two-thirds of the esophagus) can deteriorate (become weaker), while there is an increase in the non-peristaltic contractions following deglutition (the emptying of the esophagus into the stomach). In addition to the weakening of peristalsis, the frequency of peristalsis is reduced as a result of alcohol use. This means that swallowing food becomes more difficult and, because the non-peristaltic contractions increase, stomach contents and acid are forced to come back up the esophagus. This discomfort caused by eating combined with a dependence on the calories in alcohol is one reason why many alcoholics avoid food and, eventually, become malnourished.

Often heavy users of alcohol also smoke. Such a combination significantly increases the risk of developing esophageal cancer. Although it is unclear whether it is the alcohol or its enhancement of the carcinogenic effect of tobacco, cancer risks increase. This may be because there is direct damage by alcohol on the esophagus. When smoke enters the esophagus, it affects the already damaged cells. Or it may be that the nutritional deficiencies associated with chronic alcoholism may induce cell damage in the mucous, making them more sensitive to carcinogens.

The functions of the body are regulated by two major control systems: 1) the nervous system, and 2) the endocrine, or hormonal, system. The hormonal system is concerned principally with control of the metabolic functions of the body, controlling the initiation or suspension of chemical reactions in the cells, the transport of substances through cell membranes, or other aspects of cellular metabolism such as growth and secretion. Some hormonal effects occur in seconds, while others require several days simply to start, and then they continue for weeks, months or even years. Many interrelationships exist between the hormonal and nervous systems. Milk production in mammary glands, reactions to danger, and sexual and reproductive functions are all examples of this interaction.

The presence of food triggers responses by the nervous system, which notifies endocrine glands to produce hormones. The hormone gastrin is released into the blood in response to the food. Each hormone has a specific personality, or characteristic, and a specific destination and purpose. Many hormones may be present and moving through the bloodstream at once, each with a specific task. The hormones that are released signal other organs, such as the stomach and liver, as well as cell membranes throughout the body to prepare to process and accept nutrients. Some recent studies suggest that the presence of alcohol in the bloodstream may alter the production of hormones.

Questions

1. What are both the mechanical and chemical digestive activities in the mouth?

2. What is the function of enzymes?

3. How can alcohol affect the function and condition of the mouth and esophagus?

4. How might smoking accelerate the effects of drinking on the esophagus?

Training Activities

These training activities assist participants to understand and apply the content of this section. These may easily be adapted for classroom application with students.

1. Use clay or Playdough and soda straws to illustrate the concept of peristalsis in the esophagus.

2. Use puzzle pieces or cut outs to illustrate how an enzyme can only alter a specific substrate.

3. Describe what eating would be like if the body didn't produce saliva.

Section III-A

Metabolism of Food and Alcohol

Stomach and Intestines

Overview

The stomach and intestines prepare food for ingestion into the blood system. Although alcohol is less deleterious when consumed with food, it can cause serious damage to the organs involved in digestion. The liver and pancreas contribute to metabolism in the small intestine. Water, vitamins and minerals are extracted in the large intestine, but almost no alcohol remains in the alimentary canal at this point.

Outcomes

Upon completion of this section, participants will have:

- reviewed the role of the stomach and intestines in the digestive process
- examined how alcohol can disrupt the normal function of the stomach
- contrasted the differences between alcohol and food in the small intestine

The Stomach

The stomach holds about two and one-half quarts of food. It is unique in that it is a storage organ, a digestive organ, and a hormone producing organ. Once food enters the stomach from the esophagus, the stomach begins to move with rhythmic contractions. This movement helps to continue the breakdown of food. It also causes the cells in the stomach to produce enzymes. These enzymes [illegible] in the breakdown of food. (See Handout 10.)

Hydrochloric acid (HCl) is also produced at this time. HCl is an aqueous solution of hydrogen chloride. It is a highly corrosive strong mineral acid commonly used in laboratories. It is produced by the gastric cells in response to gastrin, histamine, and nerve stimulation. The presence of hydrochloric acid reduces the pH to less than 2.0 which is highly acidic. Neutral pH is 7, anything above 7.0 is more alkaline, everything below, more acidic. HCl causes the food to corrode. It is, in fact, so corrosive that it is difficult to find containers that will hold it. Mucous membranes protect the lining of the stomach from the effects of HCl by producing mucous which neutralizes the acid.

After the food has turned into a fluid-like mass known as chyme, which is the consistency of oatmeal, it leaves the stomach and goes to the small intestine. Food usually spends about 4 hours in the stomach. Normally there is no absorption of any substance in the stomach, only the breakdown of food, large particles to small.

On the other hand, while alcohol is in the stomach, some of it is absorbed through the stomach walls and goes into the bloodstream. The rate of absorption of alcohol determines the alcohol's effect on the rest of the body. Two factors influence the speed and amount of absorption and resultant intoxication: the type of alcoholic beverage and the amount of food in the stomach upon ingestion. The higher the concentration of alcohol in a drink (up to 50% or 100 proof), the more potent the quantity that is ingested and the more quickly it is absorbed. Distilled spirits, such as whiskey and vodka, effect the body more dramatically as a result of this rapid absorption. Beer affects the body in the same way, but contains food substances such as sugars which slow the absorption.

Because food absorbs and disperses the alcohol, the amount of food in the stomach determines how quickly alcohol affects the rest of the body. Food acts to slow absorption because it allows for the alcohol to be distributed throughout the stomach area rather than be pooled against stomach walls. Food must be in the stomach before the alcohol in order to have this effect.

Alcohol has two effects on human tissue, including the stomach walls--it sedates and it irritates. It slows digestion, absorption, and movement of impulses along the nerves, and relaxes the vascular system. The continuous presence of alcohol in the stomach acts to irritate and inflame the mucous membrane. This irritation, called gastritis, causes the stomach to contract and squeeze out the maximum amount of hydrochloric acid which then results in a dual irritation effect, both from the alcohol on the lining of the stomach itself, and from the increase in the output of hydrochloric acid. The result is often the development of raw sores, or ulcers.

Alcohol dependent individuals often experience high levels of nervousness when they have not had a drink. Such nervousness may cause indigestion since the secretion of digestive juices of the stomach (pepsin, mucous, HCl) are responses to nervous stimuli. Alcohol as an irritant disturbs the integrity of the epitheliums (lining cells) of the stomach by creating wound-like breaks and cyst-like lesions. In addition, alcohol's presence may alter the acidic secretions and may affect movement of the gastric muscles.

An ulcer may hemorrhage which can cause severe retching and vomiting. Hemorrhages can result from inflammation. In fact, bleeding can occur even in the absence of an ulcer simply from a seriously inflamed

stomach lining. If a large blood vessel happens to be in the area of the ulcer, bleeding can be profuse. Hematemesis (vomiting of blood) and black tarry (digested blood) stool are symptoms of stomach bleeding.

Another threat of ulcers is that they can perforate and release the stomach's contents into the abdominal cavity where the food, filled with bacteria and acid can cause infection and even death. This circumstance is a serious emergency and can only be treated by immediate surgery. Ulcers can be healed with proper nutrition, medicine, and removal of the irritant.

When a healthy stomach receives food, the stomach muscles begin almost immediately to contract and expand in a rhythmic manner. This continues the break-down of the food begun in the mouth. When this process is complete, chyme enters the small intestine by going through the pyloric sphincter.

Similar in function to the cardiac sphincter which allows food to enter the stomach, the pyloric sphincter allows food to move from the stomach to the small intestine. It is sensitive to the presence of alcohol. With large concentrations, it tends to get "stuck" in the closed position. When this pylorospasm happens, the alcohol trapped in the stomach may cause sufficient irritation to induce vomiting. This "stuck" pylorus may serve as a self-protective mechanism by preventing the passage into the small intestine of what might otherwise be life-threatening doses of alcohol.

The Small Intestine

The highly convoluted small intestine begins at the pyloric sphincter and ends at the cecum of the large intestine. It fills the abdominal cavity within the frame of the large intestine. The small intestine, 3 to 5 meters in length and about three centimeters in diameter, is roughly divided into three parts: the duodenum at the top, the jejunum in the middle portion, and the ileum at the bottom. Typically, food spends about 12 hours in the small intestine. As in the esophagus, peristalsis moves food through the intestines. The major portion of the absorption of nutrients occurs here. The partially digested food is highly acidic as it comes from the stomach but due to the mucous of the small intestine, the pH is alkaline in the intestine. (See Handout 11.)

Food digested in the small intestine is prepared to be used as nutrients by the body's cells. It must be carried by the blood to all the cells of the body. Food gets out of the small intestine and into the blood by absorption, the movement of chemicals or water into or out of an organ.

In the duodenum, the chyme is blended with enzymes from the pancreas and bile from the gall bladder. The chyme is them moved to the jejunum where most nutrients are absorbed.

Enzymes from the stomach and the pancreas break food down into nutrients, amino acids and small proteins. It is these very small particles that cross the lining of the small intestine to enter the bloodstream and become valuable to the body as fuel.

Nutrients are absorbed by the epithelial cells that line the small intestine in finger-like extensions called villi. Nutrients diffuse through the cell walls and into the villi. (See Handouts 12 and 13.) Inside each of the villi is a central lymphatic capillary called the lacteal. The lacteal is responsible for the absorption of fat from the nutrients. The remaining nutrients are absorbed into the bloodstream by a network of blood capillaries which surround the lacteal. These capillaries then dump into larger blood vessels which carry the nutrients to the rest of the body. (See Handout 14.)

Nutrients diffuse directly through the surface membrane of the epithelium and into the cell. Water, which is constantly diffusing along with the nutrients, creates a flow of fluid which assists the movement of nutrients in and out of the cell. The nutrients diffuse out through the sides of the cell into the area between the cells,

known as the intracellular space. From the intracellular space, they continue to diffuse through the basement membrane of the epithelium and finally into the circulating blood of the villi. Fats are absorbed in a slightly different manner. Digested fats are dissolved before entering the cell. Once inside the cell, the fats are "reassembled" into forms which can be more easily absorbed by the lacteal. The newly "reassembled" fatty substances are excreted into the intracellular space, and through the basement membrane. When the substances are within the villi, they are ready to be absorbed by the lacteal.

The microscopic journey of nutrients from the intestine to the blood stream is an example of nature's ability to bring together several systems. While in the intestine the nutrients blend with enzymes from the pancreas and bile from the liver. When they are broken down enough, they are absorbed into the epithelial cells which have small openings on the intestine side. When the nutrients are inside the cell, they go through another process in which they are broken down even further and then recombined with lipids (fats) before they pass through the other side into the lacteal. Although the nutrients are larger than they were when they entered the epithelial cells, they are able to move through the epithelial cell wall because the lacteal side of the epithelial cell has larger openings than the intestine side. The nutrients can easily move through, now ready to be transported by the blood system and used by the body.

Alcohol behaves differently from food in the small intestine just as it does in other parts of the body. Because of the structure of the alcohol molecule, it can easily slip through the epithelial cells without undergoing the digestive process. It moves directly into the blood from the small intestines. Remember that because of its molecular structure, alcohol begins entering the bloodstream in the mouth and continues to diffuse unmetabolized into the bloodstream throughout the digestive journey.

The Large Intestine and Anus

The large intestine also has villi or folds. It does not produce digestive enzymes and is not involved in the chemical digestion of chyme. Instead, it absorbs water, vitamins, and minerals, thus creating feces from the more fluid-like chyme. (See Handout 15.) The total length of the large intestine is only about one and on half meters. It is organized in the body in the shape of an upside down U, from the site of the appendix, extending up to near the diaphragm, across the left side below the diaphragm and downward. Neither digestion nor food absorption occurs from the large intestine. The primary activity is the reabsorption of water from the waste material back into the blood. Wastes, as a result, are concentrated.

In the colon, various bacteria live upon the residue of digestible material in the chyme. In the process of this interaction, chemical changes convert the waste materials into fecal material. From the lowermost part of the large intestine -the rectum- this fecal material is transferred out of the body through the anus.

Very little alcohol stays in the alimentary canal past the small intestine. The body does not eliminate alcohol in this way. An examination of some of the organs that support digestion reveals more about this process.

Questions

1. What are both the mechanical and chemical digestive activities of the stomach and intestines?

2. Why isn't the stomach injured by the presence of Hydrochloric acid? How does alcohol interfere with this protection?

3. How does food move from the outside to the inside of the body? How does alcohol move from the outside to the inside of the body?

4. Why is the effect of alcohol on the body different if it is consumed with food?

5. In what ways are the esophagus and the small intestine alike/different?

Training Activities

These training activities assist participants to understand and apply the content of this section. These may easily be adapted for classroom application with students.

1. Ask participants to play the role of the mouth, stomach, esophagus, small intestine, and large intestine. They are meeting at a party and getting to know each other by discussing their functions and interactions.

2. Ask participants to form small groups and write a description of the digestion of lunch from the point of view of a villi in the small intestine. Introduce alcohol and discuss the difference in the digestive process.

3. Ask participants to describe the difference between chyme and feces. Which would contain more alcohol if it had been consumed with food?

Notes - Section III-A

Section III-B

Metabolizing Food and Alcohol

Pancreas, Liver and Kidneys

Overview

Although in some ways all of the systems and organs of the body contribute to digestion, the pancreas and liver affect it directly by producing enzymes and bile which are added to chyme as it moves through the small intestine. These assist in the breakdown of nutrients so they can be absorbed into the bloodstream. The liver cleans or detoxifies the blood of alcohol. The kidney removes some alcohol through the urinary tract.

Outcomes

Upon completion of this section, participants will have:

- examined how the liver and pancreas contribute to digestion
- seen how alcohol can damage the liver and pancreas
- studied the process of alcohol metabolism in the liver
- considered the possible effects of alcohol on the urinary tract

The Pancreas

The pancreas produces enzymes needed to break down food as well as the hormones needed to balance blood sugars. It produces digestive enzymes and releases these into the small intestine just below the duodenum. It is these enzymes that break the chyme into particles small enough to cross the lining of the small intestine so that they can enter the body. (See Handout 16.)

The hormones of the pancreas are mainly related to regulating blood sugar levels in the body. The only fuel that our body uses to produce energy is a particular sugar molecule, glucose. All other nutrients, such as amino acids and fats, are used as building blocks but not as energy. The regulation of glucose in the blood is very important. If it gets too high some might be discarded as waste. If it gets too low the body stops functioning. There are two hormones that are primarily involved in controlling blood sugar levels, insulin and glucagon. Insulin is released when blood sugar levels are high. It stimulates the cells of the body to allow glucose to enter by increasing the permeability of the cell membrane to glucose. One of the primary cell types that this occurs in is liver cells. This way, when blood sugar levels are high (a condition known as hyperglycemia), the liver cells will take up a large amount of glucose and store it as glycogen for later use. Other cells of the body will take up glucose and use it to make Adenosine Triphosphate (ATP) which is the energy currency of the body. Glucagon is released by the pancreas when blood sugar levels are low (a condition known as hypoglycemia). Glucagon stimulates the cells of the liver to turn the stored glycogen back into glucose and dump it into the bloodstream. This increases blood sugar levels to a point where the body can keep using glucose for fuel.

Overuse of alcohol changes the secretions of the pancreas to the extent that the canals become swollen and plugged. The cells themselves begin to swell creating a condition called acute hemorrhagic pancreatitis. This is a very painful disorder requiring large amounts of sedation and pain-killing medication. Many people die in their first attack, and of those who survive, many experience chronic recurring pancreatitis. The reoccurrence is due to a breakdown of tissue in the pancreas and the formation of large vacuoles or tumors filled with fluid (called pseudocysts). These tumors are also painful and degrade the pancreatic function.

The Liver

The liver is a large organ that is of vital importance for the metabolism of all ingested substances, particularly toxins such as alcohol. (See Handout 17.) The liver is responsible for a host of tasks. It breaks down wastes and toxic substances. It manufactures essential blood components, including clotting factors. It stores certain vitamins, such as B12 which is essential for red blood cells. It helps regulate the blood-sugar (glucose) level, a very critical task, because glucose is the only food the brain can use.

The presence of alcohol disturbs the metabolic function of the liver. Metabolizing alcohol is always a very high-priority liver function. Therefore, whenever alcohol is present, the liver is "distracted" from other normal and necessary functions. For the alcoholic, this can be frequent.

The liver is composed of many tiny compartments called liver lobules. These lobules are circular, and consist of rows of liver cells called liver plates. Each of these liver plates is separated by small veins, called sinusoids, which carry both oxygen and nutrients to the cells. (See Handout 18.)

The liver receives blood from two sources: the hepatic artery, which supplies oxygenated blood from the heart, and the hepatic portal vein, which carries blood from the digestive tract. Blood transported in the hepatic portal vein comes from the small intestine and contains a high concentration of dissolved nutrients, but a relatively low amount of oxygen. Oxygen-rich blood is supplied by the hepatic artery. Both the hepatic artery and the hepatic portal vein empty into sinusoids which run between each of the liver plates. The walls of the sinusoids are very permeable and allow substances absorbed into the blood from the intestines, along

with oxygen from the heart, to leave the blood freely and enter the liver cells. Once diffused into the liver cells, the nutrients are metabolized into simpler forms which can be used by the rest of the body. After the cell processes these nutrients, it dumps them back into the blood which then goes to the central vein. The central vein then directs the blood back to the heart for more oxygen, and then to the rest of the body.

The liver cells have another function. Blood arriving from the intestines may contain toxins like alcohol which are dangerous to the body. As the blood passes through the liver, these toxins diffuse, along with the nutrients and oxygen, into the cells. Once toxins are in the liver cells, they stop whatever they are doing and work to detoxify the ingested poison. Within each of the liver plates lie tiny canals called bile canaliculi into which the liver cells secrete bile. These canals carry the bile into a large duct called the hepatic duct, which directs the bile into either the gallbladder or the duodenum of the small intestine, depending on where it is needed. Bile is secreted continuously by the liver cells, and is normally diverted into the gallbladder and temporarily stored. Once in the gallbladder, bile is concentrated about fivefold, and as much as 12 hours of bile secretion can be stored. The most abundant substance secreted in the bile is bile salts. These salts have two important functions in the intestinal tract. First, they have a detergent action on the fat particles in the food, which decreases the surface tension of the particles and allows the mechanical agitation (peristalsis) in the intestinal tract to break fat globules into small sizes. Second, the salts help in the absorption of fatty acids, and other substances, from the small intestines into the blood.

The principle pathway for normal alcohol metabolism is the liver. Small amounts of alcohol are eliminated in urine, sweat, and breath, but the primary site of elimination is the liver. As soon as the blood carrying the alcohol enters the liver, an enzyme called alcohol dehydrogenase (ADH) attacks the alcohol molecule, quickly removing two hydrogen atoms to create a new substance called acetaldehyde. Since acetaldehyde is a highly toxic agent which can produce nausea, rapid heartbeat, dizziness, headache, and mental confusion if present in the body in large quantities, the liver quickly initiates the second step in the elimination process. It employs another enzyme with a similar name, aldehyde dehydrogenase (ALDH), to transform acetaldehyde into acetate. Acetate is then converted to carbon dioxide and water and eventually eliminated from the body. (See Handout 19.) Acetaldehyde is a powerful toxin. Normally, it is quickly removed by the enzyme ALDH during the second step in the reaction. Drugs such as disulfiram (Antabuse), which are used to create psychological barriers to alcohol intake, work by inhibiting ALDH. The result is the rapid buildup of acetaldehyde and the severe physical reactions of nausea, flushing, and shortness of breath. Much research has been done on the molecular structure and function of ADH and ALDH in an effort to explain genetic variations that may account for individual or racial differences in alcohol sensitivity and susceptibility to alcoholism (Nystrom, 1990).

During these two steps in alcohol metabolism a great deal of energy is required to make the enzymes work. Alcohol, as a sugar, does release energy. In fact, it can release enough energy to run the liver. Since the liver is functioning to metabolize alcohol instead of food, the drinker gets no nutrient value other than sugar. None of the building blocks needed for the body are available, only sugar. Drinking alcohol will give a drinker a feeling of energy so many drinkers will not eat, sometimes for weeks at a time. Since there is no nutrient value in the energy produced by alcohol, the drinker becomes malnourished. Since alcohol is sugar, recovering alcoholics often crave sugary foods to replace the sugar that their body is used to having. This only feeds the addiction. The best thing for the recovering alcoholic to eat is carbohydrates, like bread and potatoes, which provide some sugars but also provide building blocks. Since these are digested differently from plain sugar, the addiction is not being fed, but the relief may be the same.

The liver of an average person takes approximately one to two hours to convert an ounce of alcohol. Factors such as weight and nutritional status affect the conversion rate for each person. Alcohol that is not metabolized is transported by the blood throughout the rest of the body and returns to the liver on the next cycle where more of the alcohol can be metabolized. Some of the acetaldehyde produced from alcohol in the liver is broken down into non-toxic substances. What is not metabolized is transported in the blood in the same manner as the alcohol.

Several forms of liver disease are associated with alcohol abuse. Acute fatty liver may develop in anyone who has been drinking heavily, even for relatively brief periods of time. Fatty liver gets its name from the deposits of fat that build up in normal liver cells. This occurs because of a decrease in breakdown of fatty acids and an increase in the synthesis of fats by the liver. The latter is a result of the "distracting" metabolic effects of alcohol. Acute fatty liver occurs whenever 30% or more of the dietary calories are in the form of alcohol. This is true even if the diet is otherwise adequate. Acute fatty liver is a reversible condition if alcohol use is stopped.

Alcoholic hepatitis is a more serious form of liver disease that often follows a severe or prolonged bout of heavy drinking. Although more commonly seen in alcoholics, hepatitis, may occur in nonalcoholics as well. In hepatitis there is inflammation of the liver and damage to liver cells. Also, liver metabolism is often seriously disturbed. Jaundice is a usual sign of hepatitis. Jaundice refers to the yellowish cast of the skin and the whites of the eyes. The yellow color comes from the pigment found in bile, a digestive juice made by the liver. The bile is being handled improperly and is therefore circulating in the bloodstream in excessive amounts. Other symptoms of alcoholic hepatitis may include weakness, fatigue, loss of appetite, occasional nausea and vomiting, low-grade fever, mild weight loss, increasing ascites, dark urine, and light stools.

Although in some cases hepatitis is completely reversible with abstinence from alcohol, in others it may be fatal or go on to become a smoldering chronic disease. Among patients who stop drinking, only 1 in 5 will go on to develop alcoholic cirrhosis. But 50% to 80% of those who continue drinking will develop cirrhosis. Alcoholic hepatitis is in many cases clearly a forerunner of alcoholic cirrhosis, but it is thought that alcoholic cirrhosis can also appear without the prior occurrence of alcoholic hepatitis.

Cirrhosis of the liver is a condition in which there is widespread destruction of liver cells. These are replaced by nonfunctional scar tissue. In fact, the word cirrhosis simply means scarring. There are many different types and causes of cirrhosis, but long-term heavy alcohol use is the cause in the vast majority (80%) of cases. It is estimated that about 1 in 10 long-term heavy drinkers will eventually develop alcoholic cirrhosis. It is accompanied by very serious and often relatively irreversible metabolic and physiological abnormalities. In fact, more than half of the patients who continue to drink after the diagnosis of alcoholic cirrhosis has been made die within 5 years. In alcoholic cirrhosis the liver is simply unable to perform its work properly. Toxic substances, normally removed by the liver, circulate in the bloodstream, creating problems elsewhere in the body. This is particularly true of the brain. The liver normally detoxifies most of the blood from the intestinal tract as it returns to the heart. The cirrhotic liver, now a mass of scar tissue, is unable to handle the usual blood flow. The blood, unable to move through the portal vein (the route from the blood vessels around the intestines to the liver), is forced to seek alternative return routes to the heart. This leads to pressure and "back-up" in these alternative vessels. It is this pressure that causes the veins in the esophagus to become distended, producing esophageal varices and inviting hemorrhaging. The same pressure can account for hemorrhoids.

Hepatic coma can be one result of cirrhosis. In this case, the damage comes from toxins circulating in the bloodstream. In essence, the brain is poisoned by these wastes and its ability to function seriously impaired, leading to coma. Cancer of the liver is another complication of long-standing cirrhosis. Of the people who develop cirrhosis, as many as 50% will also have pancreatitis. Still other complications may include gastrointestinal bleeding, salt and water retention, and renal failure. The main elements of treatment for cirrhosis are abstinence from alcohol, multivitamins, a nutritionally balanced adequate diet, and bed rest. Even with such treatment, the prognosis of cirrhosis is not good and many of the complications just described may occur (Kinney and Leaton, 1987).

Another phenomenon associated with cirrhosis is ascites. Here the liver "weeps" tissue fluid directly into the abdominal cavity. Again, this is caused by the back pressure. This fluid would normally be taken up and transported back to the heart by the hepatic veins and lymphatic system. Large amounts of fluid can collect

and distend the abdomen. If you were to gently tap the side of a person with ascites, you would see a wavelike motion in response, as fluid sloshes around.

Alcoholic liver disease can diminish the ability of the liver to store glucose as glycogen, the body's storage form of sugar. There is also less ability to release glucose from storage. This can lead to low blood sugar levels. Insufficient amounts of blood sugar may cause coma, essentially because the brain is without enough of a fuel supply to function. Intravenous glucose may be necessary to prevent irreversible brain damage. On the other hand, alcohol and alcoholic liver damage may lead to states of diabetes-like, higher than normal blood-glucose levels. This occurs in large part because of the effects of alcohol and alcoholic liver disease on glucose-regulating hormones in the body.

The Kidneys

The kidneys are part of the excretory or fluid waste system. Blood enters the kidney by the renal artery and is cycled throughout the kidneys, which remove wastes and function in adjusting the concentrations of various salts in the blood. After the blood has been cleaned and is free of wastes, it leaves the kidney by way of the renal vein and circulates back to the heart. The remaining waste fluid, or urine, exits the kidney through a duct called a ureter, and drains into the urinary bladder.

Nephrons are tiny filter units within the kidney. There are about 1,000,000 nephrons in each kidney. When the blood passes by the entrance of each nephron, it passes into smaller and smaller vessels. This causes an increase in pressure inside the vessels. This pressure squeezes most of the fluid out of the vessel and into the tube-like nephrons. What is left in the blood vessel is the red and white blood cells and enough fluid to move them along. (See Handout 20.)

After the fluid is moved out of the blood vessels and into the nephron, the blood vessels weave around the nephron tubes and reabsorb needed proteins, sugars and salts. What is left in the nephron tubes is moved to the collecting duct where water that was squeezed out of the blood vessel is reabsorbed through the collecting duct. (See Handout 21.) The rest of the contents of the nephron is waste and is stored with the waste from the other nephrons in the renal pelvis before it goes to the bladder. The renal pelvis is an area in the kidneys into which collecting tubes drain. Wastes leave the kidneys through tubes, called ureters, that empty into the urinary bladder. (See Handout 22.)

Water is the most important substance to our bodies. We can go without food for a much longer period of time than we can go without water. Water is kept inside the body by being absorbed across the collecting duct wall of the nephron and back into the body. Alcohol, even small amounts, causes the collecting duct to become impermeable to water. This means that the water removed from the blood in the nephrons is not reabsorbed by the body and is excreted rather than reused. The impermeability of the collecting duct makes the bathroom a popular place in a bar. It also causes dehydration of all of the cells of the body. As any one who has ever had a hangover knows, the water is sucked out of the tissues, like the tongue and the lips, and taken to the rest of the body to keep vital tissue such as the heart and brain functioning. Dehydration is a serious problem in alcoholics, even though they are drinking all the time. It can cause dementia and heart failure and ultimately death.

The urinary bladder is a hollow muscular organ where the urine is stored until it is time to expel it. This expulsion is called voiding. When approximately 300 ml of urine has accumulated in the bladder, its wall is stretched to the extent that sensory nerves are stimulated and transmit this information to the brain indicating that it is time to void the bladder. Normally people can control the bladder so that voiding only occurs under proper social conditions.

Although only a small percentage of ingested alcohol makes it to the bladder, it can still do damage there. When alcohol is in the urine it irritates the lining of the bladder and makes the control of the bladder difficult. In chronic alcoholics, control is almost impossible. Another problem with chronic alcoholics is that the tissue can swell so much that it is impossible to void the bladder. This leads to infection and can lead to a bursting of the bladder. Bladder infections are common in the alcoholic and can be painful as well as extremely dangerous.

In discussing the digestive Process, functions and organs have been presented as well as various reactions of the body to alcohol. Although presented in fairly typical euro-ethnic science fashion, there has been an attempt to infuse an Indian world view as a way of "seeing" wholeness, connections, interdependence, harmony, and lack there of.

Questions

1. What are the functions and interactions of these organs: Pancreas, liver, kidney, alimentary canal?

2. How does alcohol affect the pancreas, kidney, and liver?

3. Why does the liver receive blood from two sources?

4. What are several diseases caused by alcohol abuse?

5. Why do people who drink alcohol need to urinate more than usual?

6. Why do you think the small intestine is longer than the large intestine?

Training Activities

These training activities assist participants to understand and apply the content of this section. These may easily be adapted for classroom application with students.

1. Discuss the fact that alcohol can penetrate to every cell in the body from the alimentary canal. Consider the implications from the perspective of the Medicine Circle.

2. Group participants in pairs. One is assigned the role of food; the other is assigned the role of alcohol. They review the digestive process by describing to each other their passage through the alimentary canal.

3. Ask participants to draw cartoon characters of various organs meeting molecules of alcohol. Include dialogue in balloons.

4. Have participants create dot-to-dot drawings for various digestive organs. Ask them to exchange drawings and connect the dots.

5. In the context of the Medicine Circle, discuss how the concepts of balance and interrelatedness are reflected in the considerations of this unit. Explore applications and extensions of this thought in the context of the digestion cycle.

Notes - Section III-B

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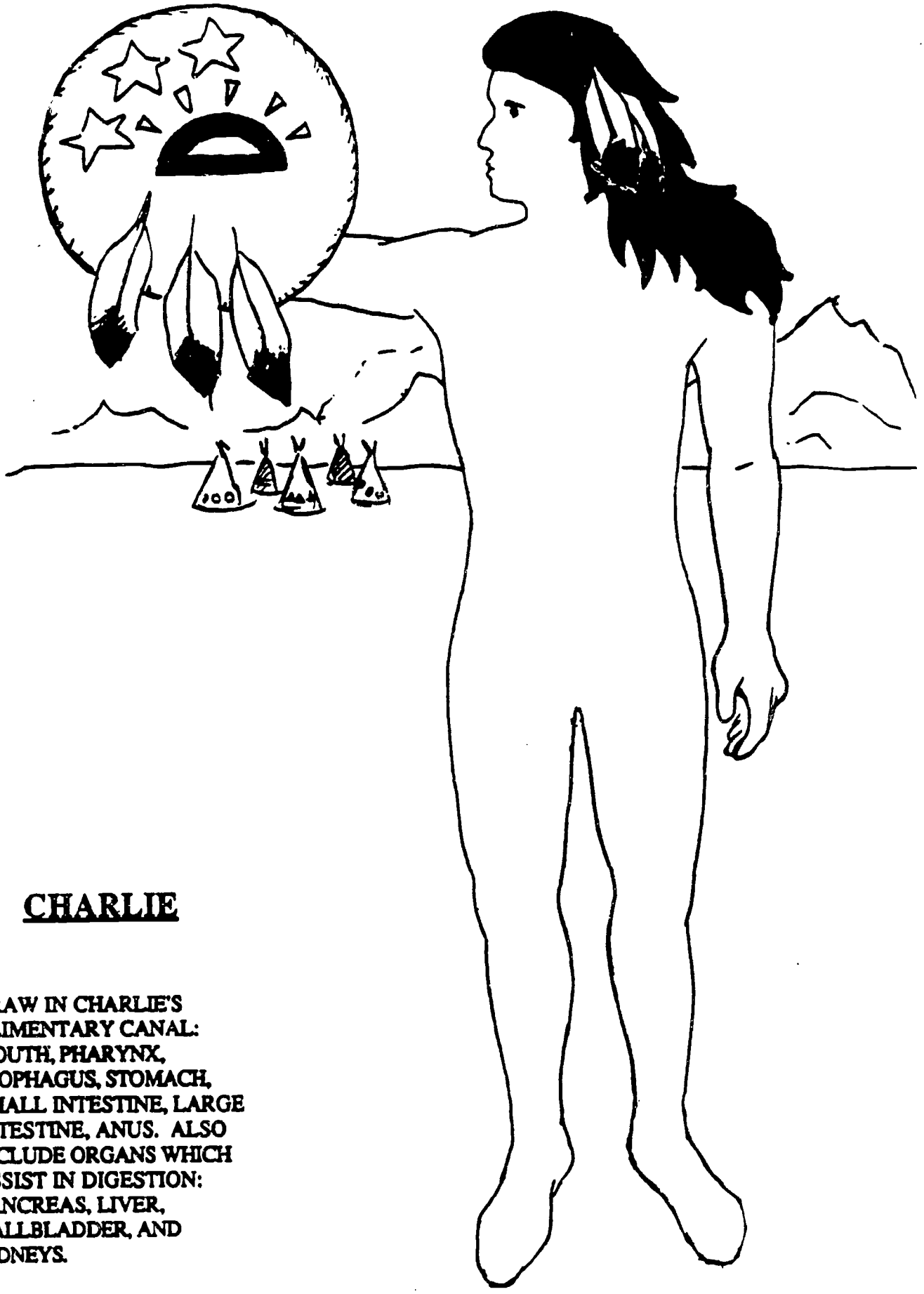
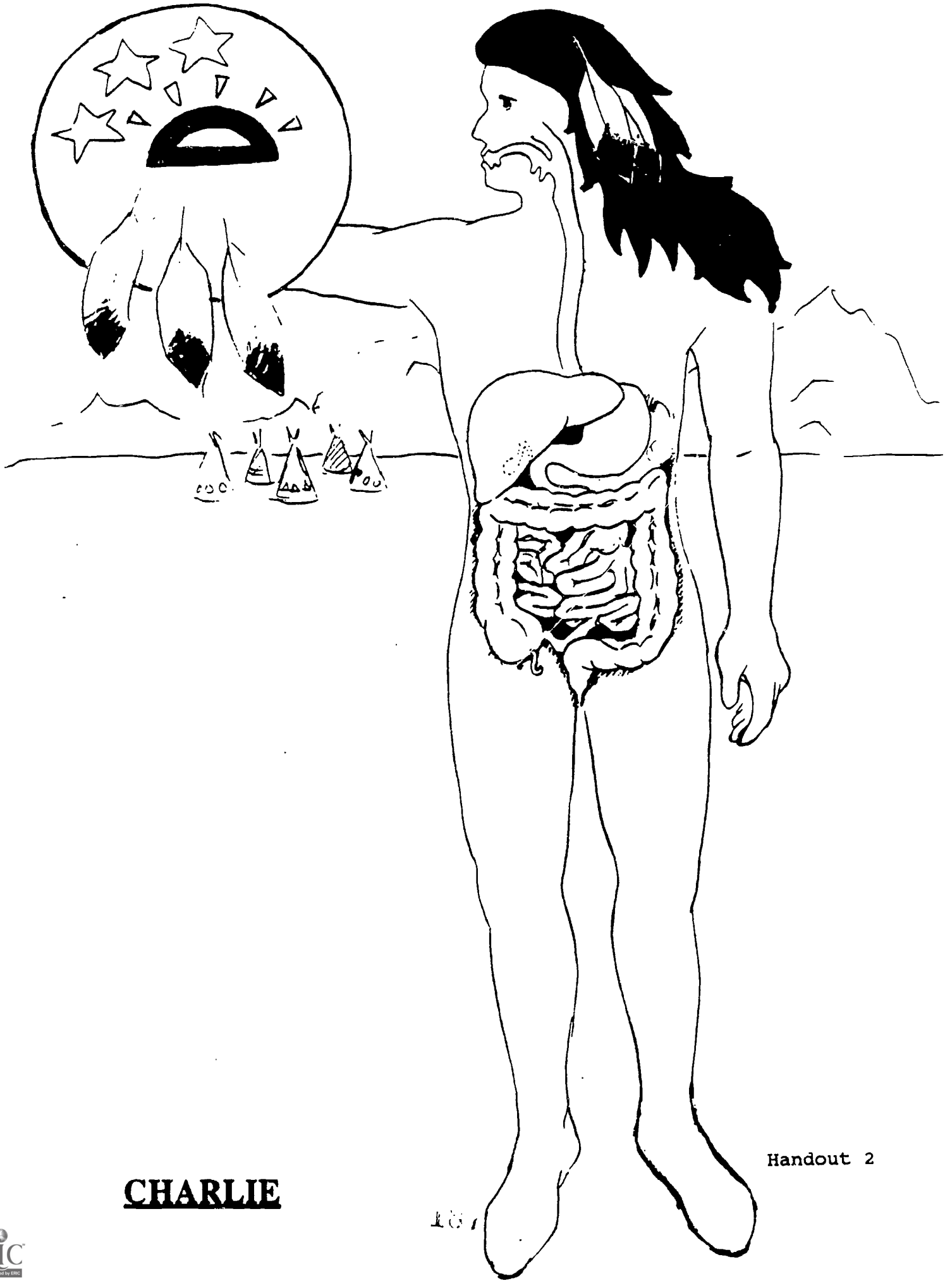
Unit Handouts

1. Charlie
2. Charlie (with parts)
3. Digest Pass
4. Charlie's Epithelial Cells
5. Food and Alcohol Molecules
6. Processes of Charlie's Digestive System
7. Charlie's Alimentary Canal
8. How Charlie's Enzymes Work
9. Charlie's Esophagus
10. Charlie's Stomach
11. Charlie's Small Intestine
12. Close up of Charlie's Small Intestine
13. One of Charlie's Villi
14. Outside to Inside
15. Charlie's Large Intestine and Anus
16. Charlie's Pancreas
17. Charlie's Liver
18. Liver and Liver Lobule
19. Metabolism of Alcohol
20. Charlie's Kidney
21. One of Charlie's Nephrons
22. Charlie's Bladder
23. Story 1 - Swims Long Way and the Squall Pot
24. Story 2 - Night Flyer and the Trickster



CHARLIE

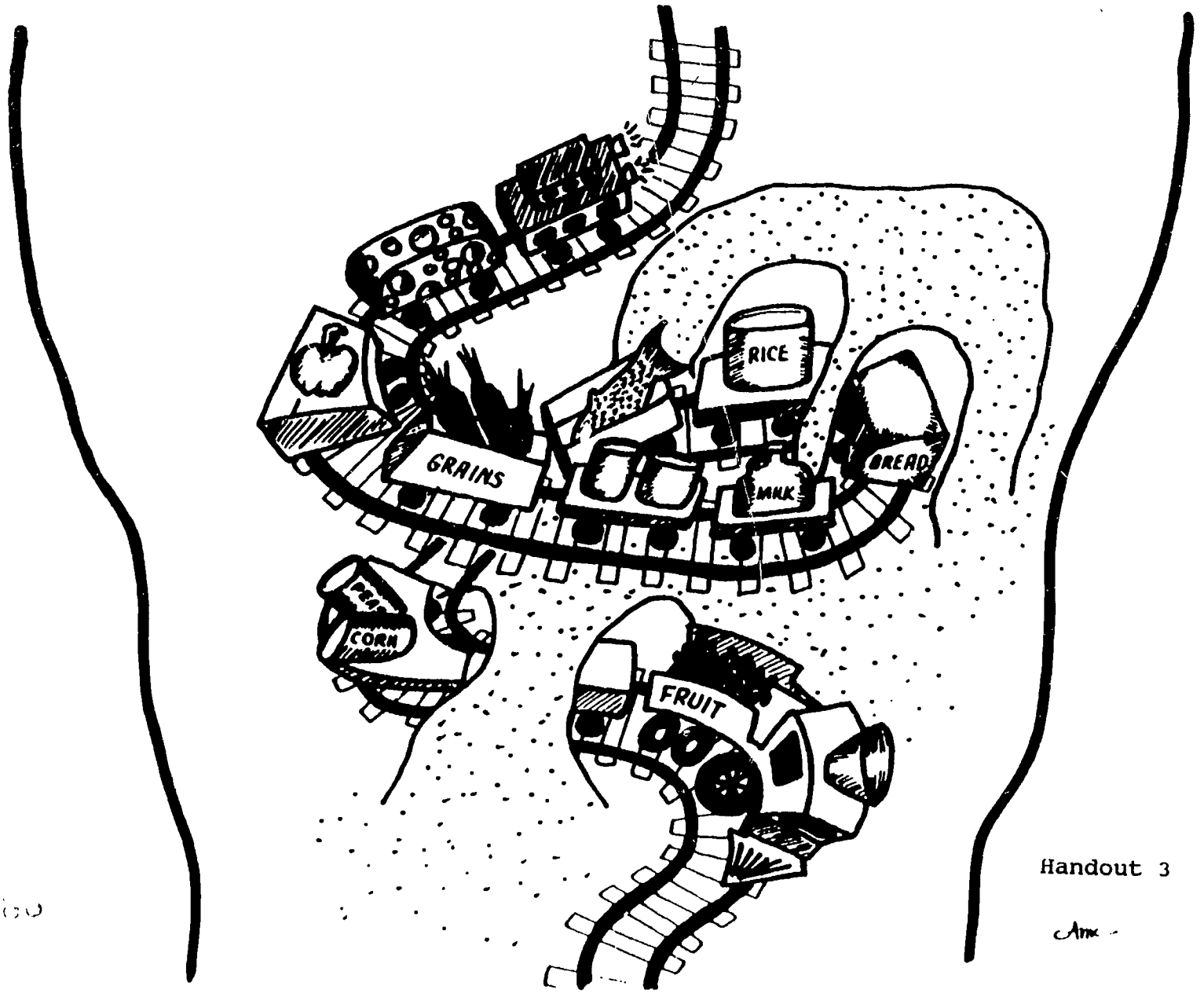
DRAW IN CHARLIE'S ALIMENTARY CANAL: MOUTH, PHARYNX, ESOPHAGUS, STOMACH, SMALL INTESTINE, LARGE INTESTINE, ANUS. ALSO INCLUDE ORGANS WHICH ASSIST IN DIGESTION: PANCREAS, LIVER, GALLBLADDER, AND KIDNEYS.



Handout 2

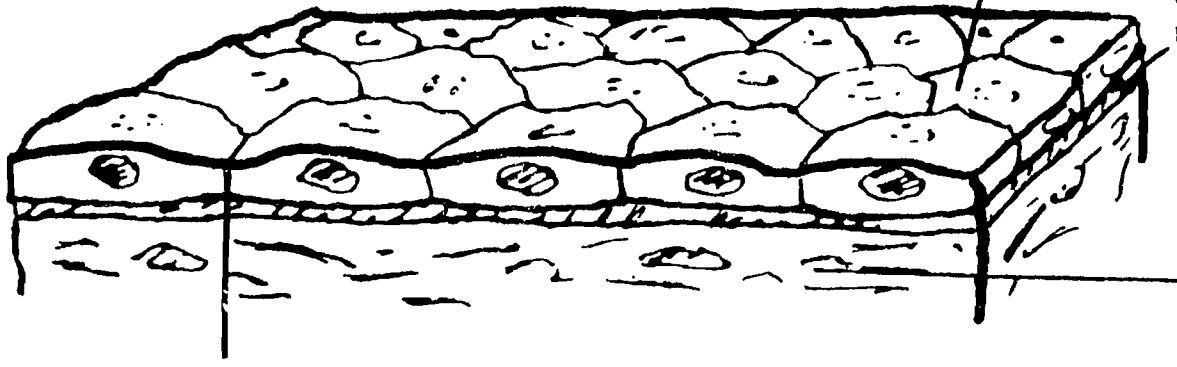
CHARLIE

DIGEST PASS



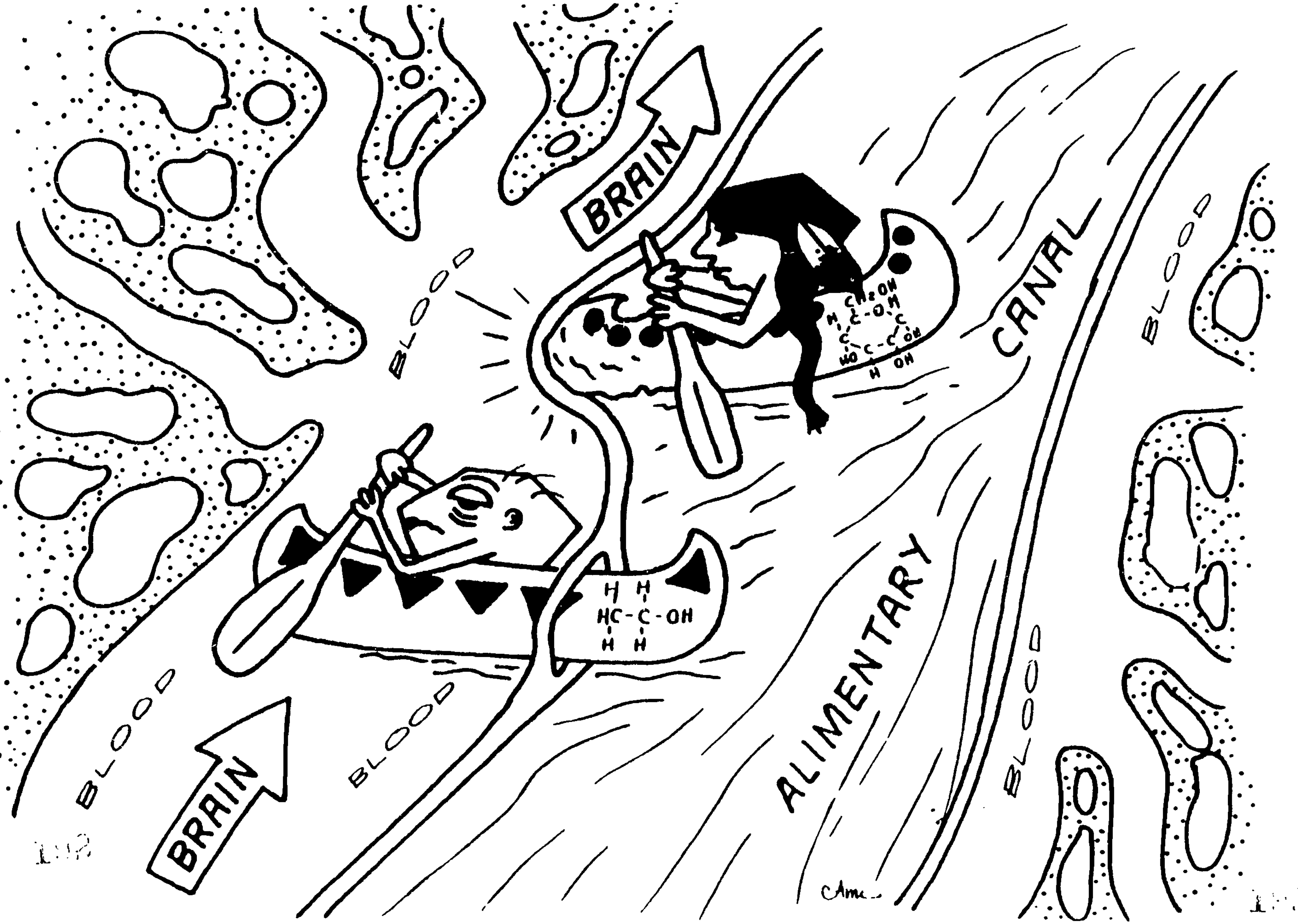
Handout 3

CHARLIE'S EPITHELIAL CELLS



EPITHELIAL TISSUES LINE ALL INNER AND OUTER SURFACES OF THE BODY. CELLS OF A TISSUE ARE HELD TOGETHER BY THE BASEMENT MEMBRANE AND INTRACELLULAR FIBERS.

FOOD AND ALCOHOL MOLECULES



PROCESSES OF CHARLIE'S DIGESTIVE SYSTEM

1) INGESTION OF FOOD AND MOVEMENT THROUGH THE ALIMENTARY CANAL

2) MECHANICAL BREAKDOWN OF FOOD

3) CHEMICAL BREAKDOWN OF FOOD

4) ELIMINATION OF WASTE PRODUCTS AND UNDIGESTIBLE SUBSTANCES

CHARLIE'S ALIMENTARY CANAL

MOUTH AND PHARYNX

ESOPHAGUS

STOMACH

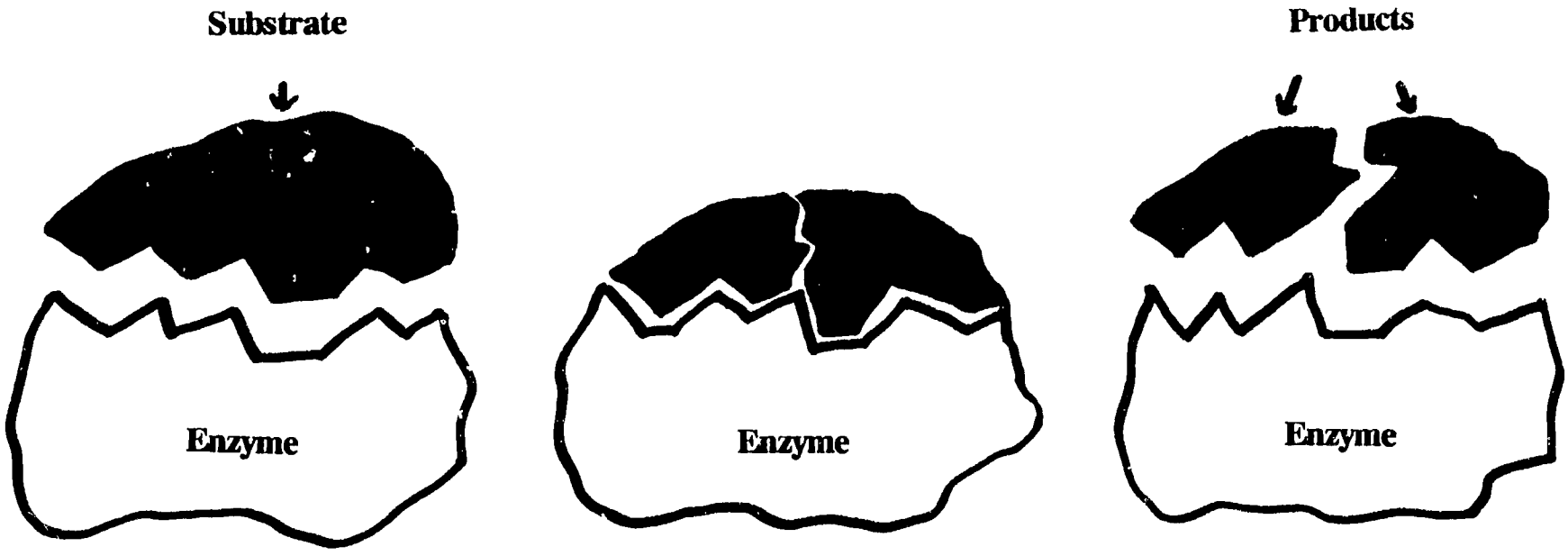
SMALL INTESTINE

LARGE INTESTINE

ANUS

Handout 7

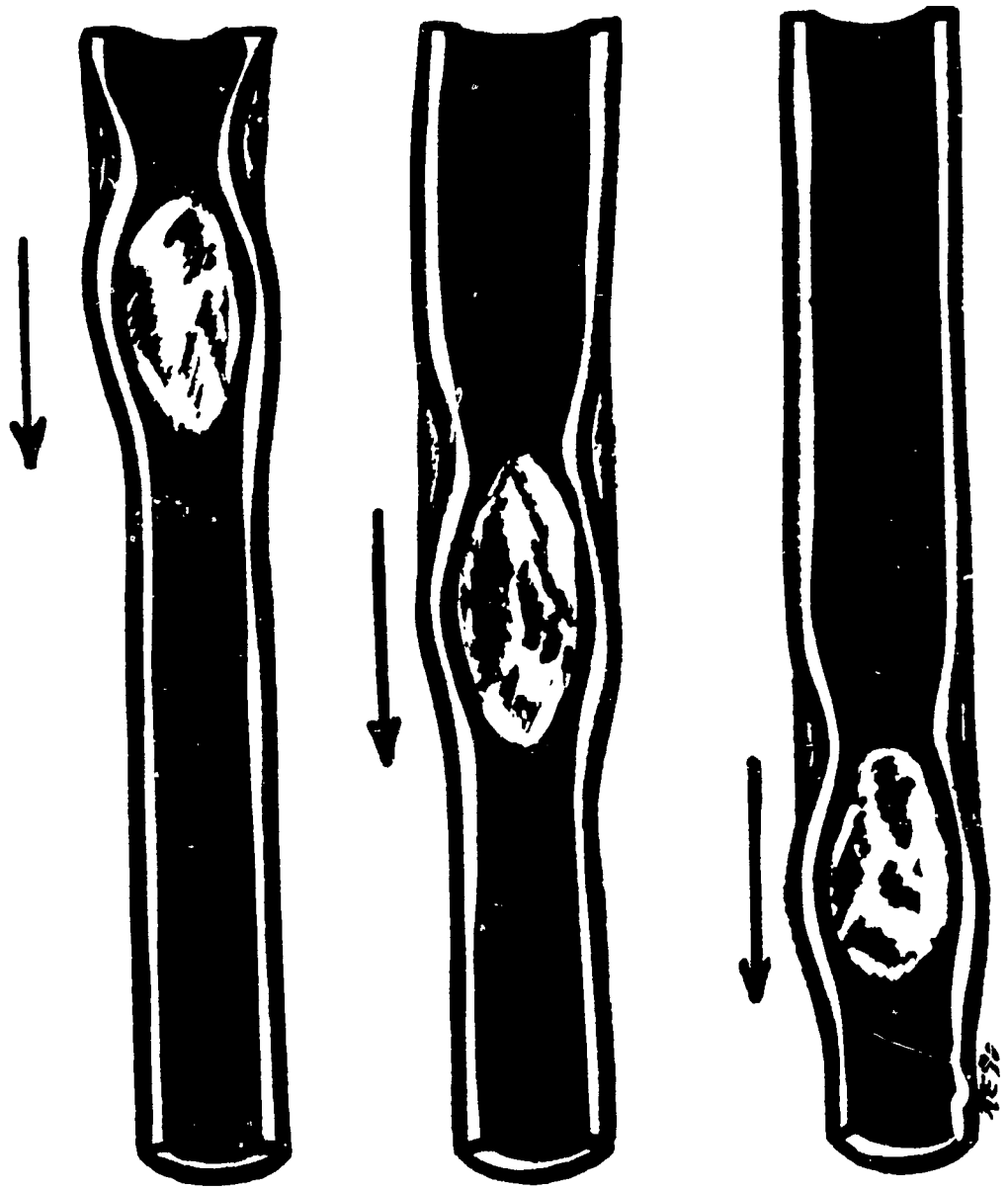
HOW CHARLIE'S ENZYMES WORK



In order to bring about a chemical change, the enzyme must unite temporarily with the molecule (substrate) participating in the chemical action.

Handout 8

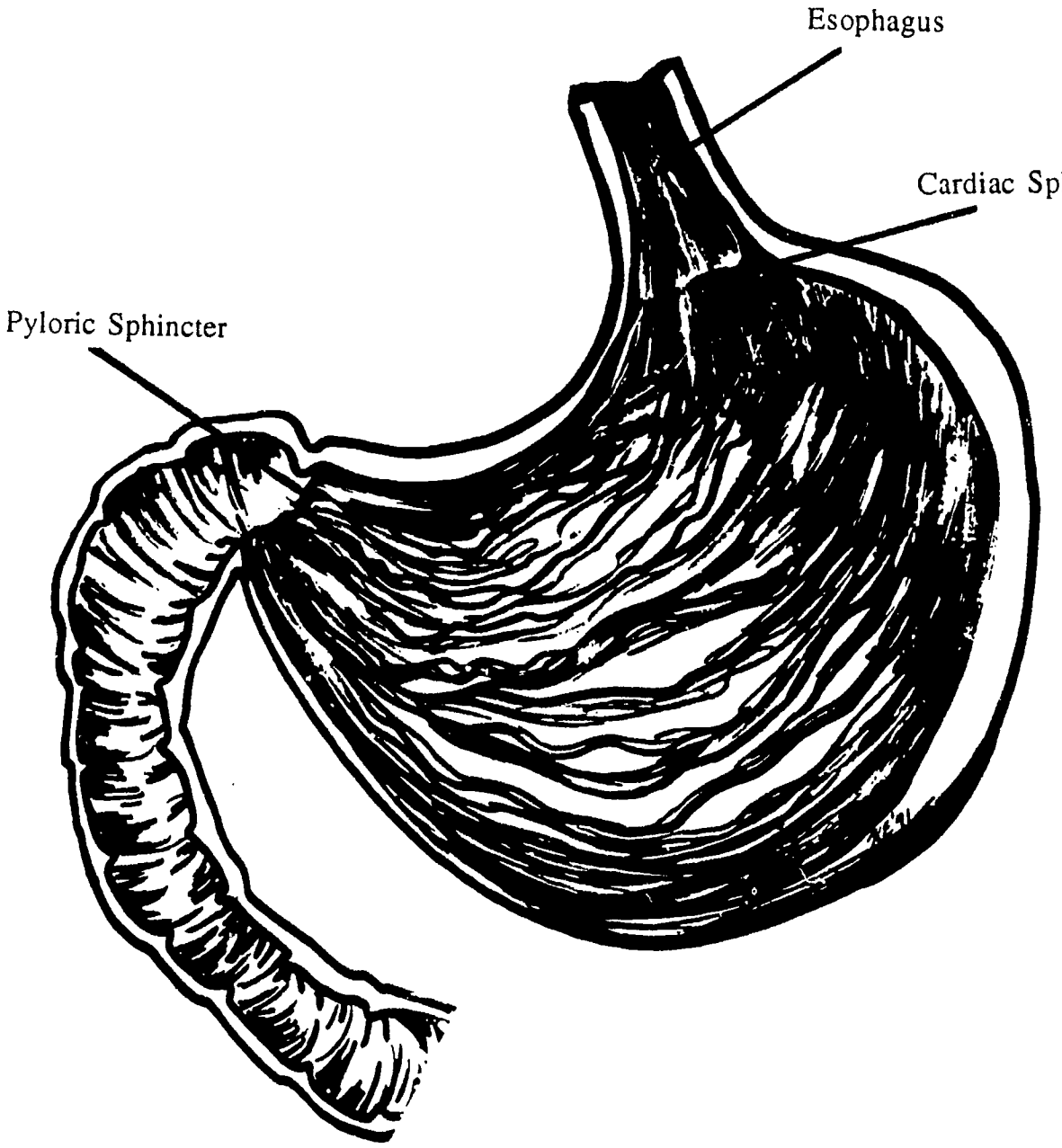
CHARLIE'S ESOPHAGUS



THE ESOPHAGUS IS A MUSCULAR TUBE THAT CONNECTS THE PHARYNX WITH THE STOMACH. FOOD IS MOVED THROUGH THE ESOPHAGUS BY PERISTALSIS, CONTRACTIONS OF THE MUSCLE WALL.

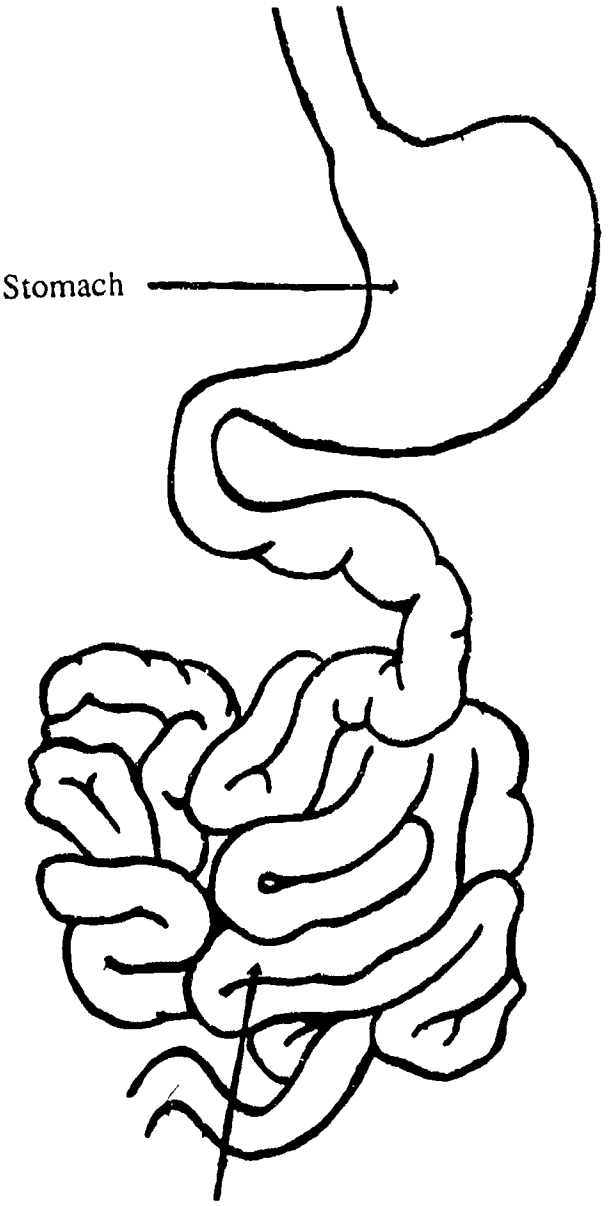
Handout 9

CHARLIE'S STOMACH



THE STOMACH STORES INGESTED FOOD AND PREPARES IT, BOTH MECHANICALLY AND ENZYMATICALLY, FOR EVENTUAL TREATMENT BY THE SMALL INTESTINE.

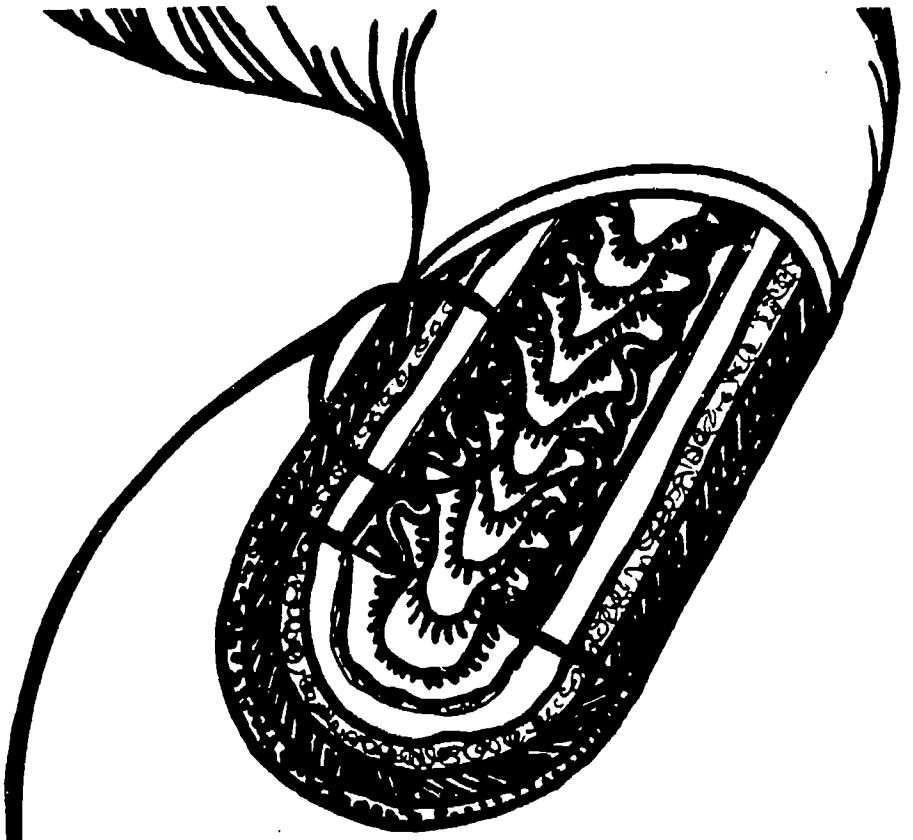
CHARLIE'S SMALL INTESTINE



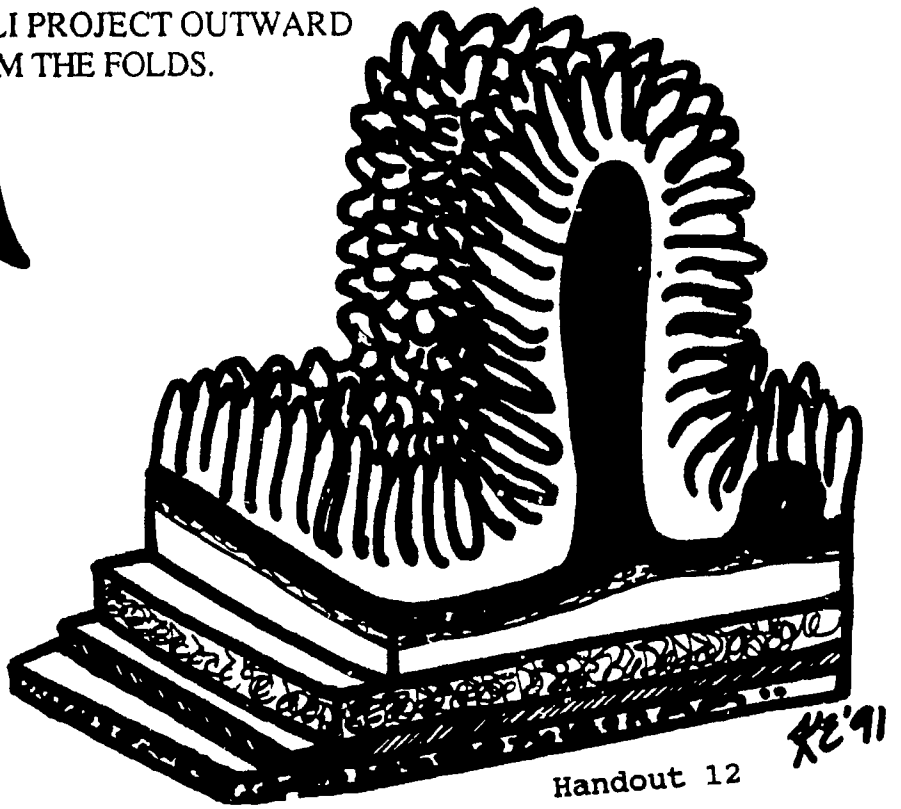
Small Intestine

THE SMALL INTESTINE RECEIVES PARTIALLY DIGESTED FOOD (CHYME) FROM THE STOMACH AND BREAKS IT DOWN FURTHER BY MECHANICAL AND ENZYMATIC DIGESTION WITH THE AID OF SECRETIONS FROM THE PANCREAS AND LIVER (VIA THE GALL BLADDER).

CLOSE UP OF CHARLIE'S SMALL INTESTINE



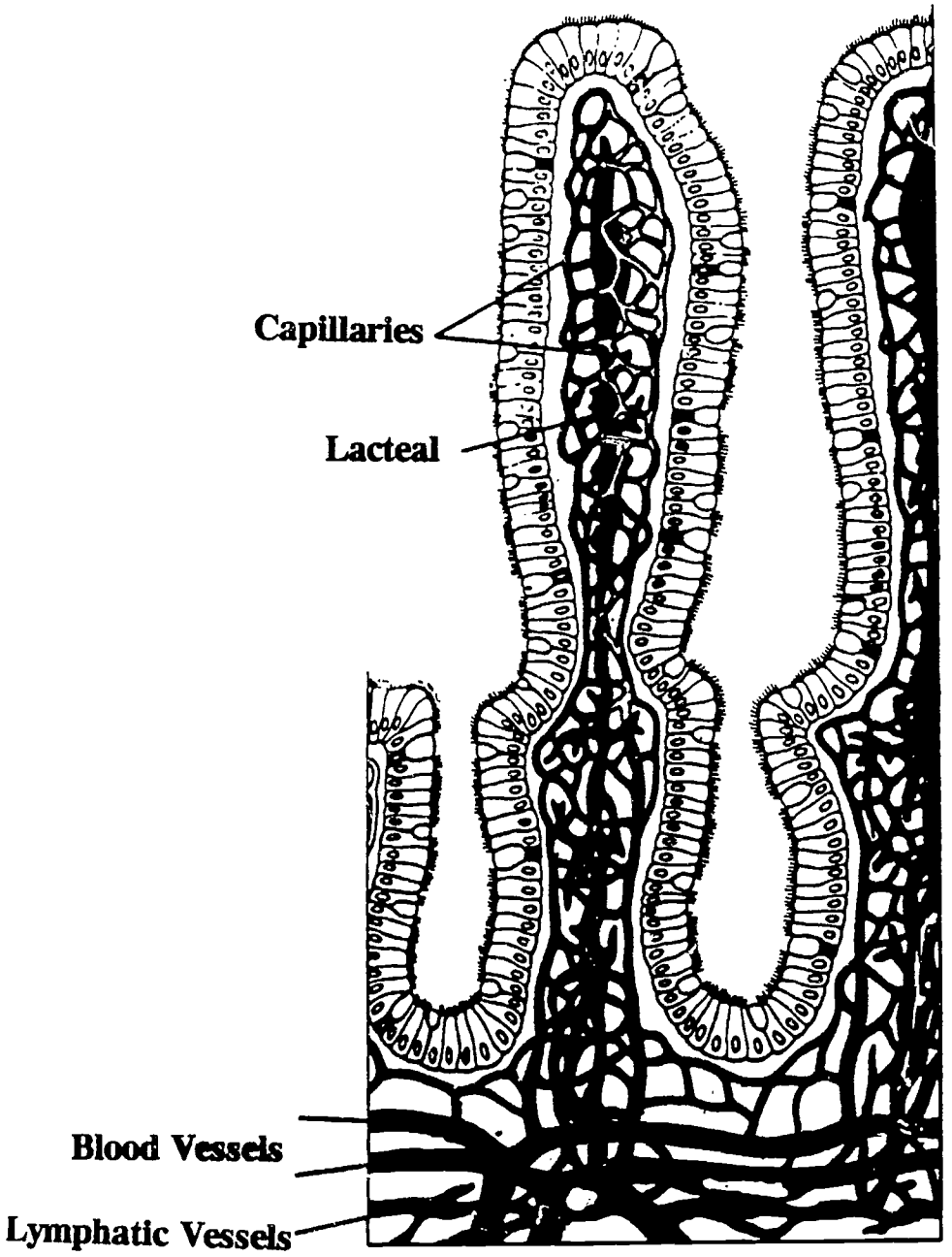
LARGE FOLDS OF EPITHELIUM
LINE THE SMALL INTESTINE.
VILLI PROJECT OUTWARD
FROM THE FOLDS.



KE'91

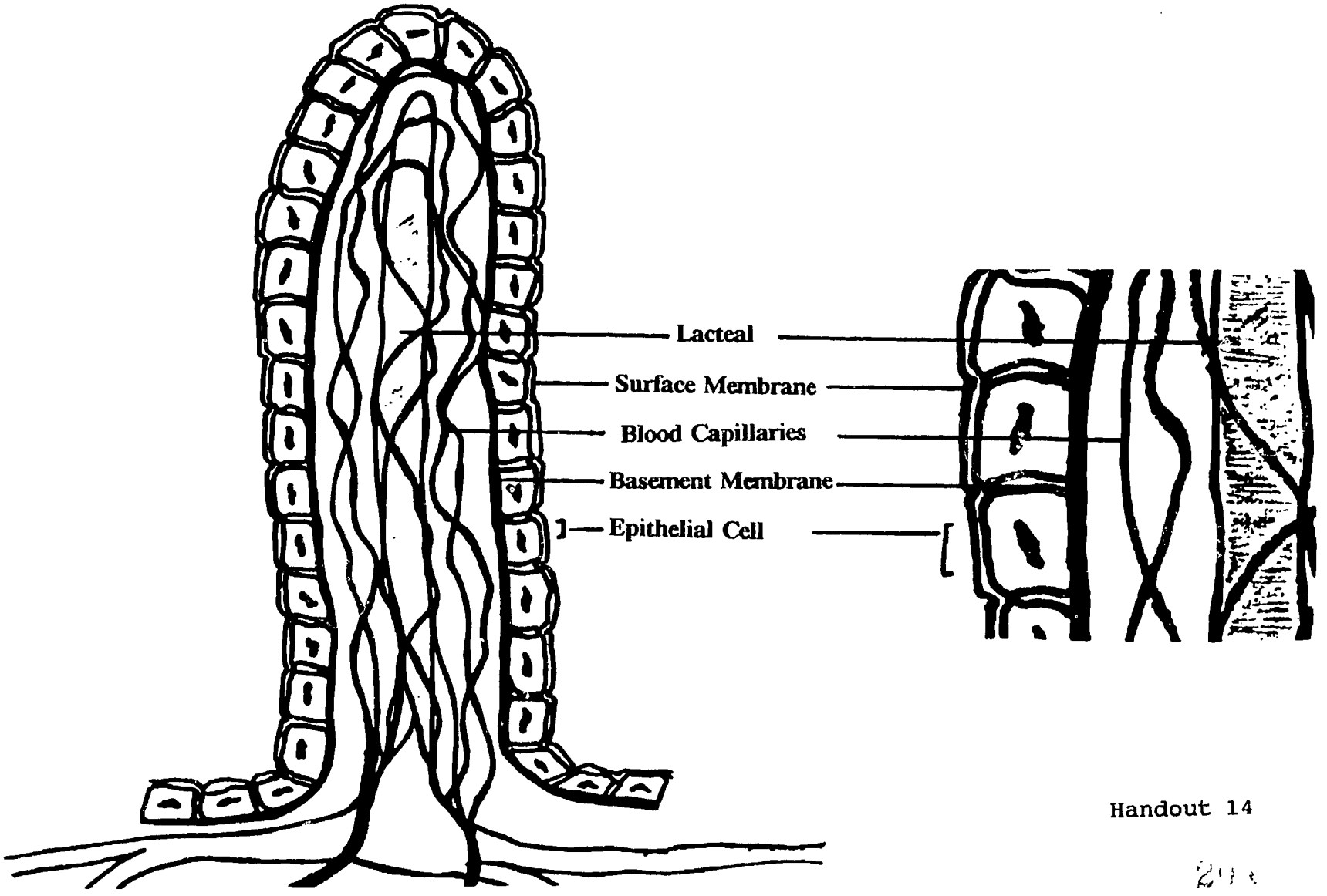
Handout 12

ONE OF CHARLIE'S VILLI



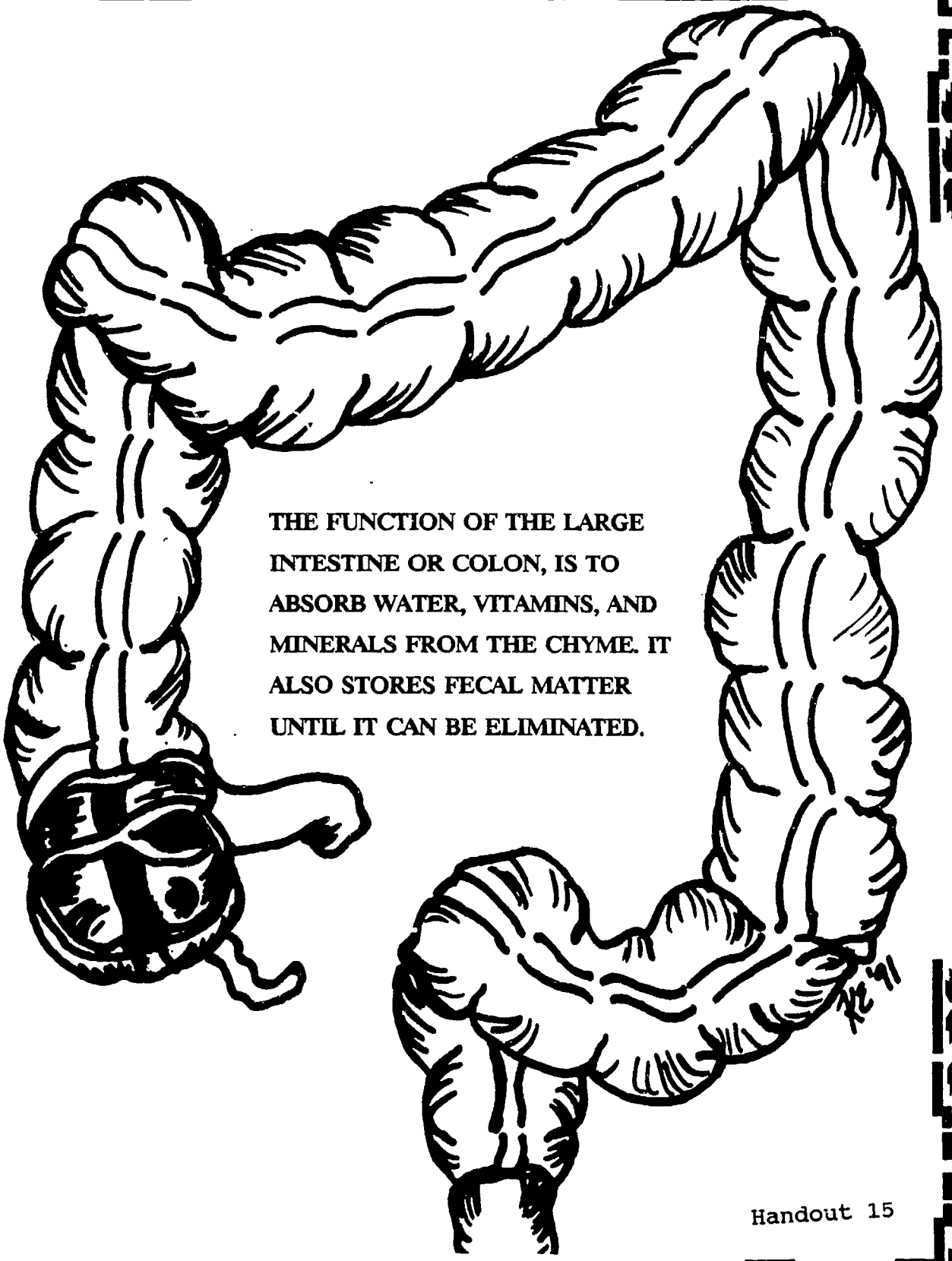
VILLI ARE FINGER-LIKE PROJECTIONS LOCATED IN THE SMALL INTESTINE WHICH ARE RESPONSIBLE FOR THE ABSORPTION OF NUTRIENTS FROM THE DIGESTIVE TRACT INTO THE BLOODSTREAM.

OUTSIDE TO INSIDE



Handout 14

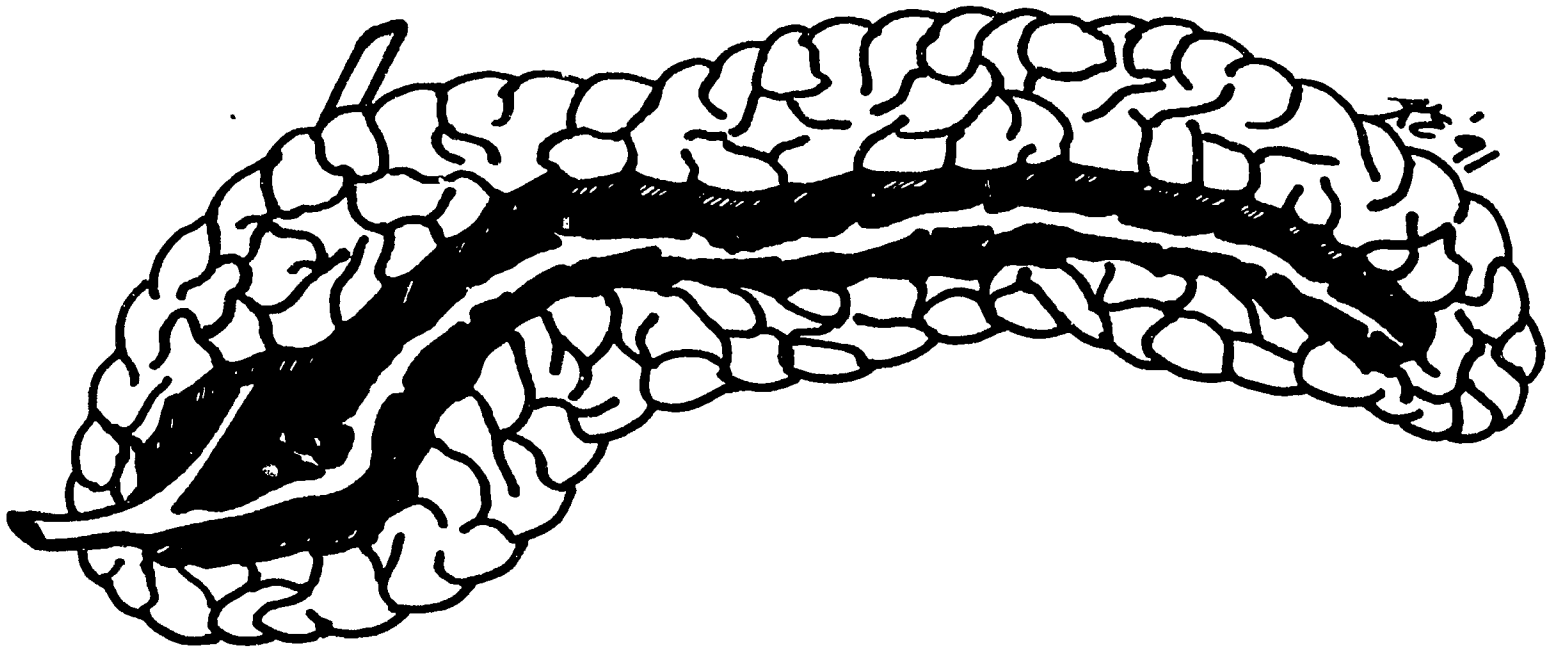
CHARLIE'S LARGE INTESTINE AND ANUS



THE FUNCTION OF THE LARGE INTESTINE OR COLON, IS TO ABSORB WATER, VITAMINS, AND MINERALS FROM THE CHYME. IT ALSO STORES FECAL MATTER UNTIL IT CAN BE ELIMINATED.

Handout 15

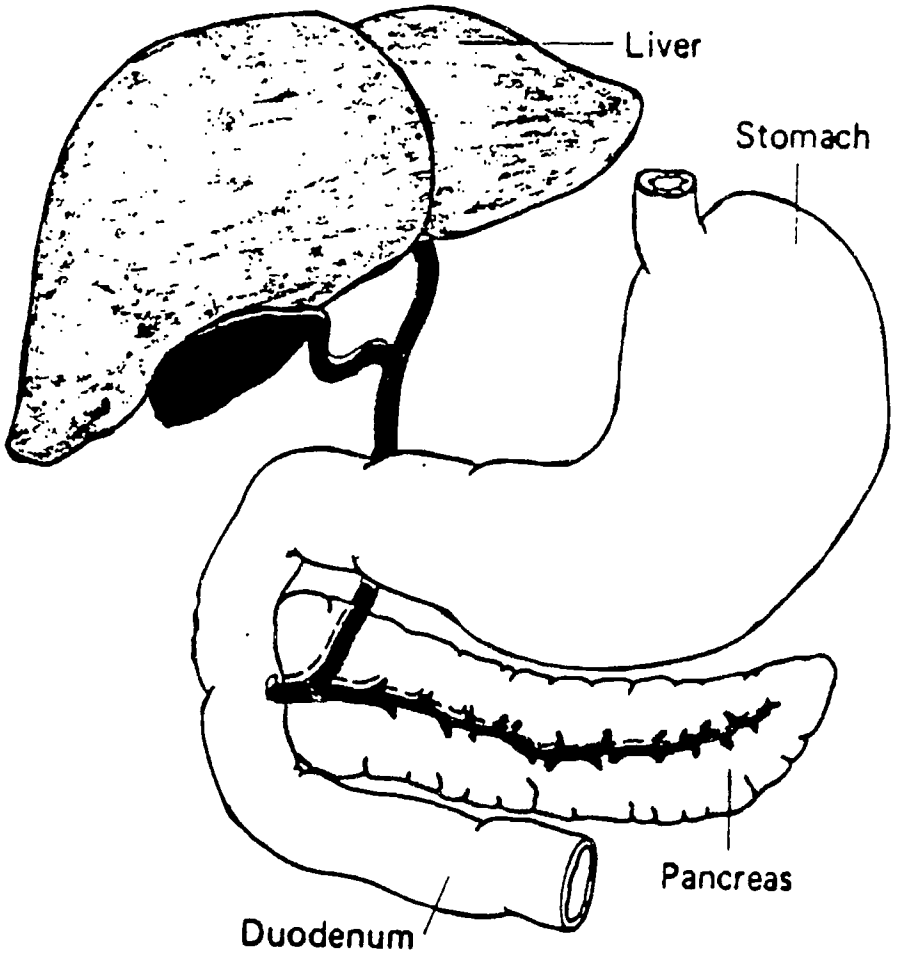
CHARLIE'S PANCREAS



THE PANCREAS IS A GLAND THAT PRODUCES DIGESTIVE ENZYMES NEEDED TO BREAK DOWN FOODS SUCH AS PROTEIN, FATS AND CARBOHYDRATES. IT ALSO PRODUCES HORMONES WHICH ARE RESONSIBLE IN REGULATING THE LEVEL OF SUGAR (GLUCOSE) IN THE BLOOD.

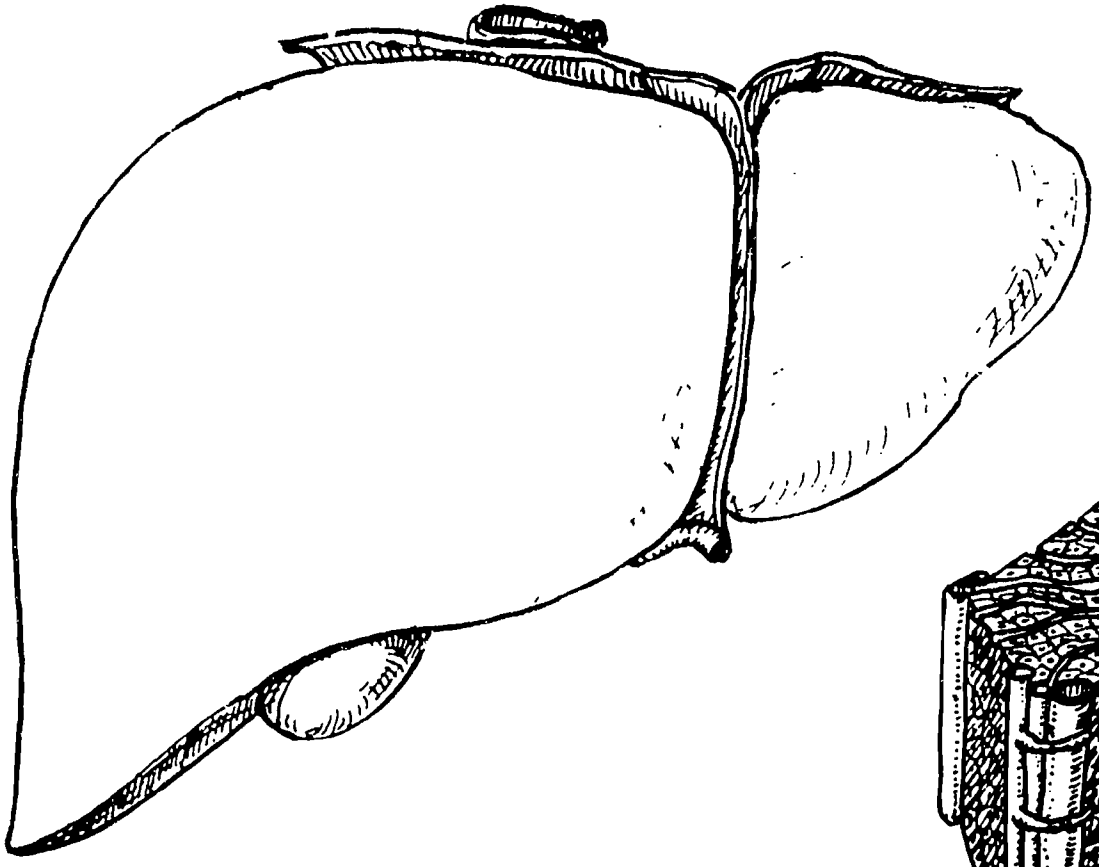
Handout 16

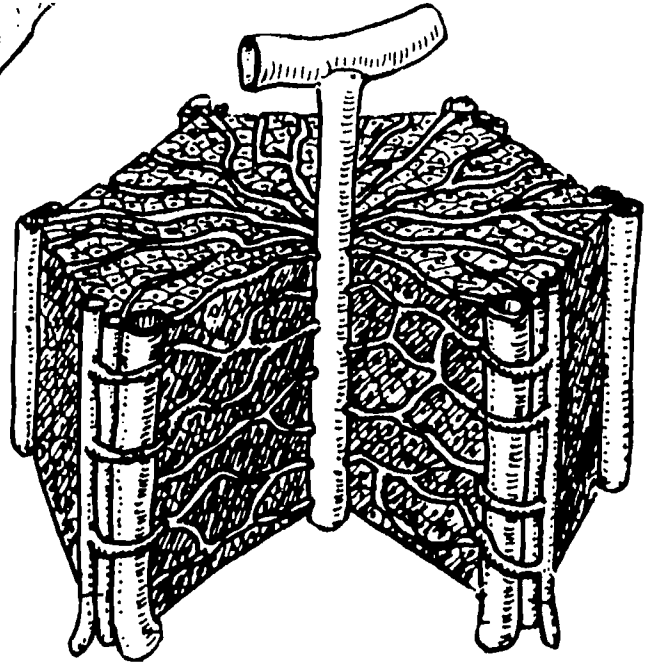
CHARLIE'S LIVER



THE LIVER PERFORMS A WIDE VARIETY OF FUNCTIONS IN THE BODY, INCLUDING STORING CERTAIN NUTRIENTS, DETOXIFYING VARIOUS POISONS AND DRUGS, AND THE CONVERSION OF INGESTED SUBSTANCES INTO FORMS WHICH CAN BE USED BY THE BODY.

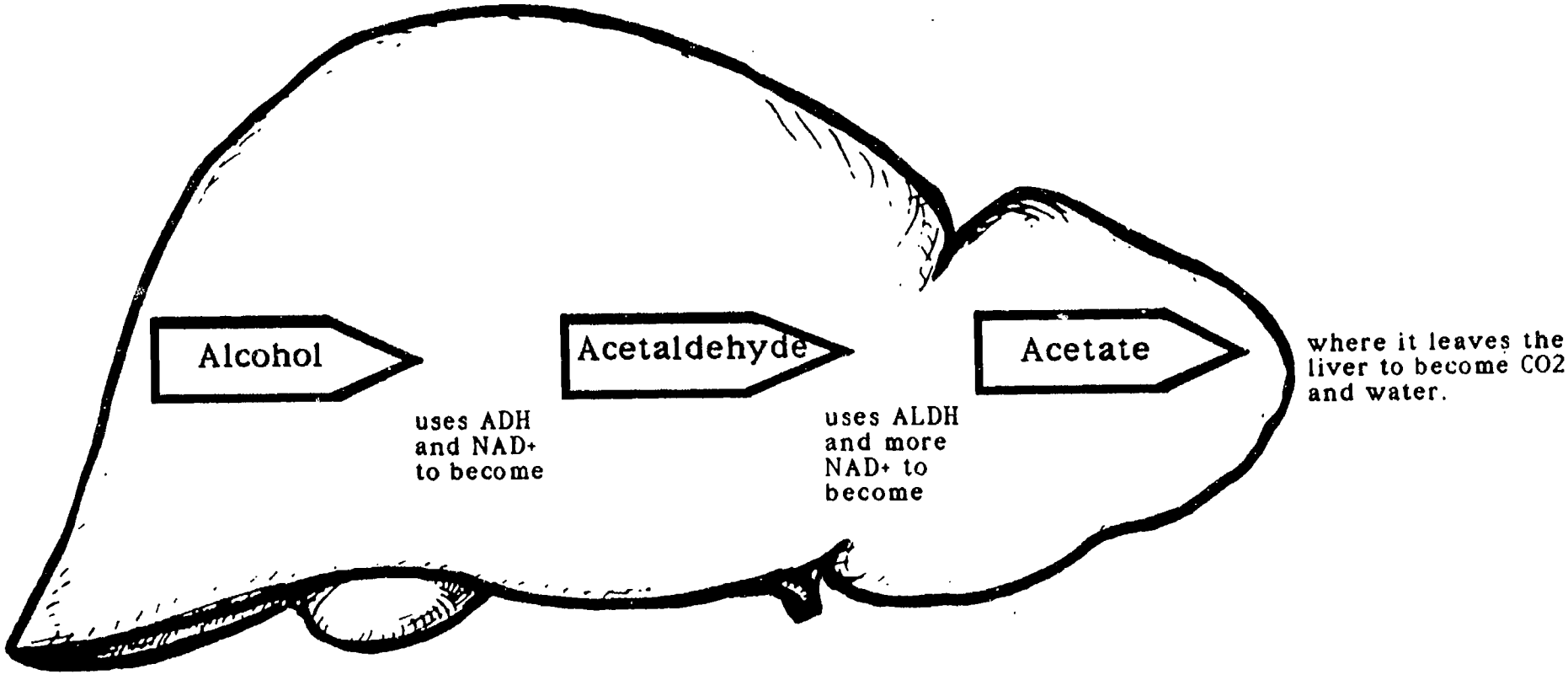
Liver and Liver Lobule





Handout 18

METABOLISM OF ALCOHOL



ADH - alcohol dehydrogenase

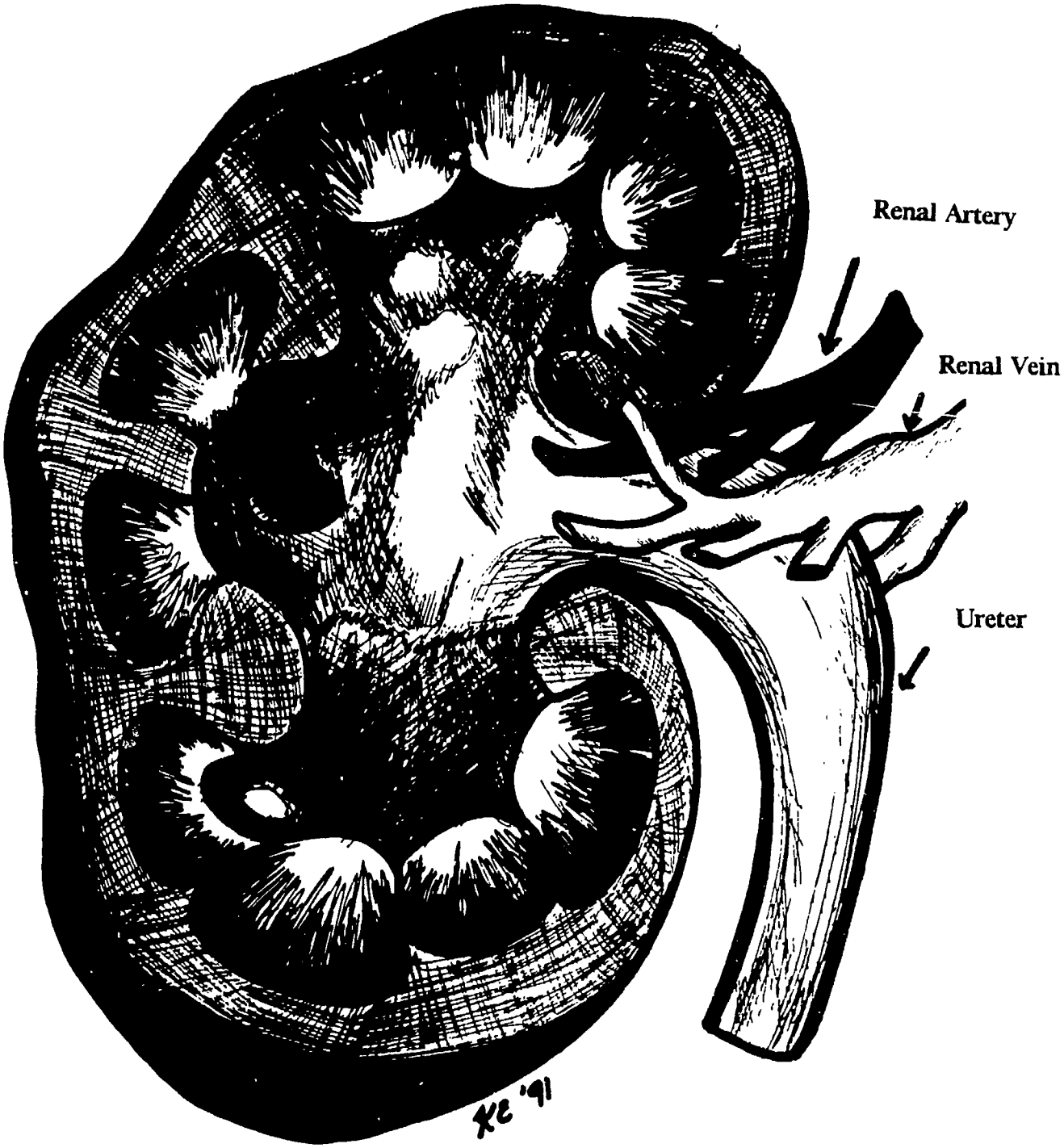
NAD+ - nicotinamide adenine denucleotide

ALDH - aldehyde dehydrogrenase

CO2 - carbon dioxide

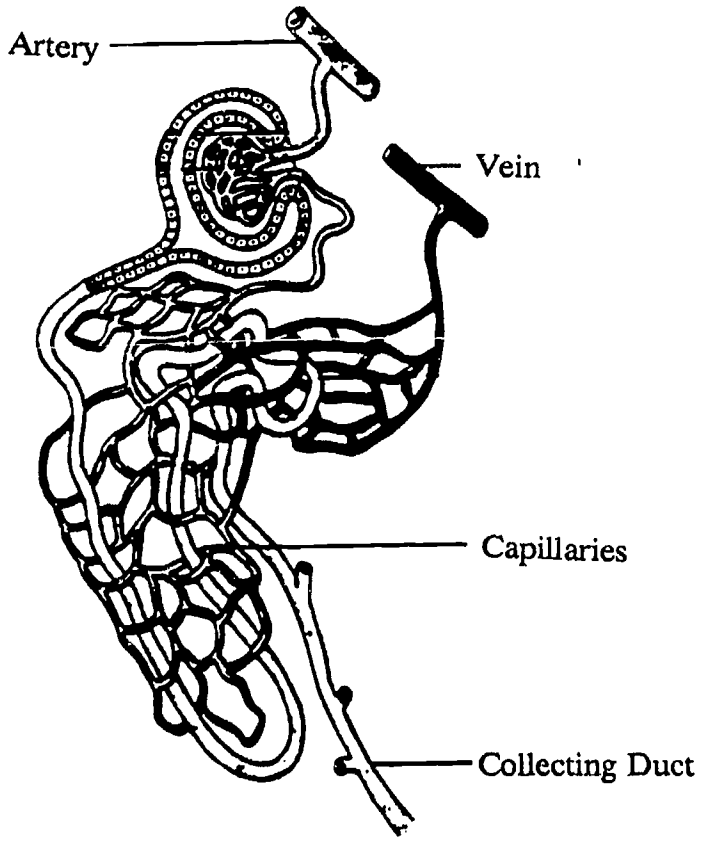
Handout 19

CHARLIE'S KIDNEY



THE KIDNEYS, A PAIR OF BEAN-SHAPED ORGANS ABOUT 10 CM LONG, ARE RESPONSIBLE FOR FILTERING WASTES FROM THE BLOOD. ABOUT 20% OF THE BLOOD PUMPED WITH EACH HEARTBEAT PASSES THROUGH THE KIDNEYS, AND THESE ORGANS PROCESS THE ENTIRE BLOOD SUPPLY OF THE BODY ONCE EVERY 5 MINUTES.

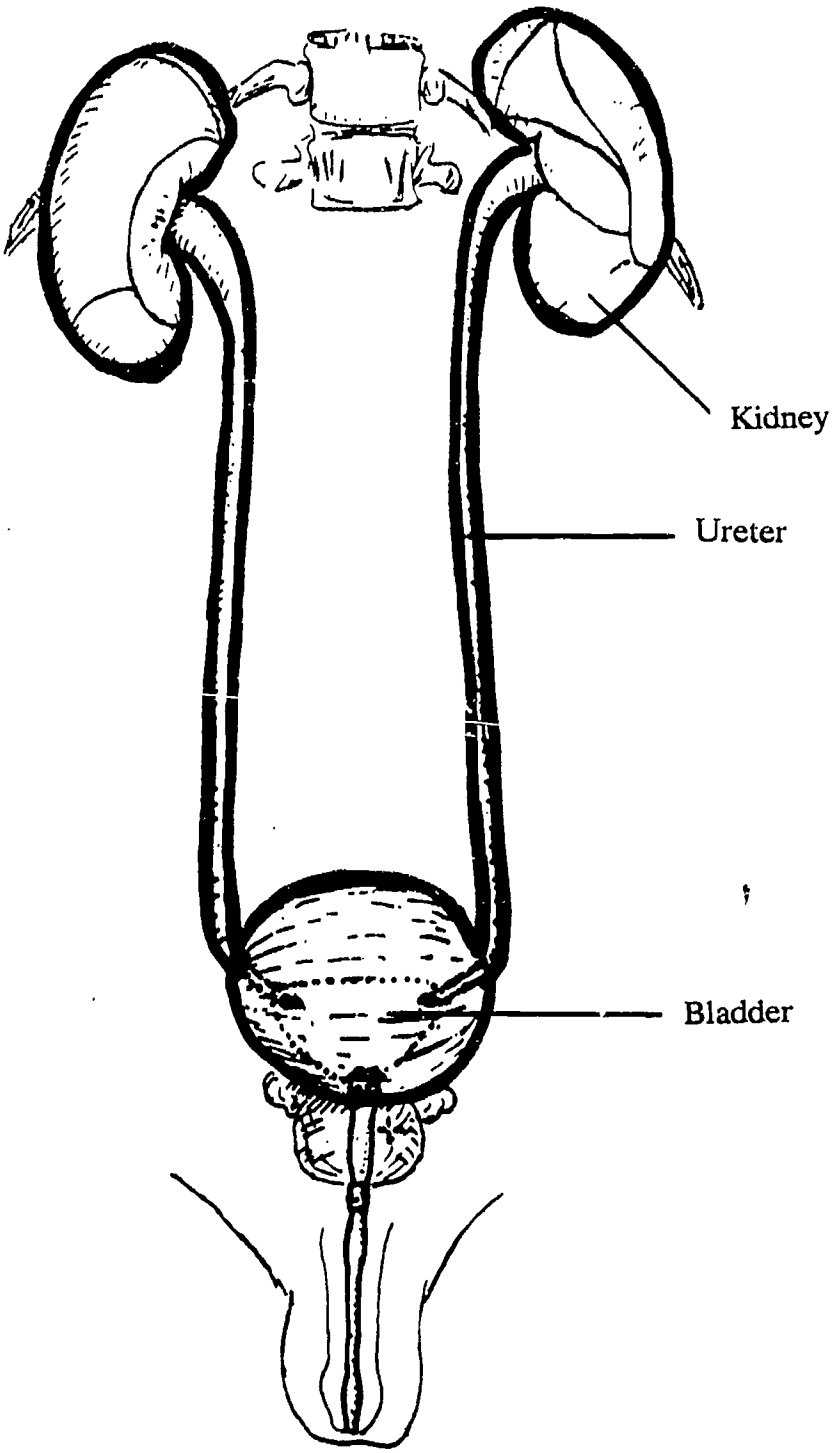
ONE OF CHARLIE'S NEPHRONS



Handout 21

THE NEPHRON IS THE FUNCTIONAL UNIT OF THE KIDNEY WHERE URINE IS PRODUCED. THE BASIC FUNCTION OF THE NEPHRON IS TO CLEAN THE BLOOD OF UNWANTED SUBSTANCES AS IT PASSES THROUGH THE KIDNEY.

CHARLIE'S BLADDER



THE URINARY BLADDER IS A HOLLOW, MUSCULAR ORGAN WHICH COLLECTS URINE AND STORES IT UNTIL ENOUGH LIQUID HAS ACCUMULATED FOR URINATION TO OCCUR.

Swims Long Way and the Squall Pot
(Story telling how sense of smell warns of danger)
As told by Carolyna Smiley-Marquez

With three of his clan brothers and one of his sisters, Swims Long Way had built a raft canoe of birch and poplar tree poles that had been felled last season by the twisting winds. These friends were older now but had yet to complete the welcoming ceremonies into adulthood. So, though they had much freedom, they were still children in many ways.

Not on this day, however. Swims Long Way had decided on a plan to cross the great water of the south (which would be called Lake Michigan by whites who came later). He thought this would assure that he would be called a warrior when he entered manhood and was busy thinking manhood thoughts as he lashed the poles together. His friends brought sap and tree tar to seal the bottom of this boat and held the narrow poles in place as Swims Long Way tied them together at the front and the back of the canoe.

It was not long before he packed a leather bag full of food and tokens and a clay pot full of gifts into the canoe and waved goodbye. He bragged how he would cross the water twice and would return in a few days.

But it did not happen as Swims Long Way had planned. Even before he was out of sight of the shore, a great squall churned up the water and swallowed Swims Long Way and all his provisions. Below and above the water he swam for many days looking for the bank where he had left his friends.

Because he was in the water, he had had many hours to do nothing but swim and think and he realized that he knew less about manhood than he thought. He did also become very sure that a warrior would have thought more and consulted more about a plan to cross the waters alone. It was about this time, the second sunset, when he found the clay pot drifting on the surface of the water. Immediately, he opened the pot and gave the gifts to the water while he asked to be directed back home again.

The lake was done with Swims Long Way about this time anyway, and washed him up on the shore. Inside his clay pot, she placed the smell of the squall that had turned Swims Long Way's boat on its end, so that he could open it at any time and remember the lesson he had learned about being wise. Whenever he opened the pot, he could smell the odor of the danger and he would not forget to heed the warnings.

As it happened, Swims Long Way turned himself into a storyteller so that he could repeat the lessons of the lake that he had learned in his long swim. And every time he would tell this story, he would open the clay pot so that all the listeners of young and old ages could recognize the smell of the squall and know that the lake could swallow them up and might not be in a mood to spit them out as it did for Swins Long Way.

In this way, he became a warrior.

Night Flyer and the Trickster
(Story for mapping exercise)

as told by Carolyna Smiley-Marquez

Raven and the night flyers (bats) met at sunset, each waiting on the thin upper branches of a cottonwood tree. They watched in silence for a long while, raven occasionally squawking as he groomed the long black feathers on his handsome wings. The night flyers dozed and woke alternately in preparation for the long night of hunting. After a while, raven, who thought very highly of himself, began to discuss with himself how superior he was to the night ones. Raven bragged, "My eyes are so excellent that I can see the small dust particles that fly around the feet of the dancers over there around the fire."

A night flyer quivered and stretched as the sky darkened. At first she considered ignoring raven and perhaps dozing a few moments more before the long night hunt she knew was ahead of her. But she thought this might be a chance to play tricks on the trickster himself. What a good laugh she would have on this bloated old bird, she considered. "Raven, oh raven," she said, in a voice that was pitched so high that it was almost silent. "I will challenge you to a game. I will give you one of my fine ears which allow to fly and hunt in the darkness; you give me one of your fine eyes, which allow you to have this superior sight. Then you be master of both daylight and darkness as can I. We will then discuss which is the better way."

Raven believed he was very clever, in fact, he believed himself so clever that he never had considered that he could be tric' ed. This seemed like a very good idea and so he agreed and immediately made the trade without asking any questions about this new ear of his and how it worked.

Just about the time he had fitted it nicely on the side of his head and just about the time he had covered his empty eye hole, he thought of a very important question. However, night flyer was long gone. He could not see her in the darkness except when she appeared for a quick moment in the firelight and he thought he could hear her shrill cry very distinctly as she darted among the dancers, swooped around the songs and prayers and drumbeats, scooping up the firebugs that danced among the sparks and smoke of the Lakota dancers' fire.

Raven heard and saw and then he thought. Then he felt stupid. Why that night flyer had tricked him, he realized. She had given him an ear, but his highest squeal would not serve to guide him through the night. So he sat, with his one eye open until the fire died down and the dancers slept, watching night flyer dart around, eating and laughing a high shrill laugh.

"Tomorrow", he thought, and closed his one good eye.

GLOSSARY

THE DIGESTIVE SYSTEM AND ALCOHOL USE

Acetaldehyde	A toxic agent produced by the liver in the initial stages of alcohol metabolism.
Acid Foods	Foods of a high acid level, having a pH maximum of 6 and a minimum of 0.
Fatty Liver	Degenerative changes in liver cells due to fat deposits in the cells.
ADH	(Alcohol dehydrogenase) An enzyme that creates acetaldehyde when reacting with alcohol.
Alcoholic Hepatitis	Inflammation of the liver due to alcohol consumption. Accompanied by systematic signs including fever, jaundice, and an enlarged liver.
ALDH	(Aldehyde dehydrogenase) An enzyme that creates acetate out of the highly toxic acetaldehyde.
Alimentary Canal	The digestive tube from the mouth to anus, including mouth, pharynx, esophagus, stomach, small and large intestines, and rectum.
Alkaline Foods	Foods containing a strong base, having a pH minimum of 8 and a maximum of 14.
Alpha Amylase	The class of enzymes that split or hydrolyze starch.
Amino Acid	The building blocks of which proteins are constructed and the end-products of protein digestion.
Ascites	The accumulation of fluid in the abdomen.
Bile	A secretion of the liver which facilitates the digestion of fats in the intestines.
Bile Salts	Alkali salts of bile.
Blood Sugar	Sugar in the form of glucose.
Carbohydrate	A group of chemical substances including sugars and starches that contain only carbon, oxygen and hydrogen.
Carbon dioxide	A colorless gas heavier than air. It is the final metabolic product of carbon compounds present in food.
Cardiac Sphincter	Muscle at the juncture of the esophagus and the stomach. Also known as the Pyloric Sphincter.
Cirrhosis	A chronic disease of the liver, characterized by scarring.
Collecting Ducts	Small ducts that receive urine from several renal tubules. Several tubules join together to provide a passage for the urine to larger straight collecting tubules (papillary ducts of Bellini) that open into the pelvis of the kidney.
Dextrose	A simple sugar formed in the digestive tract by the action of enzymes on carbohydrates.

Disulfiram/Antabuse	A drug administered orally to treat alcoholism. Trade name is Antabuse.
Duodenum	The first part of the small intestine, connecting with the pylorus of the stomach and extending to the jejunum.
Endocrine System	A system of ductless glands that produce an internal secretion discharged into the blood or lymph and circulated to all parts of the body. Hormones, the active principles of the glands, produce effects on tissues more or less remote from their place of origin. In addition to their endocrine function, some glands produce an external secretion.
Epithelial Cells	Cells that are irregular in shape, having a single nucleus. Frequently two or three are joined together.
Fatty Acid	A hydrocarbon in which one of the hydrogen atoms has been replaced by a carboxyl (COOH) group; a monobasic aliphatic acid made up of an alkyl radical attached to a carboxyl group.
Fructose	A sugar found in corn syrup, honey, and fruit juices. May be used in the body the in the same manner as glucose or may be converted to glycogen and stored.
Gallbladder	A pear shaped sac on the underside of the liver that stores bile from the liver.
Gastrin	Hormones released by the stomach that aid in the stimulation of gastric acid secretion necessary for digestion.
Glucose	The most important carbohydrate in body metabolism. This sugar can be used as energy or stored as glycogen in the body.
Hepatic Duct	The canal that receives bile from the liver.
Hormonal System	See Endocrine System.
Hydrochloric Acid	A highly corrosive stomach acid that aids in the digestive process
Ileum	The lower three-fifths of the small intestine located between the jejunum and the large intestine.
Jaundice	A condition characterized by yellowness of the skin and eyes caused by the body's inability to process bile properly.
Jejunum	The second portion of the small intestine, extending from the duodenum to the ileum.
Lacteal	An intestinal lymphatic that aids in the digestive process.
Lipid	Any of a group of fats or fat-like substances characterized by their insolubility in water and solubility in fat solvents such as alcohol, ether and chloroform.
Liver Lobule	Structural unit consisting of hepatic cells and sinusoids surrounding a central vein.
Maltose	A disaccharide that is converted to glucose in the body.
Nephron	The structural and functional unit of the kidney. There are approximately one million nephrons in each kidney.

Papillae	A small protuberance or elevation.
Peristalsis	A progressive wave-like movement that occurs involuntarily in hollow tubes in the body, especially the alimentary canal.
pH	The degree of acidity or alkalinity of a substance are expressed in pH values. The neutral point, where a solution would be neither acid or alkaline, is pH 7.
Protein	One of a class of complex compounds that occur naturally in plants and animals. Proteins provide the amino acids necessary for the growth and repair of animal tissue.
Pyloric Sphincter	See Cardiac Sphincter.
Salivary Glands	The glands of the oral cavity that secrete saliva to aid in the breakdown of food.
Sinusoid	A minute blood vessel found in such organs as the liver and spleen.
Substrate Molecule	A substance acted upon by an enzyme.
Ulcer	An open sore or legion of the skin or mucous membrane.
Ureter	The tube that carries urine from the kidney to the bladder.

Evaluation Form - Participant

Name of Unit:_____

Date of Training:_____ Location of Training_____

Instructions: Please complete this form and turn in to the trainer after completion of the training session

		strongly disagree		no opinion		strongly agree	comments
1.	The Participant Booklet was useful to me during the training	1	2	3	4	5	
2.	The content in the Participant Booklet was easy to understand	1	2	3	4	5	
3.	The activities and examples in the training were relevant to my current job situation	1	2	3	4	5	
4.	The questions in the Participant Booklet helped me to understand the material	1	2	3	4	5	
5.	The classroom application ideas and activities in the Participant Booklet can easily be adapted and used in my classroom situation	1	2	3	4	5	
6.	I learned a lot in this training	1	2	3	4	5	

7. The strengths of the training are:

8. Recommended improvements for the training are:

9. Recommended improvements for the Participant Booklet are:

10. Additional Comments (use back if necessary):

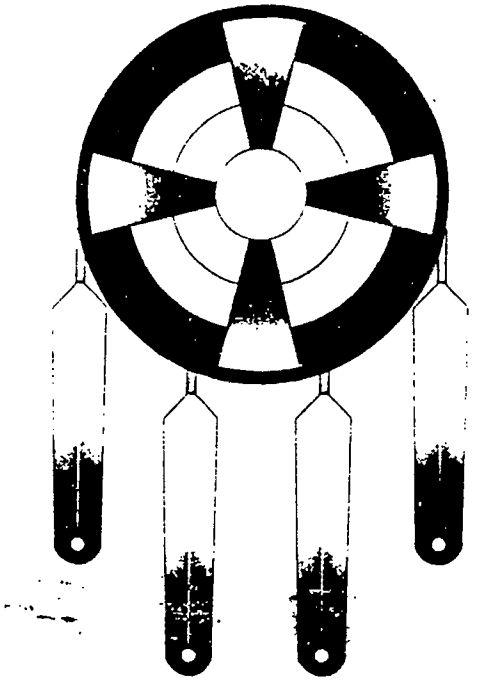
AISES

The American Indian Science & Engineering Society (AISES) is a nonprofit organization dedicated to helping American Indians seek self-reliance through careers in science and technology and to developing technologically-informed leaders for the tribal community. Founded in 1977, AISES now has more than 1,100 professional and student members from 141 tribes. AISES programs include teacher training, math and science camps, curriculum development, scholarships, campus chapters, community education, corporate mentoring partnerships and other activities which enable American Indians to enter math and science-based careers, and to serve the technological concerns of tribal nations.

AMERICAN INDIAN
SCIENCE & ENGINEERING SOCIETY
1085 14th Street, Suite 1506
Boulder, Colorado 80302
(303) 492-8658

Overheads

Science of Alcohol Curriculum for American Indians (SACAI)



The Digestive System and Alcohol Use

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