AWAKENING THE BRAIN'S POTENTIAL

Awakening the Brain's Potential

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Chapter 1

The New Frontier in Education

While completing the teacher education program and preparing for a teaching certificate, few teachers ever take a course in cognition (how the brain works). Typically, no courses in cognition are offered. At the time, most education students do not think much of it. Most believe good teaching consists of a solid curriculum, stimulating presentation, enjoyable activities, and good discipline. It seldom occurs to pre-service teachers that they might need to understand how the brain learns.

Traditionally, education has not been structured to adapt to the workings of the brain. Only recently has technology allowed us to begin to understand the brain. Over the past few decades, substantial research has been conducted, discoveries have been made, and workable theories of learning have been produced. Hart (1989) points out that, "Understanding of the incredibly complex brain is far from complete, but for educational purposes we probably know the great bulk of what is immediately useful." We now have the opportunity to rethink and recreate education. We have the opportunity to create a brain-based education.

Brain-Based Education

In the coming years, brain-based education will likely become one of the most exciting and influential topics in educational reform. Some researchers believe that brain-based education is a fundamental issue because it encompasses all areas of educational reform. Renate and Geoffrey Caine (1990) state that, "Understanding how the brain learns has implications for instructional design, administration, evaluation, the role of the school in the community, teacher education, and a host of other issues related to educational reform....Brain-based learning is not a separate thrust or movement in education; it is an approach from which all education can benefit."

Other researchers feel that basing education around the brain is important because certain conditions greatly increase the brain's ability to learn. Hart (1983) claims that our schools are less effective "because they have yet to address the brain as the organ of learning and to fit instruction and environment to the 'shape' of the brain as it is now increasingly well-understood." When the brain is not allowed to function in its natural modes of operation, then "it functions, as a rule, reluctantly, slowly, and with abundant error."

Brain-based education is an issue which affects all aspects of education and carries significant implications about learning. It may well be that brain-based education will revolutionize both traditional education and our perception of learning.

The Purpose of This Book

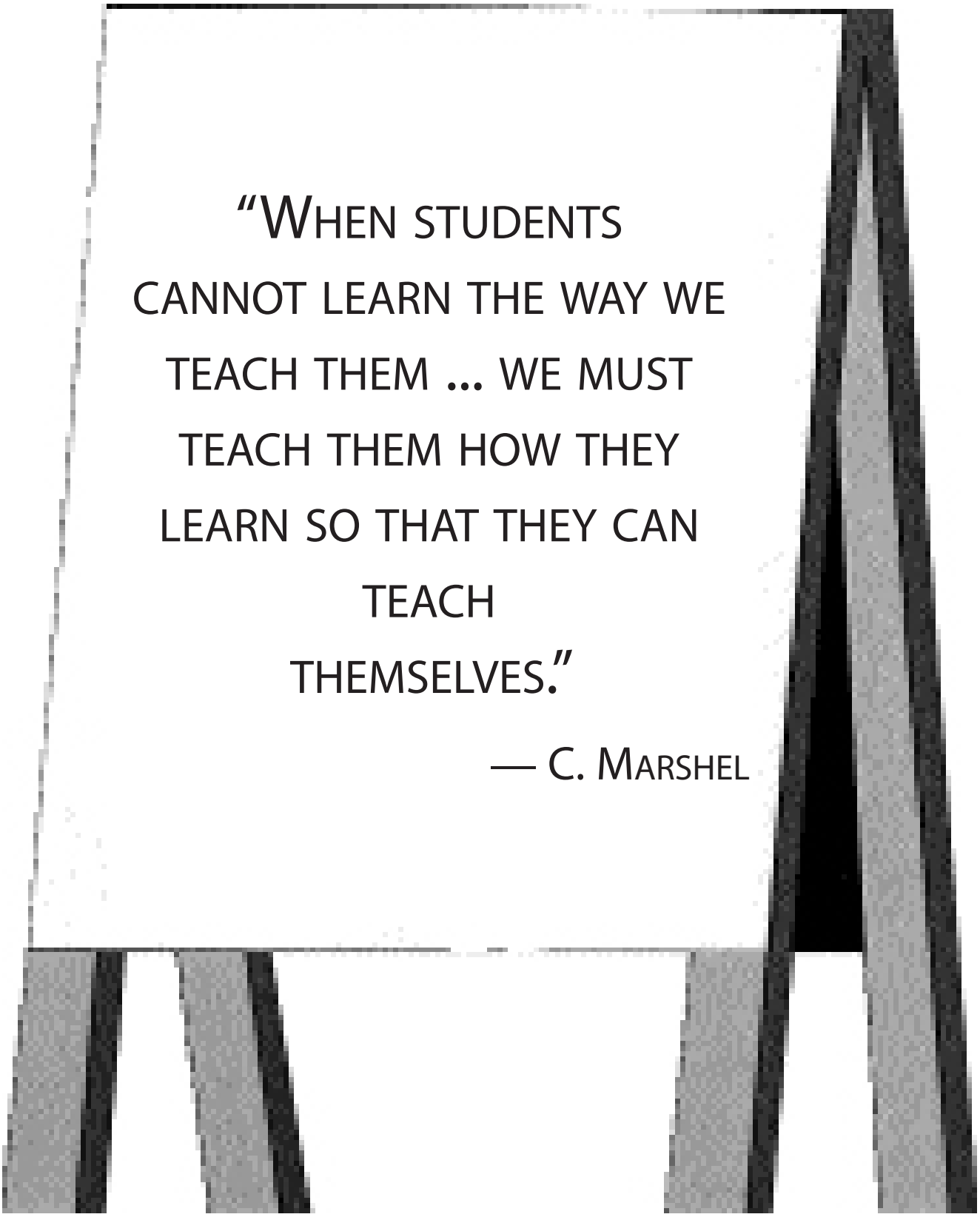
This book is not designed to instruct you on all the exciting new teaching theories and methods that have been developed based on our understanding of the brain. Many good resources are available which can teach you about developing a brain-based classroom. One book we suggest is Making Connections by Renate and Geoffrey Caine.

The purpose of this book is to:

- Provide you with the materials and information necessary to help you apply a few ideas about the basic characteristics of the brain to your teaching. It is our belief that students, as well as teachers, need to be educated about the brain. Marshel (1990) claims that, "When students cannot learn the way we teach them, we must teach them the way they learn. In short, we must teach them how they learn so that they can teach themselves." Athletes are taught about their bodies — how to develop better coordination, strength, flexibility, reaction time, and so forth — and they learn to use their bodies better. Likewise, if students are taught about their brains — how they work, how to develop memory and creativity, how to integrate information, and how to use the whole brain — they will learn to use their brains better.

- Change students' beliefs about their learning abilities. Many students, because of past failures, school conditions, family conditions, or false beliefs about their potential, believe they cannot be effective learners. These lessons teach students about themselves, about how to overcome challenges, and about the unlimited potential of the brain to learn and grow.

- Influence how you teach. It is possible to achieve more than one educational goal at a time, and it is entirely possible to promote cognitive development as you teach regular subjects. Knowing something about the brain and how it learns may help you make adjustments so that you organize your teaching approach differently and become more effective.


"When students cannot learn the way we teach them ... we must teach them how they learn so that they can teach themselves."
— C. Marshel

Characteristics of the Brain

Brain Basics

Many of you already know a great deal about the brain. Others may simply know that it is a grayish-pink, convoluted thing that thinks. Because not everyone is knowledgeable about the brain, a brief description of the basic parts and functions of the brain will be given.

The brain is composed of four major parts:

1. the brain stem
2. the cerebellum
3. the limbic system
4. the cerebral cortex

The brain stem is responsible for basic physiological functions such as regulating breathing and controlling the heartbeat. The cerebellum is the area of the brain where regulation and coordination of muscular activity occurs. The limbic system is responsible for emotions, and the cerebral cortex is responsible for higher thought.

If you make two fists by wrapping your fingers around your thumbs and putting both fists together, then you have a basic, life-size model of your brain. The area from the edges of your palms to the base of your thumbs represents the brain stem. The area from the base of your thumbs to the knuckles represents the cerebellum. The area from the knuckles of your thumbs to their tips represents the limbic system. Finally, your fingers represent the cerebral cortex. Interestingly, the structure of the brain is hierarchical. The brain stem, which is the lowest part of the brain, is the least complex. As you move upward, the brain becomes increasingly more intricate until you reach the complex cerebral cortex (see Diagram 1-1 on page 11).

The complexity of the cerebral cortex distinguishes the human brain from all other brains. It is the center of all higher thought, and much effort has been spent studying it.

One of the most important discoveries made was that the cerebral cortex is differentiated, meaning that different areas perform different functions. For example, audio information is processed in a different part of the cerebral cortex than visual information. Researchers have identified four lobes (physical areas) in the cerebral cortex. Each of these lobes performs different functions. For a description of these lobes and the functions they perform, refer to Diagram 1-2 on page 12 and Diagram 1-3 on page 13.

The cerebral cortex (along with the four lobes) is also divided into two hemispheres: a right hemisphere and a left hemisphere (see Diagram 1-4 on page 14). These two hemispheres work together, but are responsible for separate functions.

The right hemisphere controls the left side of the body and the left hemisphere controls the right side of the body. The two hemispheres are constantly interacting through a fibrous tissue called the corpus callosum. More information about the two hemispheres is given in Chapter 6.

One of the consequences of having a differentiated brain is that a narrow educational system will only develop certain parts of the brain. This book is designed to broaden the educational system so that it develops all of the diverse aspects of the brain. It also teaches students to broaden their study methods so that they use more parts of their brains. Another consequence of a differentiated brain is that if an area is damaged or underdeveloped, specific functions will be impaired. These impairments may result in learning disabilities, which are discussed in Chapter 11.

DIAGRAM 1-1

The Structure Composing the Central Core of the Brain

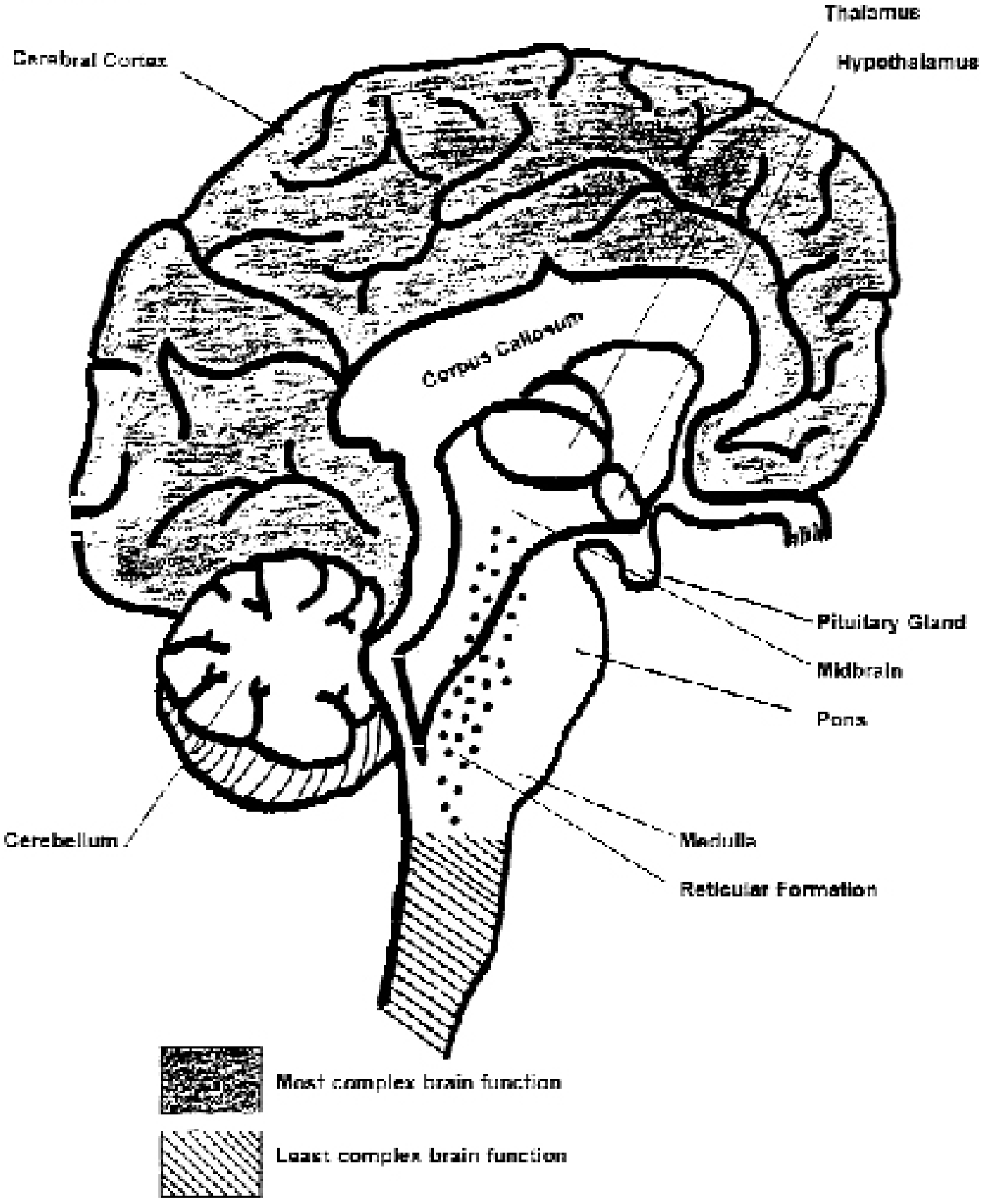


DIAGRAM 1-2

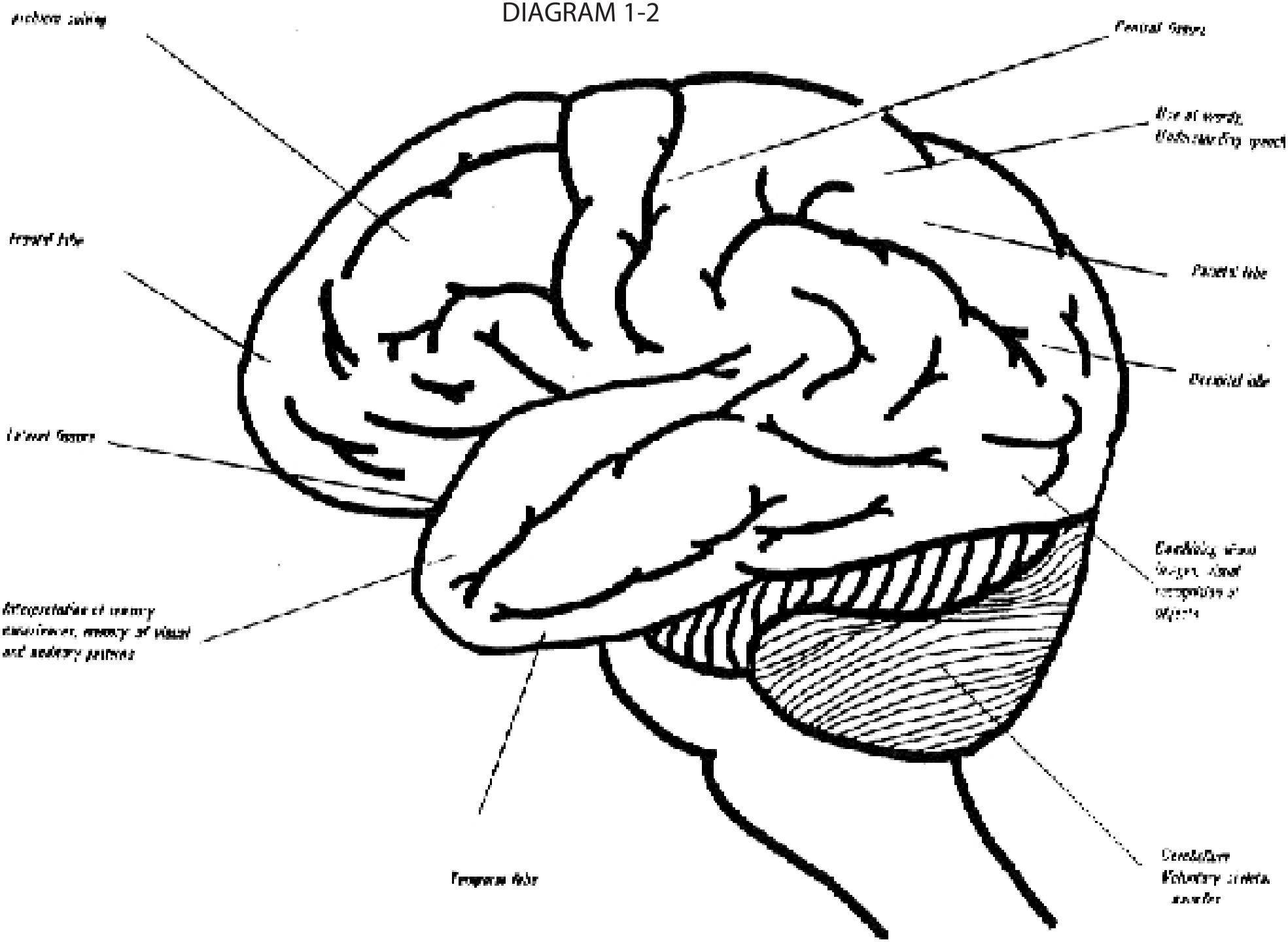
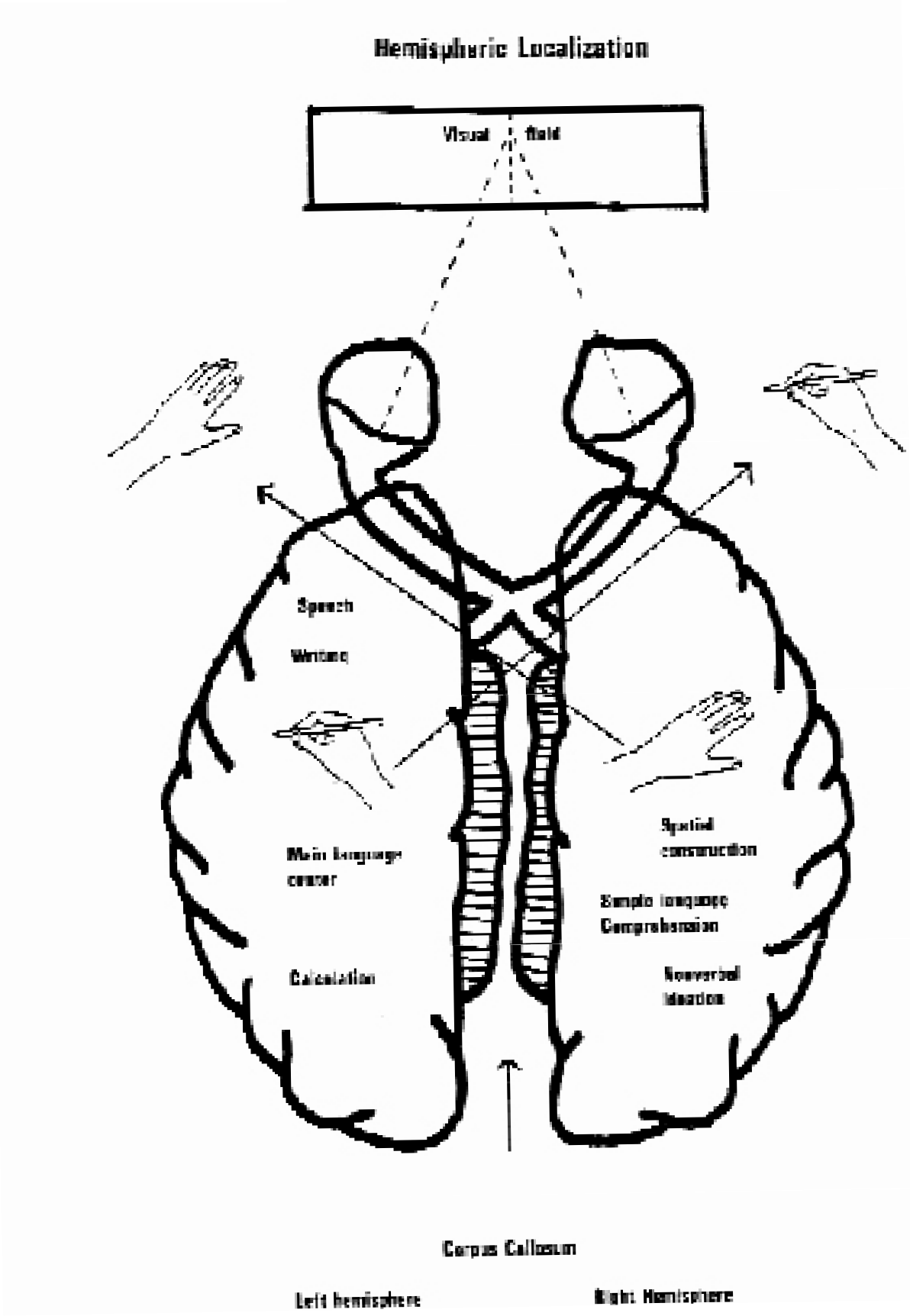


DIAGRAM 1-3

Frontal Lobes	Motor areas control movements of voluntary skeletal muscles. Association areas carry on higher intellectual processes such as those required for concentration, planning, complex problem-solving, and judging the consequences of behavior.
Parietal Lobes	Sensory areas are responsible for the sensations of temperature, touch, pressure, and pain from the skin. Association areas function in understanding speech and in using words to express thoughts and feelings.
Temporal Lobes	Sensory areas are responsible for hearing. Association areas are used in the interpretation of sensory experiences and in the memory of visual scenes, music, and other complex sensory patterns.
Occipital Lobes	Sensory areas are responsible for vision. Association areas function in combining visual images with other sensory experiences.

DIAGRAM 1-4


Hemispheric Localization
Visual field
Speech
Writing
Spatial construction
Simple language Comprehension
Nonverbal ideation
Corpus Callosum
Left hemisphere
Right Hemisphere

Ten Learning Characteristics

In addition to the basic structure and functions of the brain, there are many specific characteristics. Quite a few of these have implication for learning. In this book we focus on ten characteristics of the brain. These include the following:

- Cognitive Adaptation
- Metacognition
- Learning Modalities
- Assertive Learning
- The Brain's Hemispheres
- Multiple Intelligences
- Mind Mapping: The Use of Symbols
- Creativity: Divergent Thinking
- Memory: Retrieving Information
- Learning Disorders

These are some more popular and well-researched characteristics of the brain. Each of the following lessons focuses on one characteristic. Preceding each lesson is an introduction which gives an explanation of the characteristic. Each introduction also has a short section entitled "Effects on Beliefs" which presents how each characteristic affects students' beliefs about their learning abilities. The lessons should give you a basic understanding of the brain, how it works, and how you can improve students' abilities to learn.

The Breaking Edge

An education based on the functioning of the human brain may truly revolutionize the world of education. Now is the time when all the years of research on the brain are coming together to provide a new vision. Hart (1989) states that, "We now have a viable theory of learning (in humans, not rats) with a firm and broad scientific base, the kind of theory that is essential if education is to be a true profession. We have new definitions of learning that clarify our aims for instruction and that can lead us to new and better ways of evaluating what has been learned. Above all, we now have a clear grasp of the conditions that we need to create in schools if we are to foster brain-compatible learning."

Teachers are the key to all great changes in education.

- Teachers who learn to teach to the brain and teach about the brain will bring about a transformation in education.

- Such teachers will change schools from places where just a few students are able to succeed into places where all students can learn more successfully.

- Students will be able to experience conditions which are compatible to their brains and will also learn to adapt themselves as necessary.

These teachers will be today's pioneers on the new frontier in education.

Cognitive Adaptation

One of the remarkable attributes of the brain is its ability to adapt to many different circumstances or contexts. Recent discoveries have demonstrated that adaptation to a situation is a more basic mental activity than the development of stable mental abilities such as intelligence or problem-solving. The brain's adaptiveness can explain some unusual mental abilities. Some examples of these abilities are listed below.

- Fiji Islanders have unusual auditory memory because they pass down long genealogies and cultural knowledge orally.

- Polynesian navigators have accurately navigated thousands of miles across the open ocean using the simplest devices and feeling the temperature and roll of the waves.

- MRI scans have astonished medical scientists by illustrating that if one loses a physical function, such as the loss of a hand, then the part of the brain which manages that function disappears.

- The cerebral cortex appears to choose the location where it stores memories. The location may vary from one culture to another.

- All infants make the same sounds until about six months of age when the brain adapts to a specific language culture and begins to apply these sounds to a specific language. Interestingly, infants gradually lose the ability to recognize sounds which are not a significant part of the language to which their brains have committed.

These examples illustrate that cognitive adaptiveness is one reason why the brain is amazing in its function and ability. The examples also suggest significant ideas for education. For instance, motivation and ability to achieve might be due to a child's ability to adapt to the school learning environment rather than the presence or absence of mental abilities such as intelligence and creativity. Therefore, if parents and teachers prepare children to think and learn in the classroom, children will be better able to adapt and will be more motivated to achieve. Research findings indicate a strong positive correlation between parents' educational level and their children's grades. It is believed that parents with a high level of education have learned to adapt to the educational environment and have taught this knowledge to their children. Likewise, most parents with a low education level did not learn to adapt and were unable to pass on this ability to their children.

To help our children adjust in their learning environments:

- We must understand different styles of cognitive adaptation and the development that is possible within them.

- We must commit ourselves to teaching methods that will help children progress to higher levels of cognition.

Our ability to mentally adapt to the contexts and demands around us — and our individual style in doing so — is connected to the relationship between the left and right hemispheres and the frontal lobe in our brains. At birth, we have a sort of global cognitive perspective: our brain has not yet differentiated or structured experiences and functions into separate mental domains. As the brain grows, individual parts of cognitive functioning may develop at different speeds and to varying extents. Thus, people will mentally develop different ways of assimilating information from their surroundings (called adaptive strategies) and they will achieve this at different speeds. In some cases the brain may have developed several adaptive strategies, but prefers to use one over another.

Different Styles of Cognitive Adaptation

Henry Witkin (1962) and other researchers (see Globerson and Zelniker l989) have demonstrated that most children lean toward one of two basic adaptive strategies, or in other words, they tend to prefer one of two basic approaches to new information or new situations.

Field Dependence (FD)

This type of approach occurs when children's responses depend in large part on the "field," or environment, in which they encounter a task.

- Children using the FD strategy focus on obvious or pronounced stimuli within a given environment or task.

- They briefly scan a visual stimulus, think about it holistically, and then impulsively respond to the most striking or prominent features of the global picture before processing details (Messer 1976; Navon 1977).

- Children using a FD strategy may, for example, remember the pictures and layout of a chapter much more than the content of dense sections of text. In Piaget's experiments, children using Field Dependence tended to respond intuitively in favor of what visually seemed correct, even if thoughtful reasoning would have led them to answer differently. Their intuitive strategy was successful, however, in quick estimations of visual qualities such as

length. They are especially responsive to external and social cues in their environment, making them adept in interpersonal perception and easy-to-learn vocabulary.

Field Independence (FI)

This approach occurs when children pay less attention to the social or external cues and are more dependent on their reflective and analytic thought.

- They spend more time trying to organize and reason through their response.
- When encountering a new stimulus, they search systematically and strategically for details.
- They tend to start at the beginning and work though to the end. Their deliberateness may sometimes inhibit their ability to spontaneously and intuitively read social clues from other students.
- FI strategy is useful for learning tasks requiring more attention to detail such as methodical reading, planning, analysis, and mathematical reasoning.

Both Field Dependence (FD) and Field Independence (FI) can be useful adaptive cognitive strategies, depending on the specific task at hand. Though children evidently have inherited tendencies toward one strategy or another, children with more formal education show a higher usage of the FI strategy because most schools emphasize an atmosphere of methodically attending to details. This does NOT mean that Field Independence involves greater intelligence than Field Dependence. In fact, there were no significant statistical differences between stylistic groups in the mental attention capability, mental effort, or capacity to activate internal representational thought units (Globerson 1989; 1983). What it does mean is that in our society there is a trend for people to become more analytical and less impulsive with time, thereby favoring the Field Independence strategy.

This developmental trend from Field Dependence toward Field Independence may also stem from the increased planning and organization of the brain's frontal lobes which grow more advanced until late adolescence (Globerson & Zelniker 1989). In other words, the more mature we become, the more likely we are to utilize at least some of the Field Independence strategy because this facilitates the ability to handle complexity in analyzing parts of any problem or situation.

At an even higher developmental level, we learn to discriminate which adaptive strategy is the most appropriate for a given mental task, and then use some of each. It is important to emphasize that while most children lean toward one strategy, it is possi-

ble and even desirable to use both sets of strategies. This more inclusive approach, called Field Mobile, will be discussed shortly.

Development within Cognitive Styles

The development of cognitive strategies, specifically the development of Field Dependence toward Field Independence, is contingent upon good operative schemes in the brain called LC structures (Logical/Learning—Content/Conditioning). LC structures are not tied to age or inherited capacity. Instead, they are cultivated by family and cultural determinants, teaching, training, and learning opportunities. LC structures are tied to "the availability in the child's environment of adequate learning opportunities (mediated learning)" (Laboratory of Comparative Human Cognition 1983; Witkin & Goodenough 1981.)

Thus, children's cognitive development depends on us! Families and teachers provide the atmosphere that lets LC structures develop in the brain, which in turn helps children's developing ability to apply multiple cognitive strategies.

Between 1968 and 1977 many researchers were of the opinion that people would always resist a change in cognitive style of adaptation. They argued that people would stay in their own inherited cognitive preferences, and that attempts to teach Field Independent skills to children using mainly Field Dependent strategies would have only limited success. Yet teaching FI skills remained a desirable goal since FI strategies can improve reading and mathematics achievement.

Happily, in 1985 Globerson explained that the earlier limited attempts were flawed because the researchers were not using teaching styles appropriate to the FD learning style. They taught FI skills only in the FI-type atmosphere, which would obviously be foreign to the FD child. Globerson said that Field Independent strategies could be learned, but only if the teaching methods were comfortable for the Field Dependent thinker. He explained that the original testing had been perceptually misleading which is not a problem for children using the FI strategy, but which greatly influences the FD children. When the atmosphere was changed, Field Dependent strategy users were brought up to the expected level of competence.

Victoria Fabian's research (1982) shows the importance of not judging a child's level of competence based on demonstrated FD or FI preferences. First, she designated which children from a group scored highly Field Dependent or highly Field Independent. Next, she saw that there was a large group of children who scored in-between, showing a sort of mixed preference for the two strategies, and these children she termed Field Mobile. Fabian found that Field Mobile children tended to underperform on many tasks because they unknowingly applied the wrong cognitive strategy. But after repeated exposure and practice, the Field Mobile children achieved high range scores and even

passed both of the other groups. Basically, the children who only applied one basic cognitive strategy could sometimes score high immediately, depending on whether the task matched their abilities. The Field Mobile children, however, ultimately achieved the highest scores because of their ability to adjust to using multiple adaptation strategies (Kepner and Neimark 1984).

This is what we want for children. Families and educators can match teaching styles to children's present adaptive learning styles (FD or FI). Then they can continue to educate children by making them aware of other adaptive strategies and helping children identify when to use each one. In this way, children will begin to expand their repertoire of adaptive strategies and increase dramatically in cognitive flexibility and thereby in performance.

Teaching for Increased Cognitive Adaptation

What are some specific ways teachers can improve their teaching to foster cognitive adaptation? Globerson (1989) provided the guidelines they followed to successfully teach Field Independence to children whose original preference was limited to Field Independence. They explained that learning environments should provide many paths of access to learning through such things as:

- Multiple representations for any given concept.
- Many types of symbols (pictorial, verbal, symbolic, and formal).
- Varied activities and manipulations (concrete, sensual, ideational).
- Integration of the multiple representations into a coherent integrated body of knowledge...essential for a high-level abstract understanding.

In addition, they developed a "style appropriate" training for children who are biased toward Field Dependence which included the following points:

(1) Be aware of the children's sensitivity to the conspicuous parts of a presentation. They will notice obvious parts first, sometimes ignoring more subtle cues. Take advantage of this tendency by varying the attention-getters in different presentations and tying them to the main ideas.

(2) Develop children's self-awareness of their own cognitive styles. Encourage children to note their own tendency to attend to misleading cues and disregard less-obvious ones. Students must be aware of their own cognitive choices, procedures, weaknesses, and outcomes. (See Chapter 3: Metacognition).

(3) Teach new strategies to search for "hidden cues" and overcoming the tendency to rely only on prominent ones.

Important:
Remember when teaching either strategy, both adaptive strategies have their place in living and learning.

The principle task is to:
- help students use both strategies effectively.
- appropriately match each to any learning task.

Effects on Beliefs

Students can learn to recognize these two adaptive strategies and use them for different learning tasks. Application of this principle teaches the concept of "strategic learning." This means that students begin to believe there is a strategy for each task and the first step in learning is to identify and use the most effective strategy. This typically increases motivation to learn and confidence that learning will be successful.

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LEARNING ACTIVITIES: COGNITIVE ADAPTATION

OBJECTIVE: Teachers should learn to identify whether their students use a Field Independent or Field Dependent strategy. Students should learn how to use both strategies. They should also learn to recognize which strategy is most appropriate for a given task.

MATERIALS: Set of geometric shapes (blocks or pieces of colored cardstock will work), copies of: Diagram 2-1 (p. 30), "Which Strategy Did You Use?" sheet (p. 31), "Cognitive Adaptation" sheet (p. 32), and "Mind Problems" sheet (p. 33).

Activity #1

Since most of the activities in this book involve the brain, it will be helpful to teach the students about the brain's basic structure and function. Introduce the structures of the brain by doing the following activity.

Introduction to the Brain

Have students make two fists by closing their fingers over their thumbs. Then have them put their fists together. Tell students that their brain is about the size of both of their fists together. Next, explain that the brain is made of four basic parts. The most basic part is the brain stem. If you imagine your fists are your brain, then from the edges of your palms to the base of your thumbs represents the brain stem. Another part of the brain is the cerebellum. From the base of your thumbs to the knuckles represents the cerebellum. At the center of the brain is a set of organs and glands that make up the limbic system. From the knuckles of your thumbs to the end of your thumbs represents the limbic system. Finally, the outer part of the brain is the cerebral cortex. Your fingers represent the cerebral cortex. Your right fingers represent the right hemisphere of the cerebral cortex and your left fingers represent the left hemisphere of the cerebral cortex.

Pass out Diagram 2-1 on page 30. Point out how the brain gets more complex as you move upward.

Activity #2

Locate or make a set of geometric shapes (squares, triangles, hexagons, etc.) for each student. The math department in your school may have geometric blocks that you can use. If not, copy some geometric shapes onto different colored cardstock and have the students cut out the shapes.

Explain

The students should make a pattern from the shapes. They can make any pattern they choose and may use any method.

Observe

Carefully observe the students as they complete the activity. Try to identify which strategy each student demonstrates. Below are observable characteristics of each strategy which will help you identify which strategy a student is employing.

Field Independent	Field Dependent
•Ponder and plan before beginning •Study and compare individual shapes •Carefully examine how one color or shape appears when placed next to another •Work diligently •Concentrate hard •Tune out or ignore surroundings •Organize and plan well	•Begin putting shapes together immediately in a seemingly carefree manner •Look around to see the patterns others are making •Get distracted by surroundings •Compare pattern with patterns of others or talk about ideas with others •May not put much energy into the activity •May change pattern or start over repeatedly •The pattern relates together as a whole; it may form a picture or be a design that appears whole or complete

Record

Mark down F.I. (Field Independent), F.D. (Field Dependent), or B (both) next to each student's name.

Worksheet

Have students fill out the "Which Strategy Did You Use?" worksheet on page 31.

Explain

The purpose of this activity was not to find out what patterns students would make, but what strategy they would use to make it. A strategy is a way of doing something. Often certain strategies are better for completing a task than others. For example, the person with a good chess strategy has a much better chance of winning the game than the person with a poor strategy or no strategy at all. We generally use one of two basic strategies whenever we have a task to complete, including the task of learning. These two strategies are called Field Independent and Field Dependent. Neither of these strategies is superior to the other. However, each may be more appropriate for certain tasks.

Activity #3

Pass out the "Cognitive Adaptation" sheet on page 32. Explain that it lists the characteristics of the Field Independent and Field Dependent strategies. Read over the characteristics of each and clarify questions the students might have.

Determine Strategies

Have the students count up the number of A's that they circled, and then the number of B's that they circled on the "Which Strategy Did You Use?" sheet. The A's are Field Dependent characteristics and the B's are Field Independent characteristics. Have students compare the number of Field Dependent characteristics they circled to the number of Field Independent characteristics they circled to determine which strategy they used.

Explain

It does not really matter which strategy they used on this activity, either one works just fine. However, on many activities or learning tasks, one of the strategies is more appropriate than the other. Thus, students need to learn how to use both strategies and to recognize the appropriate strategy for a given task.

Activity #4

Explain that by practicing both strategies, students can become capable at using both of them and can recognize which is the best strategy for a certain task. In this activity students should use the Field Independent strategy. Review the characteristics of this strategy.

Mind Problems

Pass out the "Mind Problems" sheet on page 33 to each student. Have them complete it using the Field Independent strategy. The answers are given below:

1) T and V go on top, U goes below. Letters with a curve go below the line and letters without a curve go above.

2) He can feel the hoods of the cars. If Mr. White's hood is still hot, Mr. White is lying. If Mr. White's hood is cool, than Mr. Green is lying.

3) Queen of Spades, Queen of Hearts, Ace of Hearts.

Questions

Ask the students the following questions (they do not need to respond aloud) to see if they used the Field Independent strategy.

•Did you think and plan before searching for an answer?

- Did you break the problem down into parts and examine each part? (Have some students share examples of how they broke the problems down into parts. Some students will probably have a hard time understanding how to break a problem into parts. Seeing the examples of other students should help.)

- Did you pay attention to your own thoughts and feelings and ignore what was going on around you?

- Did you ignore the people around you?

- Did you concentrate on the problems during the time that I gave you?

- Did you focus intently and think hard?

- Was it hard for you to use this strategy? (Note which students say it was hard.)

Activity #5

In this activity, students will practice using the Field Dependent strategy Review the characteristics of this strategy.

Group Discussion

Have the class sit in a circle where they can see each other, and discuss a topic such as "How can we improve this class?" Encourage the students to be spontaneous, goal-oriented, attentive to the actions and reactions of others, and relaxed.

Questions

Ask the students the following questions to see if they used the Field Dependent strategy.

- Did you express your ideas and opinions freely without thinking about them too much?

- Did you recognize the general direction or focus of the discussion?

- Did you form a general picture of what will improve the class? (Have some students share their ideas about the general direction of the discussion and the general picture of what will improve the class. This will help students understand what holistic thought is.)

- Did you pay attention to social cues (the vocal & facial expressions, actions, reactions, attitudes, and feelings of others)?
- Did you concentrate in a relaxed manner?

•Was it hard for you to use this strategy? (Note which students say it was.)

Activity #6

Below is a list of tasks. As a class, discuss which strategy would be best for accomplishing each task. Both strategies might be appropriate for some tasks.

For example, the Field Independent strategy is probably best for solving mind problems because you need to break the problem down and examine each part in order to find a solution. They also require consistent concentration unless you happen to see the answer immediately. It may be helpful to talk with others, but it is not helpful to be distracted by them.

On the other hand, the class discussion on how to improve the class is probably best accomplished by using the Field Dependent strategy. In a discussion such as this, it is important to be open and spontaneous with your ideas and opinions. It is important to recognize the general direction and goal of the discussion. It is also important to pay attention to social cues so that you do not misunderstand, ignore, offend, bore, or become out of tune with the others. Finally, discussion can be long so it is probably better to conserve your mental energy than to try to concentrate intently and consistently.

Tasks

- •Complete a math assignment
- •Play a basketball game
- •Coach a basketball game
- •Comfort a friend
- •Complete a reading assignment
- •Take a test
- •Paint a picture

Closure

Explain that when we fail at a task we usually attribute our failure to the difficulty of the task or to our lack of ability. We sometimes even consider ourselves to be stupid or untalented. Teachers who see a student fail at a task sometimes believe that the student did not try or that the student lacks ability. In reality, the problem might simply be that the student has not learned the appropriate strategy for the task. Taking the time to learn how to use the appropriate strategy will be helpful. If we believe that we are capable of accomplishing a task we have the potential to succeed. Have students turn in the "Which Strategy Did You Use?" sheets. Record the results and return the sheets to the students in a future class period.

Assignment

Teacher

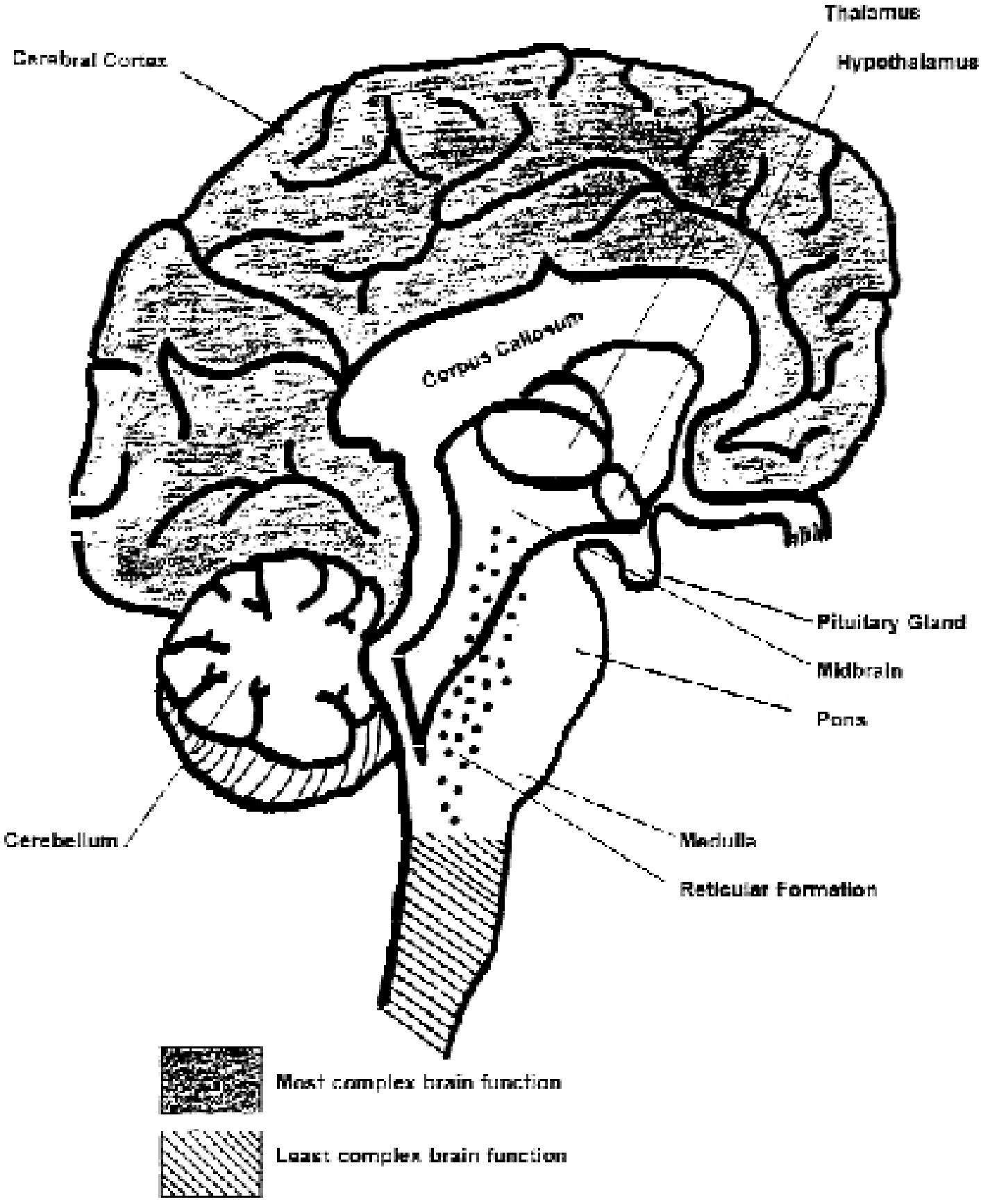
Observe students when they are completing assignments in class, taking part in a class activity, or taking a test. Try to identify which strategies the students are using. Also, note students who use inappropriate strategies for the given task. Help these students to use the appropriate strategy.

Students

Use the Field Independent strategy to accomplish a task and the Field Dependent strategy to accomplish another task. Write a description of each task and how you used the appropriate strategy to accomplish it.

DIAGRAM 2-1

The Structure Composing the Central Core of the Brain



WHICH STRATEGY DID YOU USE?

Directions: For each numbered item, circle the letter (A or B) of the statement that is most correct.

1. A. I regularly (more than just once or twice) looked at the patterns being made by others to get ideas or to compare their patterns to mine.

   B. I focused on my own pattern and did not pay much attention to what others were doing until I finished.

2. A. I started by putting pieces together the way it felt "right."

   B. I thought about my pattern and began planning it out before beginning.

3. A. I took breaks to look around, talk to others, and think about things unrelated to the pattern.

   B. I concentrated and worked consistently until I was finished.

4. A. I did not use up much energy thinking about the pattern.

   B. I thought intently about my pattern.

5. A. I concentrated on how my pattern would look as a whole.

   B. I concentrated on how individual shapes looked and fit next to other shapes.

6. A. While doing the activity, I paid attention to my own thoughts and feelings.

   B. While doing the activity, I paid attention to the things around me such as other people, the room, sounds, etc.

7. A. My pattern can best be described as representing a picture or a complete figure.

   B. My pattern can best be described as well-organized parts or a consistent sequence.

COGNITIVE ADAPTATION
(Using Thinking Strategies)

Field Independent	Field Dependent
Reflective: Spend time thinking about or pondering the task	Impulsive: Begin a task before planning it out or thinking about it much.
Analytic: Break the task down into parts and examine each part.	Holistic Thought: Look at the overall picture.
Internal Cues: Pay attention to personal thoughts and feelings.	External Cues: Pay attention to objects around you or actions that are happening around you.
Fewer Social Cues: Do not notice the actions and characteristics of people and social situations.	More Social Cues: Pay attention to the action and characteristics of people and social situations.
Longer Attention Span: Pay attention to tasks for longer periods of time.	Shorter Attention Span: Combine concentrating on the task with socializing, thinking about other things, daydreaming, etc.
More Mental Energy: Focus and concentrate intently on the task.	Less Mental Energy: Don't focus and concentrate very hard on the task.

MIND PROBLEMS

1. The letters T, U, and V are missing from the sequence below. Determine where they fit into the sequence. Do they go above the line or below it?

A EF HI KLMN WXYZ
BCD G J OPQRS

2. A police officer came upon an accident. A dead body lay in the middle of the road. A car had hit it. Two cars were parked on either side of the road. Both cars were undamaged and without any biological evidence. One belonged to Mr. White and the other belonged to Mr. Green.

   "He did it!" said Mr. Green, pointing to Mr. White. "I saw him hit that man just a minute ago as I drove up."

   "I did not!" said Mr. White. "I have been picking flowers in that field for the past two hours."

   How can the police officer determine, without even asking a question, who is lying?

3. Three playing cards are resting next to each other. There is a Heart just to the right of a Spade. There is a Heart just to the left of a Heart. There is an Ace to the right of a Queen. There is a Queen to the right of a Queen. What are the cards?

METACOGNITION

Metacognition is probably one of those "buzz words" that you have heard before, but understood neither what it meant nor how to teach students to use it. Hopefully, the following lesson plan will help you understand both what Metacognition is and how students can use it to improve their learning.

Metacognition means "thinking about your thinking."

Terms similar in meaning are reflective thinking, thought-monitoring, and introspection. All of these terms refer to some form of thinking about yourself, your abilities, emotions, thoughts, attitudes, and so on. Metacognition is the process of reflecting specifically upon your thoughts.

Researchers have found that one of the main differences between exceptional students and average students is that the exceptional students consistently use Metacognition. That is, they think about how they think, how they learn, how they understand a subject, and so on. Basically, these exceptional students are on brain-related, self-discovery missions. As a student learns about his brain, he unlocks its power. We call Metacognition "the key to the brain."

Students can be taught to use Metacognition to improve their abilities to learn. It is natural for a person to think about his or her own thoughts because the brain is organized to refer to itself and monitor its own activities. Neurons are organized in loops so that one can think or reason and then examine how the first operation took place. This natural ability can be enhanced by training and this improvement sharpens other abilities.

Students simply need to develop the habit of reflecting upon their thoughts. As they do this, they will begin to understand how they learn and the unique characteristics of their learning abilities. With time, they will be able to recognize how they can use this knowledge about themselves to become better learners. Eventually, they may even become excellent learners. For example, upon reflection a student may realize that she has the ability to look at an idea with a unique point of view. The student may develop this talent and use it to transform foreign ideas into a form to which she can relate. As a result, the student will be better able to learn new ideas.

Metacognition is one of the most basic principles related to learning. In fact, most of the other lessons in this book (such as Cognitive Adaptation, Learning Styles, The Brain's Hemispheres, Multiple Intelligences, Creativity, and Memory) involve the

use of Metacognition. The following lesson plan is designed to familiarize students with the concept of Metacognition and give them a chance to practice it.

Because exceptional students tend to think more about their own thinking, we hope to develop in all students an increasing tendency to do the same — the habit of Metacognition. This is a skill that all can improve on, and such self-aware thinking definitely affects learning.

First of all, it's important to remember just how much our cognition affects our desire and ability to learn. We are capable of modifying our mental abilities if we really want to. Research shows that seven- and eight-year-olds modify their learning strategies, depending on the incentive offered (Kunzinger & Witryol 1984). In one experiment, fifth graders were asked to memorize lists of words and told that each correct answer would be worth money. Some words were specified as worth a dime, and others only worth a penny. Not surprisingly, the children rehearsed more of the ten-cent words and remembered them better than those only worth a penny (Cuvo 1974).

Even without external motivations, our power to direct our attention toward learning specific items is also extremely strong. Psychologists Lackner and Garrett (1973) equipped subjects with dichotic earphones (meaning that the right earphone would convey different information than that coming from the left earphone). Subjects were instructed to attend to just one of the two channels, since there would be an evaluation afterward. In doing so, they managed to answer almost all of the questions about what was presented in the specified channel, and very little about what they heard in the other ear. Thus, with conscious thought, (Metacognition) our normal mental operations can be directed and improved.

With practice, a student who has incorporated Metacognition skills should be able to respond to the following questions about a given task in a way that enhances his or her own learning.

1. What items do you already know?

The student who confidently and correctly answers this has a solid starting point for study and will not waste time reviewing material that would already be easy to recall. This question may sound easy, but actually children must learn to make this assessment, for it is not necessarily an automatic capability. A recent study illustrates the difficulty children sometimes face in knowing what they already know.

Preschool and elementary children were instructed to study a group of items until they were sure that they could remember them perfectly. The older, elementary school-aged children studied, said they were ready, and generally were — meaning that they did well on the recall test. The youngest children studied, said they were ready, and typically were not. (Flavell, Friedrichs, & Hoyt 1970). In other words, during

early childhood it can be a struggle for children to distinguish learned items from non-learned ones.

In fact, this challenge is not fully mastered by the end of elementary school or by the end of high school. In harder academic situations, even college students have trouble correctly identifying how much they have actually learned. Nelson and Leonesio (1988) instructed college-age subjects to master memorization of every item on a list. The students were allowed unlimited amounts of time and were encouraged to continue a self-paced study until they were certain that they would be one hundred percent correct on the test given afterward. When they felt they had studied enough to answer perfectly, they were given the test.

Surprisingly, the average student only recalled forty-nine percent of the items correctly. They thought they knew the items, but apparently most of them had not reached the point of complete learning and assimilation. They were not sufficiently aware of their own cognitive needs to reach full retention. A valuable skill for learning, then, is the ability to monitor (through Metacognition) one's own retention and to know when it is that you know something.

2. Which items don't you know yet?

This question is related to #1, and equally important. Many students have been in a class where they felt vaguely lost and confused, but were not able to identify and articulate their own questions and concerns. Hence, no learning took place.

Through a careful examination of their own thoughts, good students can pinpoint areas of concern and then ask appropriate questions to resolve them. One study suggested that we are much more likely to know when we have got something wrong than we are to know when we have overlooked or omitted it (Krinsky & Nelson 1985). Basically, we may know that one answer is wrong, but on another question be completely unaware of the relevant fact that we should know and don't.

When the students are not practiced at assessing what they do not know, a good teacher can help the metacognitive process through a series of patient questions about the material until the students recognize which part is troubling them. Non-graded pre-tests can sometimes help students identify their own weaknesses.

3. How did you learn the items you already know?

Through metacognitive questions, students may be able to isolate and identify ways in which they learn things easily. For example, students might review a test looking for the answers they gave correctly. Then they could ask themselves, "What helped me to remember that particular fact or concept? Was it the visual drawing in the book? Was it the discussion with my study group? Did I employ associative techniques or mental imagery that helped me to remember?" In this way, students may self-diagnose

themselves as auditory, visual, or kinesthetic learners. Once students realize the techniques that they already use successfully, they can consciously apply them in new situations.

4. What mental techniques could help you learn the parts you don't know?

Some people may answer this question by simply saying that they need more time to study, but this is not necessarily the answer. Remember the college students (Question #1) who incorrectly thought they had studied enough? After the first trial, they repeated the same process, but their self-paced study time was dramatically increased. Guess what? Even with the extra time to study, their scores did not show significant improvement, and in some cases, no improvement at all. Why?

Metacognition implies that the trick to learning is consciously choosing how to learn. Instead of studying more, studying smart could be the answer. A major part of successful learning is simply applying cognitive strategies, and these are usually done by students who have developed good habits of Metacognition.

As early as age three or four, children have developed a conceptual awareness of their own mind, differentiated from other people, and have already started to employ simplistic memory strategies. For example, if asked to remember the location of hidden candy, they may verbally rehearse the word and point and stare at the location so as not to forget it (Bjorkland 1995). This is a simple strategy called rehearsal, which shows children's self-awareness of the need for different types of mental processing.

Ideally, as we grow older, our repertoire of mental strategies improves and expands. Simple rehearsal is often not as effective as associative strategies in which we mentally attach the items or ideas we want to learn with already familiar things. Eagle (1967) gave subjects long lists of words to memorize, and afterward asked subjects how they remembered the words. Some said that they just kept repeating the words over and over to themselves. Others visualized the list items in familiar places such as in their own household area, or made the words into sentences for easier recall. In the end, mental associative or syntactical (sentence) linking of items proved to be a more successful strategy in improving recall than did rehearsal. The point here is that some students consciously chose to use a higher cognitive strategy because they were aware that they would need to master unfamiliar information.

In summary, the key to Metacognition is helping students in new learning situations to ask themselves, "What do I know? What don't I know? How do I learn well? and How can I apply mental strategies to best help me to learn this material today?"

Effects on Beliefs

Many students who struggle in school believe they have inferior brains. They think they are not as intelligent as other students. They see their brain as a computer with a fixed amount of memory or capability. Students tend to believe all learning is bound by built-in capability. In reality, the potential of the brain is limitless. The brain is constantly changing and developing. Metacognition is a way to accelerate the rate of growth so that a "slow" student can eventually become a "quick" student.

Teachers often use Metacognition without realizing it. A teacher may ask a student to think about what he or she is doing. Or, a student may be asked to evaluate how he learns. By refining what you do, however, you can add impetus to learning and satisfy that old axiom that one can provide fish for the hungry man or teach him to catch his own.

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LEARNING ACTIVITIES: METACOGNITION

OBJECTIVE: Students will review and improve their beliefs about their intellectual abilities. They will learn what Metacognition is, how to use it, and how it accelerates learning.

MATERIALS: Copies of: "What I Believe about My Learning Ability" sheet (p. 46), "Mind Problems" sheet (p. 47), "Metacognition Poster" (p. 48), "Metacognition: The Key to the Brain" sheet (p. 49); Stanley and the Dinosaurs video, chalk and chalkboard or dry erase board and dry erase markers, paper and pencils, newspaper, tape, and several thick books.

Activity #1

Have students turn in their homework from the last class. Allow them time to talk about the assignment and what they learned.

Activity #2

Have students fill out the sheet entitled "What I Believe About My Learning Ability" on page 46.

Activity #3

Read or tell the following story.

There came a boy from a far-off land to the home of a computer guru. The boy sat down next to the guru and his eyes beheld a Super Nintendo. The guru said, "Boy, stay with me and I shall lead you to the land of promise in Super Mario World." Then the guru bestowed the control pads upon the boy and said, "Play." The boy played, but he died. He played again and was consumed by the fiery darts of the evil Mario World creatures.

But the boy persevered. For forty days and forty nights he did play, but his Mario did ever perish into the depths of Mario World. After forty days the guru said unto the boy, "Thou art not chosen to enter the promised land of Mario World. Behold, thou art not capable of passing the first board. Go now from me." The boy's countenance fell and he left the home of the guru. Everlastingly he believed himself a Nintendo outcast, yet he often wondered, "For what purpose were those buttons on the control?"

Explain to the students that teachers can sometimes be like the computer guru. They expect you to learn, understand, and memorize things, but they forget to teach

you how. Tell the students that the purpose of these classes is to teach them how to learn.

Activity #4

Have students try to complete the "Mind Problems" sheet on page 47. They should do the problems in order. Give them about five to ten minutes.

Check answers

Go through each problem and check whether the students answered correctly. Do not give students the right answers yet, just tell them if their answers are right or wrong.

Question

Are you good at solving mind problems? (Students frequently say they are not.)

Give answers

1) The only way is to have a line touch the top of the first dot in a row, go through the middle of the next dot, and touch the bottom of the last dot. This line would then be extended way beyond the edge of the paper. Then a similar line would come back and go through the next row of dots. (It is very unlikely that students will have seen this solution.)

2) There are only 13 triangles.

3) It's impossible.

4) Draw a horizontal line through the middle of the first one so that it becomes a plus sign. Then you have 9 + 91 = 100.

Tell students that you will explain the reason for Activity #4 in a few minutes.

Activity #5

Tell the following story about Albert Einstein.

Einstein was practically a failure at school. His grades were poor and a test revealed that he had an I.Q. of just 82 (average is between 85 and 100.) Einstein was in a situation where he was almost guaranteed to fail because he was a creative, free-thinking person stuck in a strict, military-type school.

As a result, he spent the first part of his life experiencing failure and being told that he possessed limited intellectual abilities. Yet, he became one of the greatest scientists ever. He solved problems that no one else could solve. He asked questions no one had thought of before and found the answers. He changed our whole understanding of the universe. How did he do it?

Explain

The Mind Problems in Activity #4 were set up so that you could experience a situation similar to Einstein's. Like Einstein, you were forced to fail three times in a row. Then you were given a chance to succeed. When most of us fail, two things happen: first, we believe that it is impossible to succeed (all the mind problems must be impossible); or second, we believe that we are not capable of succeeding (I am not good at mind problems).

Discuss

- How did you feel when you were doing the mind problem activity?

- How did you feel about your abilities? (Talk about the responses they gave when they were asked if they were good at mind problems. Point out that their beliefs about themselves were warped by a situation that you created. They may be the greatest mind problem solvers in the world, but they still would have failed at the task and believed that they were not as good as they thought.)

- How hard did you try on the last problem?

Questions

How can situations at school be similar to this mind problem activity or to the situation Einstein faced? Which of these beliefs you wrote down about your learning ability might be inaccurate? (Refer to negative statements on the "What I Believe about My Learning Ability" sheet on page 46.)

Explain

The difference between Einstein and most of the rest of us is that when Einstein encountered situations where he failed, he never gave up on his belief that he could be successful. And when he encountered a situation where he could succeed, he did things that nobody else was able to do.

Activity #6

Teach the following lesson.

Like Einstein, we can dramatically improve our ability to learn. So the question is: How do we do it? How did Einstein become a genius? He did it through lots of hard work and because of the following two things:

1) The brain is constantly changing, and it can become much more effective with use. The brain is not a computer with a fixed amount of memory and

capability. The brain is more like a city which is constantly growing, becoming more sophisticated, more integrated, and more powerful. The more Einstein used his brain, the more integrated, effective, and intelligent it became.

2) It is possible to learn how to use the brain better. Basically, Einstein learned how to use his brain better than most of us.

The brain changes automatically as we use it. However, it does not become more effective automatically. Learning to use the brain effectively is a lifelong process, but one place to start is to learn about "Metacognition."

Definition

Point out the "Metacognition Poster" you have created from the example on page 48. Explain that Metacognition literally means "thinking about your thinking." It is the key to unlocking your brain's power, because thinking about your thinking leads to an understanding of how you learn which leads to an understanding of how you can learn better.

Example

Read the following example of Metacognition.

"I forgot about the negative sign again! I always make that same mistake. I wonder why I make that same mistake. I always forget negative signs and other dumb little things like that. In English I always forget commas. Maybe because they're little details. I seem to have a hard time keeping track of details. Hey, I just learned something about how my brain works. I should think about my brain more often. Wow, I'm like, thinking about my thinking. Now I'm thinking about thinking about my thinking. Whoa, this is getting really deep."

Activity #7

If you have access to the Stanley and the Dinosaurs video, show the segment where the cavemen are trying to move the big rock. Stanley sits down and thinks about the process. He discovers how to use a stick as a lever and moves the rock. Then he thinks about what he has just done and says, "Work smarter, not harder."

Question

How did Stanley use Metacognition?

Activity #8

Write nine numbers on the board. Have the students try to memorize them.

Questions

What were you thinking? Were you thinking about your thinking?

Read a list of seven words (foot, snow, bread, sun, desk, car pool, turkey). Have students try to memorize them.

Questions

What were you thinking? Were you thinking about your thinking? What did you learn about your ability to memorize? How can you memorize more effectively?

Activity #9

Divide students into small groups. Give each group of students some newspaper, tape, and a thick book. Tell them that they need to build a tower, at least a foot high, that supports the book. Tell students to think about their thinking as they do this activity.

Questions

What were you thinking as you did this activity? What do you think about what you were thinking? What did you learn about the process of building a tower? What did you learn about your ability to build a tower or work with others? What are your strengths and weaknesses?

Activity #10

Ask students to come up with good Metacognition questions for the following activities.

READING

Before

What is the purpose of this reading? How could I read to accomplish that purpose? What reading strategies could I use (such as highlighting and reading bold headings)?

During

Am I understanding this material? What is the overall point? Do I understand how the information relates?

After

What did I learn? What did I learn about my ability to read? How could I be a more effective reader? Could I have used a better strategy to read this material?

MATH

Before

What am I supposed to learn from this assignment? What would be the best way to accomplish it?

During

Do I understand the assignment? What mistakes am I making? Why am I making those mistakes? How can I avoid those mistakes?

After

What did I learn? What did I learn about my ability to learn math? Do I understand the problems or can I just plug the numbers in a formula? What did I learn that could make these problems easier next time?

Closure

End the lesson by saying:

"Remember Albert Einstein. His brain was not any more gifted than yours. He simply learned how to use it better."

Assignment

Hand out "Metacognition — The Key to the Brain" on page 49 and explain the assignment.

Name_____

What I Believe about My Learning Ability

Write down what you honestly believe about yourself.

1. How smart are you? How good of a learner are you? How smart do you think you could become?

2. Describe your math ability. How good are you at math? Why? Could you ever be great at math?

3. How good are you at solving problems?

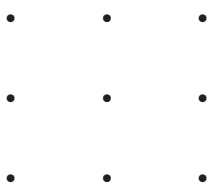
4. Describe your brain. How good is it? Is is an exceptional one, an average one, a slow one?

5. How good are you at memorizing?

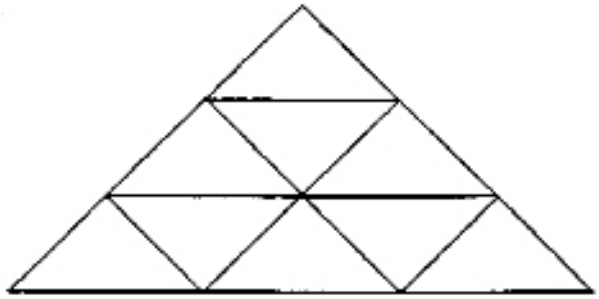
6. How creative are you? Could you become more creative? If so, how creative could you become?

Mind Problems

1. Draw three straight lines that connect all the dots, without taking your pencil off the paper.



2. Find fourteen triangles in the figure below.



3. Draw a map that solves the following puzzle.

A farmer had five sons. When he died, his will had these instructions for the division of his land among his sons:

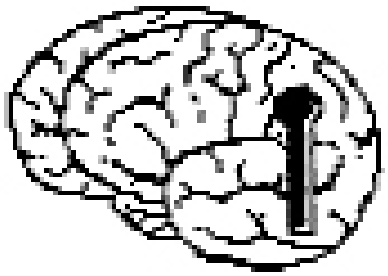
1. Each son had to be a neighbor to all the others.
2. The land of any two brothers had to have at least one edge in common, not just a point.
3. Each brother's land had to be in one piece.

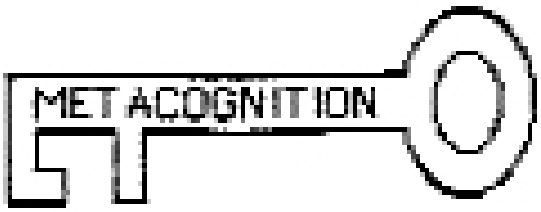
4. Add one line to the number below to make it 100.

9 | 9 |

METACOGNITION POSTER

Make a poster of this page or write the process on the board





THE KEY TO THE BRAIN

From Metacognition to Mega-Learner

Thinking about Your Thinking

Understanding How You Learn

Understanding How You Can Learn Better

Mega-Learner

Metacognition
"The Key to the Brain"

Today I learned:

1. _____

_____

_____

2. _____

_____

_____

I will do one of the following (circle one):

1. Write a list of my thoughts during two classes.
2. Write a list of my thoughts during three homework assignments.
3. Write a list of my thoughts while studying for a test.

I will read the list and write another list of what I learned about myself, how I learn, or how I can learn more effectively. I will bring both lists to the next class.

Chapter 4

Learning Modalities

All information about the environment around us must enter through our senses. The five senses are smell, taste, vision, hearing, and touch. The information that comes in through these senses is processed in different parts of our brains. For instance:

- Visual information is processed in the occipital lobe, audio information in the temporal lobe, and tactile information in the frontal and parietal lobes. How we do this is highly individualized because these areas may differ in their ability to process and store information.

- A person's brain may efficiently process and store visual information, but less effectively process and store audio information. The person will learn visual information easily but will struggle when learning audio information.

The implications for school and learning are apparent. The learning tasks teachers employ may require more visual processing than audio or tactile. A student whose abilities lie in those areas will be less advantaged when it comes to learning in a visual mode. As time passes, we all develop preferences for the modality we use most often. Teachers are typically more effective when they provide variation in the classroom — offering learning tasks which employ all three modalities — or by making it possible to learn the same tasks by using more than one modality. For example, teaching fractions can be done by visual, auditory, and tactile methods.

Consider this example. Suppose you are teaching about the solar system. You can show a picture of it and tell students about the planets and how they are organized. You could also have students hold balls of different colors and sizes and have them physically demonstrate how the planets rotate around the sun.

Research on student recall consistently favors the approach where all three modalities are used.

Students can learn to recognize which type of information their brains are most effective at processing and storing.

Recognizing your learning modality is a metacognitive process because you are thinking about how your brain thinks and learns. Students who understand their learning style can take advantage of it by transferring information into the form that is most easily processed and stored by their brain. For example, a student who recog-

nizes that he or she is a strong kinesthetic, or tactile, learner (learns by touch) could learn math more effectively by using manipulatives or getting hands-on experience related to math such as a simple construction project.

Students can also learn to make concepts multisensory. This means that students can learn to use visual, audio, and kinesthetic information to grasp a concept or memorize a fact. This is a particularly useful skill to learn because the brain functions best when allowed to integrate information. Multisensory concepts allow the brain to integrate information that is processed in different parts of the brain. The result is that a student will achieve a higher degree of learning than if he or she had focused on just one learning style. As an added bonus, the brain itself will become more highly developed as it integrates. The brain will become better at processing all three types of information and will mature in its ability to comprehend complex information.

Students can become more effective learners by using all the learning styles to process new information and by relying on their dominant learning style when needed. Teachers become more effective when they provide opportunities for this to happen.

A Look at Each Modality

Visual Learning

The notion that people tend to favor either visual, auditory or tactile learning appeared about 130 years ago when it was introduced by a psychologist named Charcot. Since then, visual learning has received more attention than either of the other modalities. In 1949, Gesell maintained that eighty percent of learning occurs through vision and that humans are the most "eye-minded" of all living creatures. Though Gesell's statistic may be overstated, clear support for the early visual learning importance is shown by the congenital tendency babies have for the eyes to constantly move in search of greater stimulation. In fact, as soon as twelve weeks after conception, a fetus' eyeballs are already moving. (Buktenica 1968).

Though most people would agree that visual stimulation enhances learning, some teachers do not use more than an occasional picture or visual aid in their lessons. Yet the impact of technology and visual design in media has established the absolute necessity for visually-based tools in the learning environment. Passive visual displays such as pictures or objects are only the beginning on the list of visual learning stimuli.

More powerful than passive visual exhibits are interactive visual "tools" in which students are themselves actively participating to create visual models. Student use of interactive visual tools enhances recall, creativity, spatial, and artistic skills. Student-created visual representations integrate students' holistic ideas and allow teachers to quickly assess children's overall comprehension. Three visual tools are briefly discussed below (taken from Hyerle 1996). In each case, though teachers may give examples or

provide an outline, students should be chiefly responsible for creating the representations.

Mind Maps / Brainstorming Webs

This visual tool facilitates children's organization of free associations and loosely related concepts in addition to being just generally fun. See Chapter 8 for examples and a more detailed discussion.

Task-Specific Organizers

These help children to visually grasp structured relationships and complex related data. Examples are pedigree charts to show a family tree or related animal families and hierarchal charts showing who reports to whom in the government or an organization.

Thinking Process Maps

These tools facilitate more linear thinking by allowing visual expression of sequential or cyclical events or processes. Students might draw circles illustrating the cyclical life process of butterflies, for example, or create historical time lines.

Auditory Learning

When children enter school for the first time, they are better listeners than readers. In fact, students' auditory perceptual skills are not just important for listening comprehension. They are, in fact, even more strongly related to children's success in reading comprehension (Weaver 1975). Since reading depends greatly on hearing instructions and matching symbols with internal vocalization of sounds, researchers agree that more auditory perceptual training could help prevent many learning disabilities. Such auditory perception consists of the sensation of hearing integrated with the activity of listening (Rampp 1976). Thus, even though some children may be more responsive to auditory learning than to other modalities, lack of formal opportunities to develop listening skills will hinder their development. Just as student participation is superior to passive visual displays, so student auditory and verbal participation is superior to passive listening.

Information can be assimilated in auditory learning through simple lecture, rhythmic attraction of poetry, or especially through music. Thousands of students can remember all fifty states in the U.S. because the list was put to music. Students can be taught to change the lyrics of their favorite songs by substituting school concepts for easy recall. Auditory learning has special advantages for some who suffer from stuttering or other language difficulties. Because singing tonality is processed by a different part of the brain than ordinary language, students who cannot say their own name without stuttering can sing songs and even say their own name in the song. Hence, difficult cognitive tasks can likely be successful completed if presented in the learning modality most appropriate to the learner.

Teachers who use auditory learning methods will not only reach students who otherwise would be less responsive; they will also discover learning benefits to children who normally prefer another teaching modality. The research of Peter Wolff (1971) illustrates the benefit of including auditory measures in teaching. When asked to recall all of the items on a long list, most children did better when they were shown a picture of each item along the way (visual learning modality). However, this visual memory aid facilitated recall chiefly for the items at the beginning of a long list. Children's recall of items at the end of the list improved most when children were able to repeat out loud the labels for each picture (auditory learning modality). In other words, it appears that our memory stores information differently based on which sense — vision or hearing — acquired it. It also appears that the forgetting process happens in different ways for the information acquired in each learning modality. Thus, the more modalities we involve for a certain cognitive task, the better will be the overall performance.

Kinesthetic Learning

Kinesthetic learning is also known as Tactile or Mobile Learning Style because it involves both touch and movement. This type of learning is the mainstay of infants during the first two years during Piaget's sensorimotor stage — children are constantly grabbing and sucking objects in their quest to understand the physical world. Many of the concepts we think are related to visual learning actually have their roots in prior tactile or kinesthetic exposure. For example, it is cognitively impossible to understand visual demonstrations of resistance, weight, or thrust in physics without prior physical motor experience. Similarly, the visual recognition of sandpaper would be meaningless without the tactile familiarity with "roughness." On this basis, some perceptual-motor theorists believe that "all learning begins with movement" (Learch 1974).

Even after the toddler stage, kinesthetic learning can create such a powerful base for a cognitive understanding of concrete operations that Piaget recommended a very active curriculum between the ages of seven and eleven (Gilbert 1977). Using physical activities, movements, and senses in the learning process will involve the children's whole body, get their attention, and lend reality to concepts that otherwise would remain passively no more substantial than the diet of TV and media intake.

Peter Werner (1979) and Anne Gilbert (1977) along with many others have listed literally thousands of ways to teach reading, writing, arithmetic, sciences, and history through movement and tactile senses. A few examples are as follows.

Letter recognition

Trace letters with your finger on the student's back, letting him or her guess which letter it is. Have children form the letter using their own bodies.

Molecule organization

In the gym have students assigned as electrons or nucleus particles. Have them organize their position relative to one another on the floor and then vary it for the gas, liquid, or solid state.

Geometry

Create a grid on the floor and have children walk along it according to coordinates or equations. Or have them create with their own bodies both symmetrical and asymmetrical poses.

History

Let them literally act out both sides of a historical battlefield, with names for captains and cities. Let them touch old artifacts or try removing the seeds and carding cotton.

Working with problems and solutions in a school environment often brings forth emotions and feelings of frustration. Physical movement channels energy and frustrations because it is pleasurable and promotes positive attitudes. It may help the socially inarticulate child to become involved and motivated. There is some additional evidence that many kids with learning disabilities have poor motor coordination and balance. Improved motor skills tend toward improved reading skills (Learch 1974).

Integrated Modalities

Teaching in all Learning Modalities contributes to the cognitive well-being of children because they will more likely encounter information in the form that is easiest for them to understand and remember. Note that children can receive a concept that is presented in one modality and mentally store it using another modality (Buktenica 1968). People with perfect pitch, for example, see tonal differences in terms of color. Of three children listening to the same tape, one might close his eyes and visualize according to what he hears; another might repeat inaudibly to herself what she is hearing; and a third child might make gestures with hands or body corresponding to the sounds presented. The trick is to help children be aware of their own tendencies, teach to them in those ways, and also help them adapt their own learning styles to a variety of tasks.

Effects on Beliefs

Students who are audio or visual learners have an advantage in school. Students who need hands-on experience sometimes feel "stupid" because they typically have a more difficult time in school. This is because few schools can afford the time and resources to provide learning through tactile means and teachers are typically less well acquainted with these methods. If these students can be led to recognize their special capacities, they will change their beliefs about their abilities to learn. Also, all students should recognize that they can improve their ability to learn by understanding the different learning styles.

Teachers need to think about how to employ methods which require use of all three modalities. It is not necessary to teach every lesson using each modality, but if you make use of all three as often as possible, students who are less able in one area will not systematically be excluded from achievement and recognition for learning.

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LEARNING ACTIVITIES: LEARNING MODALITIES

OBJECTIVE: Each student should learn what his or her learning modality is, what his or her learning modality characteristics are, and how to use this learning modality to learn more effectively in school. Students should also learn how to be multisensory learners.

MATERIALS: Copies of: "Learning Modality Test" sheets (pp. 61-62), "Learning Style Characteristics" sheet (p 63), "Learning Style Certificate" (p. 64), Homework Assignment Sheet (p. 65); and dry erase board (if available).

Activity #1

Have the students turn in their homework from the last class. Allow the students time to talk about the assignment and what they learned.

Activity #2

Give the following introduction.

Each of us has a unique way of learning. Some of us learn best by listening to the information. Others learn best when we can see the information. Still others learn best by doing something physically. Understanding how you learn best is an important part of learning to use your brain better. Discovering your personal learning style is a type of Metacognition.

Activity #3

Administer the "Learning Modality Test." on pages 61-62. Follow the instructions given. Pass out the "Learning Style Characteristics" sheet on page 63. Ask students to decide which set of statements (Visual, Auditory, or Kinesthetic) seems most like them. A student's dominant learning style is indicated by the set of statements which best describes that student.

Activity #4

Hand out the copies of the "Learning Style Certificate" on page 64. Have students write down what their learning style is. Students may not have one dominant learning style. If not, have students write down the two most dominant, such as Visual/Audio.

Write the following information about learning styles on the board or make a colorful poster. Talk about the characteristics of each learning style, and have students fill out the "Characteristics" section of the "Learning Style Certificate."

LEARNING MODALITY CHARACTERISTICS

Visual

- Learn best by seeing the information.
- Learn fast, but forget equally fast.
- Recall is helped by writing information down.
- Drawing pictures, charts, and diagrams is helpful.
- Using colors to organize notes and visualizing information is also helpful.

Audio

- Learn best by hearing the information.
- May be helped by using a tape recorder and by making up rhymes or songs.
- It is also helpful to study with others, verbally quiz each other, talk over concepts, etc.
- Participating in class discussion is also beneficial.

Kinesthetic

- Learn best by using body in the learning process.
- They need to write down the information or have hands on experience with it in order to learn it.
- Highlighting information with a marker or squeezing something in one hand can be helpful.
- Taking frequent breaks and walking around while studying can be beneficial.

Question

How can knowing that you are a visual, audio, or kinesthetic learner help you to use your brain better?

Explain

The results of the "Learning Modality Test" and the "Learning Style Characteristics" evaluation should be combined to suggest what your dominant learning style is. You should also compare these results with a reflection on your past learning experiences when deciding what your dominant learning style is.

Activity #5

Pick a subject such as "driving a car." Students who are high in one style should show the others how the subject could be learned using their learning style.

For example, a visual learner should demonstrate how drawings, charts, diagrams, could be used to learn how to drive a car. Each student should take a turn as the "coach." This activity demonstrates the opportunities to use our learning styles.

Activity #6

Teach a simple lesson which uses all three learning styles. For example, teach students that the cerebral cortex is the outer part of the brain by:

(1) drawing a picture.

(2) giving a verbal explanation.

(3) having students make their hands into fists with the thumbs under the fingers, and place their fists together. (The fingers represent the cerebral cortex and the hands together are about the size of the brain.)

The purpose of this activity is to help students recognize the value of using more than one learning style.

Activity #7

Question

How could you use your learning style to learn math?

Give the following examples.

Visual

3 x 2 could be drawn as three groups of two dots or two groups of three dots. Word problems can be drawn out.

Audio

Chant, "A negative times a negative is a positive!" (from the movie Stand and Deliver)

Kinesthetic

Use manipulatives. Do problems on fingers.

Question

How could you use your learning style when reading?

Give the following examples.

Visual

Visualize, draw pictures (Mind Mapping), highlight with colors, etc.

Audio

Read out loud or repeat confusing sentences out loud, such as, "Assemble part 4597 into the hydrostatic cylinder slot 1563 being sure not to cross wire 8359530 with wire 8359531."

Kinesthetic

Take notes, underline, highlight, take breaks, and walk around.

Closure

Conclude the lesson with the following message.

All of us can achieve great things when we learn how to use the brain effectively. The way we learn to use the brain is by thinking about how we think (Metacognition). Becoming aware of our personal learning style is an important way in which Metacognition can help us use our brains better.

Assignment

Hand out the Homework Assignment on page 65 which is divided into tasks for Visual, Auditory, and Kinesthetic learners.

Learning Modality Test

This is an informal test which measures students' ability to process and temporarily store small bits of information. The results of the test should help students identify which of the learning styles is most natural and efficient for them: visual, audio, or kinesthetic. However, the results of this test are not one hundred percent conclusive. Instead, the results suggest a dominant learning style which students should evaluate against their lifelong experience.

Instructions: Do the three memory activities with your students (order does not matter). As you do the activities look for the following physical characteristics in your students and mark a V for Visual, A for Audio, and K for Kinesthetic after their names. Students may demonstrate more than one characteristic.

VISUAL LEARNERS

They tend to look up or close their eyes when trying to recall the words. (They're trying to picture the words in their minds.)

AUDIO LEARNERS

They tend to mouth the words. You might even hear them whispering the words. (They're trying to recreate the sound of the words in their minds.)

KINESTHETIC LEARNERS

They tend to use their hands a lot when trying to recall the words. They may count on their fingers, tap their pencil, fidget around a lot, write words with their finger, or even smack their head.

Visual Activity

1. Tell students to memorize, without writing or saying the words out loud, the following list of words as you write them on the board
   chalkboard, freeway, cousin, globe, typewriter, exit, basket

2. Soon after you have written the words, erase them.

3. Have students write down the number of words they can remember.

Auditory Activity

1. Tell students to memorize, without writing or saying the words out loud, the following list of words as you give it to them orally. Read the words slowly and repeat the list twice.
   file cabinet, kitchen, sidewalk, laundry, rubber bands, pasta, computer

2. Have students write down the number of words they can remember (They shouldn't repeat the words out loud or write them down.)

Kinesthetic Activity

1. Tell students to write down the following words as you read them orally:
   office, carpool, outlet, lagoon, snowstorm, clock, telephone

2. When they finish writing down the words, have students turn their papers over and write down as many of the words as they can remember.

Interpreting the Results

Tell students that they just completed a Visual, Auditory, and Kinesthetic memory activity. Have them identify the memory activities on which they did the best. The activity a student did best on is probably his or her dominant (most natural) learning style.

Also, tell students about the physical learning style characteristics and let them know if you marked an A, V, or K next to their name.

Learning Style Characteristics

VISUAL LEARNERS

- When remembering items, I try to visualize them.
- When taking notes, I like to doodle, draw pictures in the margins, or use colors.
- I have a hard time understanding what people are saying.
- I enjoy doing puzzles.
- When taking a test, I often remember where on the page of my notes or textbook the answer is.
- I like to be aware of my appearance — how my clothes look, how my hair is behaving, etc.
- It is much easier for me to follow a map than to follow verbal instructions.

AUDITORY LEARNERS

- I can remember things that I heard better than things that I have read.
- When reading, I often mix up words that look the same, like "though" and "thought".
- I have an "ear for music" (can distinguish notes, tone, etc.)
- I would rather listen to a lecture than read a textbook.
- When I write, I tend to cross-out words and erase a lot—it looks kind of messy.
- It is easier for me to follow verbal instructions than written instructions.
- Reading and writing are tiring and difficult for me.

KINESTHETIC LEARNERS

- I learn best by actually doing something, such as doing a lab in science.
- When studying, I like to get up and walk around frequently.
- It helps me to learn something if I can watch someone else do it first.
- I often speak with my hands (use hand motions while speaking).
- I am good at physical activities such as dance and sports.
- I tend to use a trial-and-error approach to solving problems, rather than logically thinking through the problem.
- I can quickly learn physical tasks such as how to use tools or a sewing machine.

Learning Style Certificate

My Learning Style is:

Characteristics of my learning style are:

Homework Assignment*

Visual Learner

Take notes for a week in a class. The notes should include lots of pictures, figures, and diagrams.

or

Study for a class or test by making a visual representation, such as a picture or diagram, of all the important information.

Audio Learner

Use a tape recorder to record a class for a week. Then listen to the tape.

or

Study for a class or a test by repeating the important information out loud, talking about it with a friend, or by making up chants, rhymes, or songs for the important information.

Kinesthetic Learner

Take lots of notes for a week in a class and highlight or underline all the reading assignments.

or

Study for a class or a test by getting hands on experience with the important information or by using bodily actions to learn it.

*Bring a written explanation of what you did to the next class.

Chapter 5

Assertive Learning

Assertive Learning is both a set of skills and an interesting characteristic of the brain. Learning is more effective when more of the brain is involved and active in the process. An energized brain will be able to give greater attention and organize information more successfully. Assertive Learning is a set of behaviors students need to master in order to make use of the mental capabilities they are developing. A talented body will go to waste if the athlete does not have the dedication to train it. Likewise, a brilliant brain will go to waste if a student does not have the discipline to use it.

Unfortunately, the group conditions of our classrooms often allow and even encourage students to become passive. Students watch more TV and spend more time as spectators than active participants. In school, students are expected to sit quietly at their desks and wait for the teacher to tell them what to learn and how to learn it. Students are rarely taught how to monitor and control their own behavior and how to invest themselves in the learning process. Rather, teachers typically take control of students' behavior by frequent regulation.

In the process, they assume more responsibility for their students' learning than the students do. Think for a moment about how teachers typically assume responsibility and fail to relinquish it.

Teachers:

- Give specific assignments and use a system of rewards and punishments.
- Typically are required to tell students exactly what to study for a test and monitor all make-up work for the students.
- Often feel forced to take these responsibilities upon themselves because if they do not, students may not motivate themselves.

The net result of all this is that many students fail to invest in the learning process and assume less responsibility for learning. They may also have difficulty acquiring a sense of responsibility for other aspects of their lives.

An alternative to taking the responsibilities of the students upon yourself is to teach them how to take charge of their behavior and learning. Assertive Learning Skills help students do just that. When students learn to be active or responsible, teachers have to carry less of the burden. Also, learning is accelerated because by assuming responsibility; more brain energy is being used in a positive way. Interestingly, research

reveals that a sense of agency (freedom and responsibility to learn) enhances learning rates and improves levels of recall. Further, the application of agency significantly improves the ability to employ high order, or more complex reasoning, to learning tasks.

Another benefit is that teachers have more freedom. Teaching only in simple and repetitive ways is restrictive. When students are more responsible, teachers typically can provide more open-ended and creative projects for their students.

An Additional Word to Teachers about Assertive Learning

Most teachers love the idea of having students take more responsibility for their own learning. However, teachers may resist introducing Assertive Learning Skills, saying that students resist new direction. Students may say it is too challenging to have to move out of the comfortable, passive learning role. Teachers may think it difficult to shift educational responsibility to students. A brief look at historical and international advances relating to Assertive Learning shows that teaching active learning to children is both possible and desirable.

Since the 1960s, a series of educational reforms have begun to challenge the longstanding instructional theories that "viewed students as playing a reactive rather than a proactive role" (Zimmerman 1989). The new reform movements show self-directed learning (Cropley 1977; Knowles 1975), autonomous learning (Weltner 1978), independent learning (Treffinger & Barton 1981), and learning through active self-regulation or active learning (Zimmerman 1986). Basically, educators are recognizing the huge responsibility that students have to take control of their own education through what we call Assertive Learning.

Assertive Learning involves at least ten basic skills that students must be aware of and practice in order to be in control of a learning situation. These skills are presented more fully in the "Learning Activities" section of this chapter.

For now, it is sufficient to summarize them as:

1. Organizing Work
2. Listening
3. Clarifying Instructions
4. Questioning
5. Estimating
6. Predicting the Results
7. Starting
8. Staying on Task
9. Self-Monitoring
10. Completing Work

Notice that all of the skills involve verbs. The student is expected to assume the duties of active participation, thought, self-monitoring, and supervision. Expecting such responsible behavior from students, and teaching them Assertive Learning Skills, has produced great results — not only here in the United States, but in many countries around the world.

In Denmark, one hundred schools under the direction of the Minister of Education participate in quarterly regional seminars where teachers are trained not only to be assertive learners themselves, but also to lay that responsibility on the students (Dolin & Ingerslev 1997).

In the Netherlands, twenty secondary schools started the program "All Learners Active" in which all of the students would have to assertively involve themselves in their own education. Teachers were first trained to change their teaching style to include some instruction-management skills that would foster active learning in students. Then they gave assignments to groups along with high-level questioning and limited reaction to students' questions. In this way, the responsibility for organizing, interpreting, and supervising the educational experience fell mainly on the students, though they were still directed by the teachers' inquiries. The schools that implemented this program showed marked improvement in learning participation and attitude over schools that did not implement the program (Stern 1997). Similar programs have been or are currently being conducted in the United Kingdom, Spain, Germany, Finland, and Australia.

In France, 144 educators were asked "For you, what makes quality teachers?" The answer was overwhelming: ninety-nine of the teachers said it was "the ability to motivate students." In other words, the real drive in learning should be the individual students' motivation. Teachers are only effective when they can foster personal student ambition, not pushing students from behind, but motivating students to use their own resources to learn.

A Teacher Quality seminar in Austria asked which skills were necessary for a truly effective teacher. At the conclusion of the conference they had determined eleven essential points of pedagogic skill. Of all possible teaching traits and characteristics, teacher emphasis on Assertive Learning was considered by far the most important, since nine of the points summarized ways to encourage active student participation in learning.

According to the consensus of the Austrian conference (Ribolits 1993), teachers should:

1. Allow pupils to assume responsibility for their own learning process.

2. Encourage pupils to perform a self-evaluation of talents and weaknesses.

3. Dispose of a repertoire of pedagogic skills in order to respond to pupils' individual needs — arousing and retaining curiosity, promoting independent, and action-oriented work.
4. Promote learning and work by discovery and research through processes and through the senses.

5. Impart different learning techniques.

6. Grant sufficient time and create flexible free scope.

7. Take up suggestions and allow the finding of solutions and their implementation.

8. Teachers promote pupils' self-reliance.

9. Teachers provide for opportunities of relating theoretically acquired knowledge to lifetime situations.

Point #9 re-emphasizes why Assertive Learning is essential for students. Today's children will face real-life learning necessities, including multiple career changes and frequent job retraining. If they can be active listeners, self-starters, self-evaluators, and questioners, they will be significantly more prepared for the educational necessities of the future. Thus, educational goals both here in the United States and abroad must include focus on student responsibility in Assertive Learning.

Effects on Beliefs

Many students believe that external factors such as the school, teacher, class, or textbook are responsible for their success or failure. They take a passive role in their own education. They say things like, "I can't learn math because my teacher is so boring," or "This textbook is so confusing there's no way I can get a good grade in this class." Students will even blame their failure on the fact that the teacher did not remind them to make-up a test. When students believe that external factors control their success, they typically do not put forth the effort to succeed because they don't see the connection between personal behavior and success.

Assertive Learning principles help students believe in the power of their own effort and ability. When students use Assertive Learning Skills, they activate the brain's energy because they see that their actions (rather than external things) are responsible for the results.

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LEARNING ACTIVITIES: ASSERTIVE LEARNING SKILLS

OBJECTIVE: Introduce your students to the Assertive Learning Skills (ALS). You will help them gain an understanding of each one and learn how to use them in school to become better learners.

MATERIALS: Copies of :ALS definition sheet (pp. 74-75), Flexihexagon sheet (p. 78), "ALS Checklist" sheet (p. 77), "Listen and Draw" sheet (p. 76), "Assertive Learning Skills" Assignment Sheet (p. 79); ALS cards (make sets of index cards which have the name of each Assertive Learning Skill written on them and sets which have the short definition of each Assertive Learning Skill), scissors, markers, and glue sticks.

Activity #1

Check off assignments from last class. Allow students time to talk about what they did and what they learned.

Activity #2

Give the following introduction.

We have talked about how our brains can naturally grow smarter and how we can learn to use them better. However, a great brain will do you no good if you lack the ability to be responsible for your learning. For example, you could be the greatest mathematician in the world, but if you are so unorganized that you always lose your assignments, you will still fail your math class. In this class, you will learn about Assertive Learning Skills. These are the skills that allow you to be in charge of your learning.

Definition

Explain what it means to be an "Assertive" student by contrasting it with being "Aggressive" and "Passive."

Passive Mouse

- Does not do anything unless the teacher asks.
- Only writes down the notes that the teacher says to write down or writes on chalkboard.
- Only studies exactly what the teacher says will be on the test.

Aggressive Monster

- Only learns what he or she wants to learn.
- Doesn't do anything the teacher asks.
- Only does assignments the way that he or she wants to do them.

Question

What do you think an "Assertive" student is like?

Activity #3

Pass out the Assertive Learning Skills (ALS) definition sheets on pages 74-75. Display a poster of the Assertive Learning Skills or write them on the chalkboard. Allow students to look over them.

Use the following tasks to introduce the Assertive Learning Skills. After completing each task, ask students which ALS the task focuses on.

ALS Cards

Divide the class into small groups. Give each group two sets of ALS cards (names and definitions) and have them mix them up on their desks or table. Ask them to arrange them by matching the name to the definition. When they finish, ask them to evaluate their work. (Organizing Work, Self-Monitoring)

Tell students to turn the name cards face down and randomly pick a card. In the following activities, they should demonstrate the ALS on the card they picked.

Listen and Draw

As you speak, have students follow the directions given on the "Listen and Draw" sheet on page 76. Do not make copies of this sheet to pass out, the students should draw on their own paper. (Listening, Questioning, Clarifying Instructions, Estimating)

Procrastination List

Have students make a list of five things they do to avoid doing homework. (Starting, Staying on Task, Finishing)

Animal Game

Think of an animal. Have students try to guess what it is by asking questions to be answered "yes" or "no." (Questioning)

Have students guess what ALS cards the others in their group have picked.

Activity #4

Pass out the "Assertive Learning Skills Checklist" on page 77. Each student should monitor the student to his or her left. Have them check the appropriate box each time they observe an Assertive Learning Skill being demonstrated during the next activity.

Activity #5

Pass out Flexihexagon sheet on page 78, scissors, markers, and a glue stick to each group. Have students follow these instructions:

1. Cut out Flexihexagon—outside line only. Place it vertically in front of you.

2. Count up four triangles from the bottom and fold up.

3. Fold back (toward you) the top triangle on the section that you just folded.

4. Count three triangles down from the top. Fold the section down (toward you) and place the top triangle under the triangle you just folded back. Use a glue stick to hold in place. A hexagon is now formed.

5. Now color each triangle on one side of the hexagon. (Just use one color.)

6. Repeat on the other side of the hexagon, using a different color.

7. Flip the hexagon surfaces to expose more uncolored sides. There are six more uncolored sides. To flip the hexagon: a) fold back and forth along all the triangle lines (this makes the hexagon easier to flip); b) put both thumbs under unfolded edges of hexagon in the center of the hexagon; c) pull thumbs up and out to expose unmarked triangle sides.

8. Color the exposed triangles a new color. It will take two or three flips to expose all six uncolored triangles.

Closure

Conclude the lesson by saying:

Each of these Assertive Learning Skills can help you take charge of your learning. These are the behaviors that you need to develop to accompany your growing brain. You can probably slide through middle school and high school without a knowledge of how to be responsible for your behavior and learning, but life beyond high school is a totally different story. In order to be successful in life you must learn how to take charge of your behavior and learning.

Assignment

Hand out the "Assertive Learning Skills" homework assignment on page 79.
1. ORGANIZING WORK: I arrange and plan.

Assertive Learning Skills

Do I have all the supplies I need to be successful with a project or an assignment? Is my environment, workplace, lighting, etc., conducive to my success?

Am I aware of how best to get the work down on paper so I or anyone else can read, follow, or use my work? Is there a better way to simplify any confusing area or part? Can I experience the personal power feeling when I am in control of my environment?

2. LISTENING: I am an active learner.

Am I an active learner by listening to the teacher, my parents, or friends? Am I being quiet so that I can listen to my inner voice? Am I paying attention? Do I listen in order to receive instructions necessary to start and complete, to problem solve, to ask and answer questions, to spark my imagination?

3. CLARIFYING INSTRUCTIONS: I create a clear understanding.

Am I able to repeat back to the teacher or to myself what I understood that I am to do? Do I know how to start and proceed? Do the instructions make sense to me?

In math, clarifying instructions means I will ask myself if I understand what the problem is asking and if I know what information I need to solve the problem.

4. QUESTIONING: I ask and answer questions.

Do I, could I, would I ask a question to myself, to a teacher, to a parent, or to a friend about something I did not understand or wanted to know?

Am I an active learner and listener? Am I involved and paying attention to the discussion, activity, or lecture, etc., so I will be able to contribute by answering questions?

5. ESTIMATING: I judge and evaluate.

I will estimate how much time it will take me to complete my work. When I finish my work, I will compare the actual time against my estimated time. How did I do? Does estimating help me make better use of my time?

In math, estimating helps me to make reasonable judgments about what the answers to the problems will be.
6. PREDICTING THE RESULTS: I declare the outcome in advance.

Do I know how my assignment or task will end? What will I have as a result of my work? Do I understand the law of cause and effect here? Do I know that the more I understand what I must do and understand the best way to do it, that I will experience better results with the end product? Can I give myself credit for my predicting great results and know that I have created those results?

7. STARTING: I begin the work.

Do I begin my work immediately after it has been presented or at the agreed upon starting time? Do I avoid distractions, daydreaming, and procrastination?

Starting in math means I know how to set up the facts and to begin computing to find the answer to the problem.

8. STAYING ON TASK: I keep working.

Do I keep working until my assignment or project is completed? Do I experience that satisfied feeling of knowing that through my persistence I have been productive?

9. SELF-MONITORING: I evaluate my attitudes and habits.

I take a look at myself by evaluating my behavior and study habits. I can talk to myself and describe what I am doing. Am I on task and working toward the goal being pursued? Do I need to make any changes in my behavior, thoughts, or attitude?

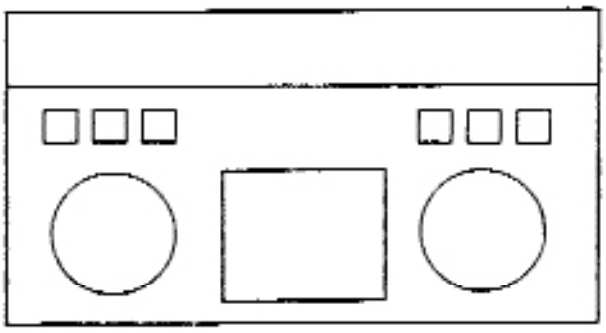
10. COMPLETING WORK: I finish my work.

Are all parts of my work or project finished? Have I set up a system to "check-off" so I know that I have finished my work? Have I experienced and acknowledged the feelings of success, satisfaction, relief, and pleasure that come from following through and finishing?

Listen and Draw

This is a fun activity to help students experience early listening success. Present the directions below at a normal, conversational speaking rate. Use normal inflection. Repeat each instruction once. Pause after each instruction to give students time to complete the task before going on.

1. In the middle of your paper, draw a rectangle. It should be about 7 inches long and 3 inches high.



2. In the middle of your rectangle, draw a smaller rectangle. It should be about 2 inches long and 1 1/2 inches high.

3. On both sides of the small rectangle, draw a circle. Each circle should be about 1.5 inches in diameter.

4. Above each circle, draw 3 very small squares. Each will be about the size of a telephone push button.

5. Next, look at the top of the big rectangle. Draw a half-inch vertical line at each end of the rectangle.

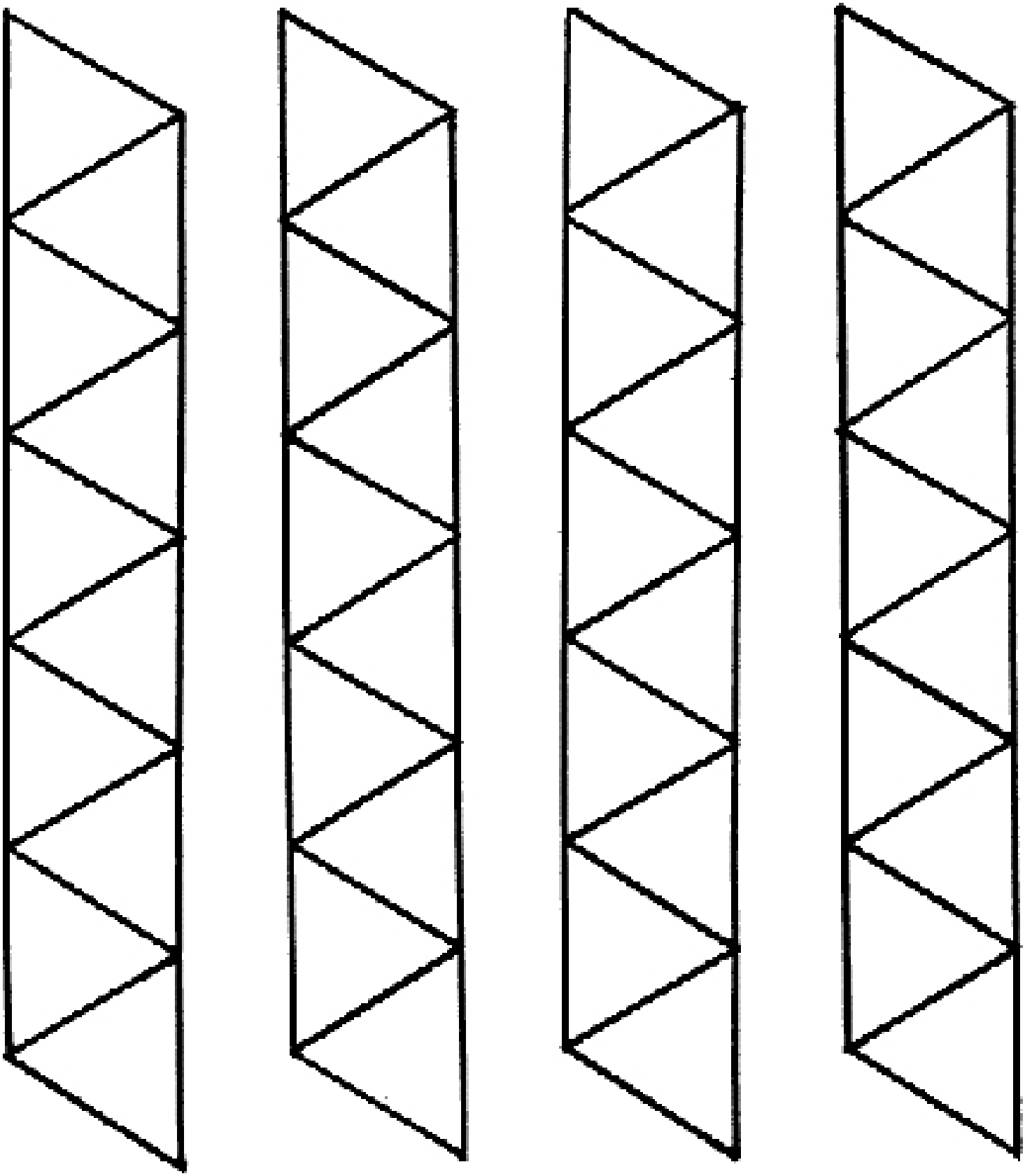
6. Last, connect those two lines with one long, straight, horizontal line.

7. What did you draw? (answer: a boom box)

ASSERTIVE LEARNING SKILLS CHECKLIST

Date _____ Name _____

1. Organizing Work					6. Predicting						
2. Listening						7. Starting					
3. Clarifying Instructions						8. Staying "On Task"					
4. Questioning: Asking & Answering					9. Self-Monitoring						
5. Estimating						10. Completing					



Assertive Learning Skills

Assignment

Pick a class and an Assertive Learning Skill you are going to use in that class for a week. Write down specifically how you are going to use that Assertive Learning Skill. For example, if you choose Questioning, you could write, "I will ask at least two questions in Math every day."

_____

_____

_____

_____

Bring a written summary of what you did to class on _____ (date)

Chapter 6

Teaching to Both of the Brain's Hemispheres

You are probably already familiar with the right and left hemispheres of the brain. In fact, the topic has become so popular that it has distorted our understanding of the brain and distracted us from other important aspects of the brain. However, if understood correctly, this aspect of the brain can help teachers be more effective and can help students become better learners.

Theories about the left and right sides of the brain are not as clear-cut as they seem. The two sides of the brain are not as unique and independent as we like to imagine. Instead, both sides are continually working together and performing similar functions. However, it is true that our brain is differentiated, meaning that it has specific areas for certain tasks. For example, nouns and verbs are stored and processed in separate parts of the brain. The primary center for linguistic reasoning is in the left hemisphere and the primary center for spatial reasoning is in the right hemisphere.

The right brain is different from the left brain, but no more so than the front of the brain is different from the back of the brain. It is also important to remember that the brain is very adaptable. If one hemisphere is damaged or even totally removed (for example, due to surgery performed on people suffering from severe seizures), the other hemisphere will adapt and take over many of the functions of the other side of the brain.

The left and right sides of the brain simply provide a convenient way to talk about the different characteristics of the brain. We can group together the characteristics which generally appear on each side of the brain. For example, "imagination" is part of a process that involves more of the right side of the brain than the left. Grouping characteristics of the brain into the "right and left brain" can be helpful for two reasons:

- students can recognize which functions of their brains are more highly developed.

- students can work on developing and integrating their whole brain.

As with Learning Modalities, students can learn to recognize and capitalize on their natural abilities. We refer to the side of the brain which receives sensory information first as the dominant side. Cerebral dominance develops gradually and is usually fully formed by about age five. Children unable to establish dominance usually have learning difficulties of one kind or another.

Students can learn what the characteristics of their dominant side are and use these characteristics when learning. For example, students using their left hemispheres

could capitalize on their abilities of logical deduction to solve a problem, whereas other students could use their right hemispheres to capitalize on their abilities to imagine an original point of view to solve the same problem. Notice how it would be more effective if students were taught to use the functions of both sides of their brain.

Once students are aware of the characteristics of the different parts of the brain, they can work on developing each of these characteristics and integrating their whole brain. Observational studies indicate that a typical classroom usually gives heavy emphasis to tasks which require left hemisphere activity. This situation creates two disadvantages. First, some students typically employ right hemisphere activity to learn and are thus disadvantaged by more frequently having to learn in a way that is less "natural" to them. Secondly, a principle benefit of having two hemispheres is the added stimulation which results when both are employed simultaneously.

When teachers understand how the brain works and the functions of each hemisphere, they can elaborate their teaching methods to include tasks for both. For example, reading skills are enhanced if students learn to tell imaginary stories. Learning math facts is faster if students are asked to draw a picture which includes numbers and relations between numbers. Creative games invite use of both hemispheres and adds to learning enjoyment as well.

Albert Einstein reported that he discovered the theory of relativity by imagining what it would be like to ride alongside a particle of light. Seeing himself in a chair floating along with this particle, he realized that the light would bend as influenced by gravity. Since our sense of time is affected by light, it was understandable that his famous equation emerged. Leonardo da Vinci "saw" many inventions and even portrayed them in writing long before he could analyze how they could practically be built or used. Mozart "heard" many of his compositions before he actually wrote them.

Improved Student Performance: Teaching to Both Sides

Traditionally, school training is oriented toward left-brain analytical activities in math and reading. In light of past emphasis, it can be easy for teachers to continue strictly in the pattern of assigning homework in reading, writing, and mathematical proofs. While such left-brain assignments are valuable and necessary, they sometimes preclude the development of right-brain thinking in both teachers and students. Right-brain learning may be achieved through different methods such as visual aids, movement/kinesthetics, music, metaphors, and hands-on learning. It is not necessarily true that students need to have a left-brain orientation to succeed in math and verbal tasks. Students with right-brain preferences can be just as capable if learning circumstances allow.

Consider again Albert Einstein. He once described his own thinking process this way:

> The words of the language, as they are written and spoken, do not seem to play any role in the mechanism of thought...[which] in my case [is] visual and some of muscular type. Conventional words or other signs have to sought for laboriously in a secondary stage, when the...associate play is sufficiently established.

Einstein's thoughts began with a right-brain preference: spatial style that seeks and constructs patterns. Then he processed the results and verbalized them according to a more left-brained procedure (linear, step-by-step analyzation of the parts of the pattern). When teachers give due emphasis to teaching for both sides of the brain — balancing right-brain teaching methods with the traditional left-brained ones — students' performance improves! This is true even when the nature of the cognitive task is considered "left brained."

Under-performing students in California were lucky to have Ms. Diane Streeter as their eleventh-grade grammar teacher. Though some students in the class had tested well in grammar (perhaps one of the most linear, verbal tasks taught), the majority of students could not even identify simple parts of speech, despite having had grammar classes for years. She decided to teach them using fantasy — one of the methods of involving right-brain visual/spatial processing. For example, students were told to close their eyes and imagine themselves as nouns: boxy, heavy, and immobile. Then they were to imagine themselves as certain verbs and other parts of speech. By the end of the unit, most of the students had mastered parts of speech. In fact, many of them became so confident about their new understanding that they wanted to be re-tested against the "smart" students who had originally qualified to bypass Ms. Streeter's training. In some cases, students who received the fantasy training after their original grammar test "failures" actually surpassed the "smart" kids who had not received right-brain style training (Williams 1983).

In sciences, Wittrock (1977) managed to teach kinetic molecular theory to kindergarten and primary school children. According to the famous child development theorist Jean Piaget, this would have been impossible because children younger than the symbolic and concrete operational stages do not have full reasoning and logical capacities yet. But Wittrock bypassed the left-brain logical approach in favor of a more right-brain one. He used pictures, concrete examples, and simple text in which all verbal abstractions were represented graphically. The children not only learned the concepts, but remembered them a year later!!

Wittrock's research also showed that students recall vocabulary words better when they integrate left- and right-brain learning. He started with a basic score for students who were merely instructed to write down the words and definitions (left-brain training only). When students were asked to trace over pictures of the definitions (a slightly more visual, right-brained approach), the students' recall scores improved a little.

Then, Wittrock asked children to both read the definitions and draw their own pictures to represent them. This approach resulted in the highest scores.

There are neurological reasons why learning simultaneously in two modes is advantageous. If given a row or list of items, the right visual field (left brain) processes items in a row serially and the left visual field (right brain) processes in parallels (Nebres 1977). If the number of stimuli is large, serial processing would be disadvantaged, since it is slower. Thus, a dual capacity to process new information would be more useful. In practical classroom terms, if a sequential teaching approach isn't working, consider using a spatial, pattern-seeking learning strategy, because this approach offers an alternative which may be more congenial to a child's leaning style.

Even in such linear, verbal tasks as teaching business communication, S. K. Rotalo (1982) incorporates right-brain teaching methods by showing the class photographs of people in different careers and asking them which letter style (i.e., formal, semi-formal, social) would be most appropriate based on the dress and environment of the people in the pictures. She maintains that, "a right brain dominant person can memorize much easier if a clear image can be formed using the...ideas to be recalled."

Neurophysical researcher Patricia Davidson illustrates how teaching to both brains is necessary in math. She identifies in students two different "math styles" which correspond to left- and right-brained preferences.

Style I (left-brained) students

- They prefer...a "recipe" approach to math, in which they follow a step-by-step sequence of operations, moving forward to a solution. They seldom estimate, tend to remember parts rather than wholes, and have a strong need for talking themselves through procedures...they are often very precise in carrying it [the recipe] out, but while they may arrive at the right answer, they may remain totally unaware of the logic that gives meaning to what they are doing.

Style II (right-brained) students

- They are impatient with step-by-step procedures and likely to make mistakes while doing them. Such children are good at estimating, may spontaneously give a correct answer without knowing how it was arrived at, and are superior at recognizing large-scale patterns (Loviglio 1981).

Obviously, neither style alone represents ideal learning. The teacher's job is to help students recognize their own style's weakness, and then adapt. Style I learners can be taught that "step one" requires an estimation and that the "final step" in a calculation is checking the actual answer against the estimate. They should also be encouraged to talk their way through. Style II learners, on the other hand, can be taught to use spatial

ability and recognize their own trouble spots by paying more attention to the individual elements of larger patterns.

Class presentations should be tailored to both learning styles, for example, doing math problems on the board and talking through them at the same time. Davidson (1982) says, "Often a problem should be done two different ways; to avoid confusion, teachers should explain what they're doing and inform students that they need not master both approaches, only the one that's easiest for them." This dual method of presentation is not only appropriate for math, but for every subject. Presenting concepts in left-and right-brained fashion allows students the advantage of multi-level cognitive processing, added chance of recall, and development of creative ability to see relationships between problems and real-life solutions.

Effects on Beliefs

For the most part, our schools require students to perform left-brain tasks in a left-brain environment. Students who do not fit in to the "left-brain mold" will typically struggle in this environment. They tend to believe that they are less intelligent because they cannot do as well as other students even though they may have put in twice as much effort. Even geniuses such as Einstein, Beethoven, and Blake, to name a few, struggled terribly in a school environment that differed from the natural functioning of their brain.

Students who understand the characteristics of the brain can recognize the conditions in which they will struggle or succeed. They will understand they are not less intelligent but are faced with a mismatch between what is being required of them and their natural mode of learning. While they may function better in a different environment, they also need to learn to adapt themselves by learning to use both hemispheres. Also, remember the adaptability of the brain; over time it can improve its abilities to function in a given environment.

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LEARNING ACTIVITIES: THE BRAIN'S HEMISPHERES

OBJECTIVE: Students should learn what their dominant hemisphere is, what right/left brain characteristics are, how to recognize right/left brain settings and activities, and how to be more successful in school by applying this information.

MATERIALS: Copies of: "Left/Right Brain" test (pp. 90-91), Diagram 6-1 (p. 92), "Right/Left Brain Characteristics" sheet (p. 93), "Right/Left Brain Conditions" sheet (p. 94), "Extend the Line" sheet (p. 95), "Left Brain/Right Brain" Assignment Sheet. (p. 96); and a tape with different types of music.

Activity #1

Check off assignments from last class. Allow students time to talk about what they did and what they learned.

Activity #2

Have students take the "Left/Right Brain" test on pages 90-91. Help students score the test. This test is short and unofficial. It should merely suggest which hemisphere is more dominant.

Activity #3

Pass out Diagram 6-1 on page 92. Remind students that the cerebral cortex is divided into right and left hemispheres. Explain that the right hemisphere controls the left side of the body and the left hemisphere controls the right side of the body. Show that even though they are separate, they always interact through the corpus callosum. Certain characteristics and abilities are located on different sides of our brain.

Scientists have grouped together the characteristics which appear most strongly on the right side of the brain and termed these "right brain" characteristics. They did the same with "left brain" characteristics. So, the test you just took indicates whether your right or left brain characteristics are more dominant.

Activity #4

Hand out the "Right/Left Brain Characteristics" sheet on page 93. Take some time to talk with students about the results of their tests.

Questions

Do the results seem accurate? What does it mean to be right or left brained? What does it mean to have a "dominant" side?

Activity #5

Hand out the "Right/Left Brain Conditions" sheet on page 94.

Explain

Some conditions and activities are more right brained and some are more left brained. We function better in conditions and activities that match our natural abilities.

Questions

Why is it helpful to recognize the conditions in which we function best? (Possible answer: "So that we create these conditions where possible.") Why is it also good to recognize conditions we struggle in? (Possible answer: "So that we'll be prepared to work hard and develop characteristics which are not our strongest.")

Explain

This sheet (Right/Left Brain Conditions) will help you recognize right and left brain conditions.

Activity #6

Hand out the "Extend the Line" sheet on page 95.

Explain

Extend the line which is printed on this sheet. You can do this in any way you want — draw a picture, write words, use a marker, use a pencil, etc. You can do more than one line drawing if you choose.

Activity #7

Give the students a big piece of paper. Play a tape with a variety of music on it, and have them draw pictures or designs as they listen to the music. Tell them to relax and let themselves be guided by intuition.

Activity #8

1. Give the students a topic to write on ("My Most Scary Moment," "My Earliest Memory," "My Most Embarrassing Moment," "A Day in the Life of a Long-Necked

Dinosaur," "The Day I Turned into an Animal," "Ralph and His Girlfriend from Venus," etc.).

2. Give them each a sheet of paper and a pencil.

3. Let them write for five minutes, following these rules:

- They cannot stop writing. If they cannot think of anything to write, then they should write, "I can't think of anything to write, I can't think of anything to write."
- They should write whatever comes into their minds.
- They should not worry about spelling, grammar, etc.

4. Now, have the students rewrite the story. They should correct spelling, fix grammar, improve sentence structure and clarify ideas.

5. Have them share their stories with each other.

Activity #9

Conduct a summarizing discussion by asking the following "metacognitive" questions:

- Why are the activities we did in this lesson beneficial?
  (Possible answer: "They help to integrate both sides of the brain.")
- Why might it be helpful to identify the right and left brain characteristics in an activity?
  (Possible answer: "So you can capitalize on your strengths.")
- What parts of the activity we just completed focused on left-brain characteristics?
- Which parts focused on right-brain characteristics?
- Which parts did you do best and which parts did you like best?
- How can recognizing right or left brain conditions help you be more successful in school?
- How could you make the conditions related to school more similar to your natural abilities?
- How can recognizing the right- or left-brain characteristics in activities help

you be more successful in school?

Closure

Sometimes we are placed in situations that do not match our natural learning abilities. This is what happened to Einstein in school. When this happens to us, we tend to think we're not intelligent. Remember what some of you have said about your beliefs about your abilities to learn? It is important to realize that we can learn in the right conditions and that we should try to create these situations when possible.

Also, we can be like Einstein who was determined enough to survive the adverse conditions and eventually created conditions which matched his natural abilities. Once he did this, his learning increased at an incredible rate.

Assignment

Hand out the "Right Brain/Left Brain" assignment sheet on page 96. Ask the students to complete it and bring it to the next class.

Left/Right Brain Test

Circle the number of each statement that you consider to be true.

1. I usually notice what time it is.

2. I would rather take a true-false, multiple-choice, or matching test than an essay test.

3. I tend to forget people's names, but I remember their faces.

4. I like to daydream and use my imagination.

5. I learn best by seeing and hearing.

6. I learn best by touching or doing.

7. I like assignments that are open-ended rather than structured.

8. I would rather just go do something than think it all through beforehand.

9. People think that I'm creative.

10. Even though I sometimes get mad and upset, I'm usually considered a rational or controlled person.

11. I don't mind taking a few risks when I think it's worth it.

12. It is easy for me to express my feelings.

13. I like to plan things out and know what's going to happen ahead of time.

14. When I want to, I can really concentrate.

15. Melodies are easy for me to remember.

16. I am good at math.

17. I can learn new vocabulary words easily.

18. I like to work with details.

19. When doing a jigsaw puzzle, I can see the whole picture easily even if I

have not placed many pieces.

20. I don't mind doing something over and over until I master it.

21. I am good at giving clear and logical directions.

22. Sometimes I make decisions based on what feels right rather than thinking through all the pros and cons.

23. I can sometimes remember things by picturing where I read them on a certain page.

24. I have a daily and weekly schedule of when I do things.

Scoring

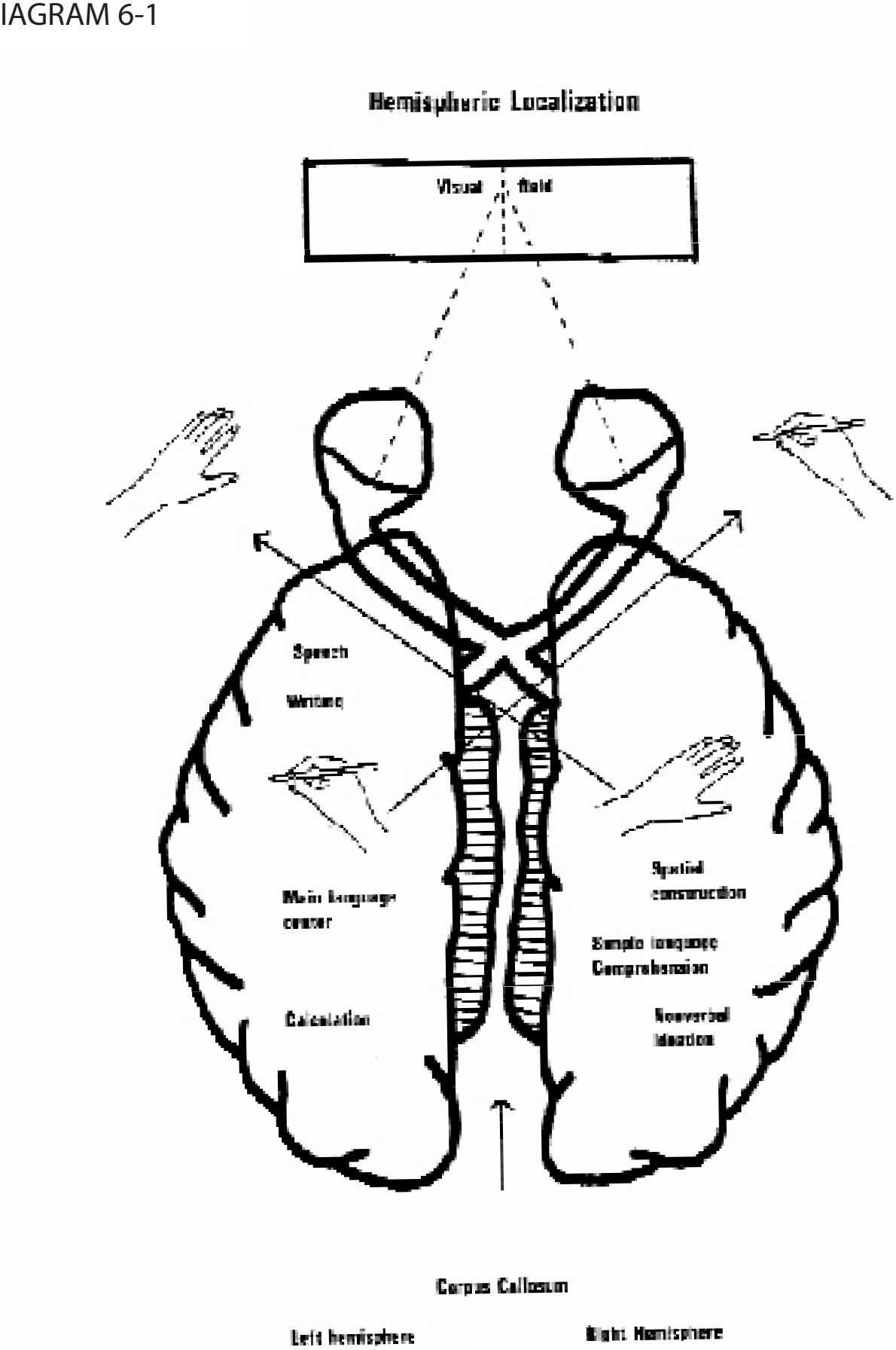
- Statements 1, 2, 5, 10, 13, 14, 16, 17, 18, 20, 21, and 24 are left-brain characteristics.

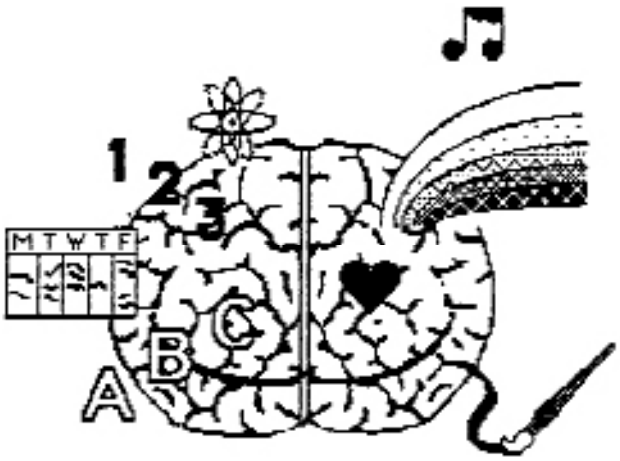
- Statements 3, 4, 6, 7, 8, 9, 11, 12, 15, 19, 22, and 23 are right-brain characteristics.

Left Brain Score = the # of left brain characteristics you circled = _____
Right Brain Score = the # of right brain characteristics you circled = _____

The side of the brain with the higher score is probably your dominant side. This means the characteristics of that side of the brain are more natural for you to use and that you prefer to use them. You are still very capable of using the characteristics of the non-dominant side of your brain — although it may require more effort. It is important to remember that both sides of our brains are always working together.

DIAGRAM 6-1


Hemispheric Localization
Visual field
Speech
Writing
Main language center
Calculation
Spatial construction
Simple language Comprehension
Nonverbal ideation
Corpus Callosum
Left hemisphere
Right Hemisphere



LEFT BRAIN CHARACTERISTICS	RIGHT BRAIN CHARACTERISTICS
Technical	Imaginative
Scientific	Intuitive
Mathematical	Conceptual
Rational	Holistic
Analytical	Inventive
Logical	Ambiguous
Problem Solving	Original
Theoretical	Visual
Factual	Impulsive
Objective	Experimental
Realistic	Risking
Convergent	Divergent
Precise	Artistic
Formal	Spatial
Verbal	Perceptive
Systematic	Interpersonal
Administrative	Emotional
Procedural	Empathetic
Organized	Sociable
Conservative	Spiritual
Confident	Musical
Structured	Sensitive
Disciplined	Responsive
Practical	Subjective
Predictable	Trusting
Detailed	Adaptable
Controlled	Harmonious
Dependable	Idealistic
Planning	Talkative

Right-Brain Conditions

LANGUAGE — The teacher speaks in an emotional, animated, dramatic style. The teaching method is humorous, simple, descriptive, and positive.

ATTITUDE — The mood is relaxed, playful, noncompetitive. Students feel they can be open to inspiration. They pay attention to surroundings. They feel free to hum, whistle, or sing.

SETTING — The room is warm, attractive, casual, comfortable, and interesting. It has colorful displays. The work place is flexible and anything could happen.

RULES — The rules are unstructured guidelines that allow for personal expression, encourage openness, and allow for the expression of strong emotions.

SCHEDULE — Flexibility and spontaneity are important. Students may be allowed to lose track of time completely.

ASSIGNMENT — Homework involves imagination, visualization, drawing, colors, shapes, patterns, the manipulation of physical objects, or the use of the body. The assignment allows students to be original, express emotion, wonder, speculate, estimate, read between the lines, act spontaneously, take risks, or try new things.

Left-Brain Conditions

LANGUAGE — Words are formal, factual, and precise.

ATTITUDE — Students show minimal emotion. They are efficient, confident, and responsible. They sit up straight, maintain eye contact, and stay on task.

SETTING — The room is neat, orderly, and businesslike.

RULES — The rules are structured and precise.

SCHEDULE — Punctuality and efficiency are important. Students maintain an awareness of time and time limits.

ASSIGNMENT — Assignments are organized and neat. The assignments deal with analyzing, criticizing, or calculating information.

Extend the Line

Think of many varied and unusual ways you could transform this line into something else.

LEFT BRAIN/RIGHT BRAIN

Assignment: Pick a difficult subject in school and answer the following questions.

1. Is the language used in the class more right or left brained? Give examples of how the language is either more right or left brained.

2. Is the attitude of the class more right or left brained? Give examples.

3. Is the classroom setting more right or left brained? Give examples.

4. Are the rules in the class more right or left brained? Give examples.

5. Is the schedule in the class more right or left brained? Give examples.

6. Keep track of the class assignments for a week. Are they more right or left brained? Give examples.

7. How could you make the class conditions more similar to your own right- or left-brained characteristics? On the back of the paper, write a list of all the possible ways that you (not the teacher) could make the conditions similar to your characteristics. There are many things you can't control, but there are some things you can control such as how you do the homework.

Multiple Intelligences

Our society thinks of intelligence the same way we think of mercury in a thermometer: there is a certain level which can be measured and evaluated. When students take a test they are evaluated as hot, cold, or lukewarm, and then they are expected to perform at a level consistent with their "intelligence." In reality, intelligence is not so simple. Intelligence is not a "thing" which can be easily measured. Rather, our brains all function in different ways and at different levels in different areas. I.Q. tests and most school tests simply measure the level of functioning in two areas: verbal and logical/mathematical ability.

Howard Gardner, a professor at Harvard, was the first person to create a theory that accounted for the more complex nature of intelligence. His "Multiple Intelligence" theory describes seven areas of intelligence. All of us have some ability in each of the seven areas, but usually we are stronger in one or more of them. The Seven Intelligences are:

1. Verbal/Linguistic
2. Musical/Rhythmic
3. Logical/Mathematical
4. Visual/Spatial
5. Body/Kinesthetic
6. Intrapersonal
7. Interpersonal

These seven areas seem to describe the most basic and universal functions of the brain. They provide a richer paradigm with which to view intelligence. Thinking of intelligence in terms of an I.Q. test score forces us to limit our understanding of children. That is, in school we will only think of them as high, average, or low in this respect. By accepting the idea of Multiple Intelligences, we enrich our perception of students as well as our teaching.

We can now teach to each of these intelligences by organizing a curriculum that requires learning in each domain. We can help students identify where they are strong and where they need to become stronger. This helps them have a more accurate view of themselves rather than overestimating or underestimating themselves based solely on I.Q. This more accurate perspective promotes a mature approach to learning as well as to social relationships.

As with Learning Modalities and the hemispheres of the brain, students can use the theory of Multiple Intelligences to recognize their natural abilities. If they under-

stand the qualities of each intelligence, they are usually able to recognize their natural abilities. They can then capitalize on these abilities, when possible, to accelerate learning.

Students can also learn to use more of the intelligences when learning. Any learning task may employ more than one kind of intelligence. Gardner's research is supplying data which suggests that employing more than one intelligence at a time forces a person to develop creative and symbolic thought. This action integrates more parts of the brain and produces a higher level of reasoning. For example, researchers have discovered that listening to music by Mozart while studying improves test scores.

If these results and others like them confirm Gardner's theory, they also open up an entirely new avenue for teachers to improve intelligence and creativity while they are teaching. Apparently any combination of intelligences fosters improved reasoning.

Background on the Model of Multiple Intelligences

To understand how revolutionary the model of Multiple Intelligences really is, just ask yourself how many times in the last month you have heard someone use the plural word "intelligences" in ordinary conversation. Did anyone say, "Shauna's intelligences amaze me"? Or how about just, "Henry is multi-intelligent"? Chances are that you, like most people, only hear and use the singular form "intelligent" or "intelligence." Intentionally or not, we tend to define people along a narrow spectrum of dumb to smart.

The reason why we generally refer to "intelligence" in the singular form (without specifying the context or skill we mean to admire) is that we have been influenced by history to think of intelligence as a thing — a single capacity which one possesses in greater or lesser degree — instead of as a multi-factor combination of experiences, likes, and capacities. Understanding the history of how we came to think this way will help us to understand the model of Multiple Intelligences.

This idea took root in Paris, France, where a school administrator was frustrated by low performance. Some students with low scores, he reasoned, were trying the best they could, but simply did not have a talent for academia. Yet he knew that others were certainly capable of higher performance but were lazy, unmotivated, and disinterested. How was he to distinguish the two groups? To answer his question, in 1905 he hired a psychologist named Alfred Binet to figure out a test that would separate the students according to their capacity for school performance (Association for Advance Training 1988).

Binet developed several types of tests in accordance with his belief that intelligence is a multi-faceted construct that includes a variety of skills, abilities, and talents. Binet basically believed in Multiple Intelligences. However, Binet's answer was considered too complicated for the simple question of which students' success was most likely. So, he was encouraged by other people to simplify the whole evaluation into a single score, which he did. (Guilford 1979).

The test was devised to predict future performance. Since it tested students' verbal and mathematical reasoning abilities, it indeed predicted the students' performance in a school where those subjects would be of chief concern. It seemed like a good idea, and many other psychologists began revising and creating similar tests.

Binet combined with Theophile Simon to refine the original score. For the Binet-Simon evaluations, the single score was then compared with scores of other kids until an average score for a given age group was determined, and a child could be assigned a mental age. Then, German psychologist William Stern decided to compare the mental age in a ratio to the chronological age of the child thus yielding a new number which he named the "I.Q." or "intelligence quotient." The I.Q. and a modified "Stanford-Binet Intelligence Scale" were subsequently imported to America by Lewis Terman in 1916 (Rebok 1987).

Keep in mind that this is the source from whence come our biases about the word "intelligence." The original tests were NOT made to measure artistic creativity, musical genius, athletic prowess, interpersonal knack, and other similar products of the human brain and body that are so important to a successful life. The psychometric tests originally existed primarily to predict how well a student would do within a school atmosphere that consisted mostly of reading, writing, and arithmetic. The tests accomplished in large part exactly what they set out to. The unfortunate thing, however, was that the idea of "I.Q." (which was actually just a mathematical ratio) became associated in our minds with a singular concept of intelligence. We practically equated the words "intelligence" and "I.Q." as though intelligence were as simple as a one number score on a pen and paper test.

Though the notion of intelligence as a singular quantitative entity caught hold in the public lingo, other psychologists began to question this definition of intelligence. Wasn't intelligence a broader, more inclusive concept? To answer this question, in 1921 the Journal of Educational Psychology held a symposium. Therein, seventeen leading experts offered interpretations of the word "intelligence" ranging from "general modifiability of the nervous system" (Pinter) to "good response from the point of view of truth" (Thorndike). After the symposium, some extended the psychometric approach, such as Charles Spearman, who continued to look for the essence of the single unitary intellectual ability he called "G" for "general capacity."

Many, however, sought to broaden the definition of intelligence to encompass more human skills and experiences. They thought that the one-dimensional percep-

tion of intelligence was extremely limiting. A few of the criticisms of psychometric intelligence tests include:

1. Though such tests do predict school performance, they do not adequately predict life outcomes (McClelland 1973).

2. They do not take into account enough racial, economic, and personality factors (Kaplan 1985; Oakland & Parmelee 1985; Zigler & Seitz 1982).

3. Public opinion summaries of the prototypically intelligent person expect very different types of cognitive skills for different age groups, so intelligence cannot be limited to one set of skills (see Siegler and Richards 1982).

4. Two people may be considered very intelligent by the general public even though their traits are extremely dissimilar (Neisser 1979).

5. Social-cultural contexts demonstrate that what in one environment would be intelligent, in another would be irrelevant (Sternberg 1985).

Attempting to truly expand the definition of intelligence, a number of psychologists put forth models of multi-dimensional intelligences. One of the most ambitious, J.P. Guilford, extensively identified one hundred eighty unique cognitive factors in the "structure of the intellect" (Guilford 1988). An approach this detailed, however, has been criticized as simply too complex for most ordinary applications.

In 1983, Howard Gardner of Harvard offered his distinctive theory of seven Multiple Intelligences in the book Frames of Mind. (Discussion was continued in the books Multiple Intelligences (1993) and The Unschooled Mind (1991)). What sets Gardner's model apart is the unique set of criteria he used in its development. Gardner had been working with many retarded, exceptional, autistic, and brain-damaged subjects. In addition to these, he also noted culture differences in cognition and even diverse animal cognition. He noticed that certain cognitive capacities seemed to operate separately in the brain and that brain damage which destroyed, verbal ability, for example, did not necessarily destroy musical or spatial ability. Physical or athletic prowess did not involve the same information-processing sensitivities needed for musical intelligence. An idiot savant with little self-awareness or judgment might in fact retain amazing numerical abilities. Also, training in one "intelligent" skill area does not necessarily improve performance in another any more than learning vocabulary words teaches someone to draw.

Gardner looked at a variety of skills, capacities, and aptitudes before concluding that at least seven seemed to operate with relative independence from each other, and these he named the Seven Intelligences (the following pages include profiles of each): verbal/linguistic, logical/mathematical, visual/spatial, musical/rhythmic, body/kines-

thetic, interpersonal, and personal (Gardner 1993). Gardner asserted that while some school performance will depend greatly on the traditional linguistic and logical intelligences, post-schooling success, career competency, and happiness probably depends as much or more on the use of the other intelligences. All of these satisfied Gardner's overall description of intelligence: "the ability to solve problems or...fashion products... valued in one or more cultural or community setting" (Gardner 1993). He expressed his hope this way:

> Once we begin to try to assess other kinds of intelligences directly, I am confidant that particular students will reveal strengths in quite different areas, and the notion of general brightness will disappear or become greatly attenuated
> (ibid).

Influencing Kids by Using the Multiple Intelligence Model

So how can Gardner's model be applied by teachers and parents? First, Gardner proposes that we follow two propositions (Gardner 1993).

1) Instead of...pretending that all individuals have (or ought to have) the same kinds of minds, we should...try to ensure that everyone receive an education that maximizes his or her own intellectual potential.

In effect: We shouldn't demand that all students conform to a certain definition of intelligence or capacity. It isn't necessary for everyone to have identical minds and ways of thinking and reasoning.

2) It may once have been true that a dedicated individual could master the world's extant knowledge...now, however, no individual can master even a single body of knowledge completely.

In today's world where specialization is a foregone conclusion, it may be helpful to focus early on a child's individual strengths as a potential way to contribute to society, rather than forcing him or her to follow only the verbal/mathematical traditions until age eighteen. Not all students have to follow the same instruction patterns to be bright and capable of contributing in a valuable way to society.

What do children need, then, to direct their individual intelligences toward a meaningful contribution to society? Gardner says three things must be accomplished.

- The child's unique blend of preferences within the intelligences must be assessed.
- They must be matched with adequate complimentary curriculum.

- They must be matched with the educational opportunities for the broader community.

Following these steps, let's consider an imaginary child named Isabel. For the past two terms, while studying fractions and then pre-algebra, Isabel has received C's in math. Math classes at her school are based primarily on lectured explanations from the teacher at the chalkboard and reading chapters and answering questions about them. No one expects Isabel to do well at math because there don't seem to be any signs of her mathematical reasoning proficiency. In traditional school approaches to intelligence, the teacher and/or parents would simply assume that Isabel is "below-average," and be content with her present level of performance.

But how could that be reversed in a Multiple Intelligence approach? One day, while on a field trip to a children's hands on museum, (Gardner highly encourages frequent and varied excursions out into the community context) the teacher notices that Isabel constantly hovers around a big puzzle board with different sized interlocking foam blocks. She is much faster than the other children in seeing the spatial relations and fitting together the puzzle. The teacher also remembers that Isabel in her spare time likes to draw buildings from various perspectives. Both of these preferences seem to indicate that Isabel has a high degree of spatial intelligence, and is able to judge relationships between objects with accuracy.

Having made a preliminary assessment of Isabel's preferred intelligence, the teacher then has the wonderful opportunity both to enhance Isabel's capacities in that sphere, and also to use Isabel's preferred spatial learning style to teach other necessary concepts such as math. Such enhancement is what is meant by creating complimentary curriculum. To build upon Isabel's spatial intelligence, this teacher might first want to encourage Isabel's drawing and puzzle solving, and let her parents know that she shows promise in spatial cognitive tasks. Then perhaps Isabel could be introduced (through class integration or simply by her parents) to visual or hands-on teaching aids utilizing relationships between objects. She might be encouraged to produce drawings or moldings as projects instead of writing written responses.

Next, so that Isabel could master important concepts in other intelligence domains like math, the teacher might teach fractions by actually letting Isabel cut up a pie in class, and dividing and combining the pieces in various ratios. The teacher might also use more geometric figures to illustrate the algebraic concepts, since this will appeal to the visual, spatial learning style which is natural for Isabel.

Additionally, Isabel's teacher and parents will want to expose her to all sorts of matching community roles and professions which demand spatial intelligence. They might take her to tour buildings and talk with architects. They might enroll her in art classes, in which she can develop a portfolio of her own creations and be proud of her

own creative progress and individual intelligence. She might explore map-making, surveying, and graphic design with computers.

If Isabel's spatial intelligence is assessed, it can be matched with curriculum and with community roles to prepare her for not only a more successful academic environment, but also a valuable place in society. That is the goal of focusing on Multiple Intelligences — so that teachers can personalize their teaching and guidance for maximum student potential. A kinesthetic learner might be taught history with a dance or physical war game instead of with verbal readings. An interpersonal learner might learn her grammar by working on assignments in a team relationship with other students. And so forth every child has at least one identified intelligence that can be used productively in the learning process.

Effects on Beliefs

An understanding of Multiple Intelligences can change students' beliefs about their abilities to learn. School curriculums typically focus on verbal and logical intelligences. Students who are not strong in these areas often struggle in school. They may believe they are not as smart as other students. Once this conclusion is reached, it is often used by an individual to estimate how well he or she will do on any learning task. The actual quality of learning is then affected not by real ability but by the student's estimate of his or her ability.

However, if students understand Multiple Intelligences, they can recognize areas in which they are talented. They may also realize that school is an artificial environment because it requires ability in a limited number of intelligences; the real world involves many more of the intelligences. They can come to understand that they have the abilities to learn and excel in other areas and careers.

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LEARNING ACTIVITIES: MULTIPLE INTELLIGENCES

OBJECTIVE: Teach your students what the Seven Intelligences are, which ones they need to develop, and how to use them to be a better learners.

MATERIALS: Copies of: Diagram 7-1 (p. 109), Diagram 7-2 (p. 110), "Seven Intelligences" sheet (p. 111), "Self-Report Card" sheet (p. 112), "Multiple Intelligences Focus Log" (p. 113); balloons, yarn, pipe cleaners, tape, and construction paper.

Activity #1

Check off assignments from the last lesson. Allow students time to talk about what they did and what they learned.

Activity #2

Give the following introduction.

Questions

Who is more intelligent: a great artist who is bad at math or a great mathematician who cannot draw? What about a person who relates very well with others but is not a good writer, or a great writer who cannot relate to people? Does it take intelligence to be able to draw or relate to others?

Explain

The world used to believe that intelligence or smartness was something that could be measured and scored on a test. Intelligence was like the mercury in a thermometer; you were either hot, average, or cold. Now, people realize that intelligence is much more complex. It turns out that there are many different areas where people can be intelligent. This new idea, that people can be intelligent in many areas, is called Multiple Intelligences.

Activity #3

Remind students that the cerebral cortex is the outer part of the brain. It is the most complex part of the brain and is what separates humans from other animals. We used to believe that it was pretty much the same everywhere, which was why we believed that intelligence was just one general thing. Now we understand that different areas of the cerebral cortex serve different functions. Researchers have identified four major areas or lobes of the cerebral cortex. Each lobe has a different function.

Pass out Diagrams 7-1 & 7-2 on pages 109-110. These two diagrams describe the characteristics and location of the four lobes.

Explain

Individual brains have more advanced and less advanced areas. As a result, the advanced areas will serve advanced functions. For example, if the specific area of your brain that deals with use of words is advanced, then you will be good at using words. Every individual will have areas in which he or she is more intelligent or gifted because of the more advanced parts of the brain. When we say there are "Multiple Intelligences," we mean that there are many different areas of the brain that have specific functions. Some of these areas are going to be more advanced than others. Howard Gardner's research has revealed Seven Intelligences. These are seven areas where we vary in amount of "intelligence" the current level at which our brains function. This does not mean that these are the only areas, but they are seven basic ones. All of the intelligences are equally important.

Pass out the "Seven Intelligences" sheet on page 111. You may also want to display a prepared poster while you talk about and explain each intelligence.

Activity #4

Hand out the "Self-Report Cards" on page 112. Students should record information about themselves related to each intelligence. This activity should help students become aware of the capacities they already have.

Activity #5

Have students face forward and simultaneously repeat the alphabet and count — 1, A, 2, B, 3, C, etc. Now, have students face a neighbor and do the same thing. Next, have them close their eyes and contemplate the numbers and letters as they repeat them. Then, have the students visualize each number and letter as they do it. Have them keep visualizing, but now add a rhythm to the repetition. Finally, add a finger snap or clap to the rhythm. Tell students they have just used all Seven Intelligences at once.

Activity #6

Give the following introduction: The Smithsonian Institute has asked our class to make a display of a creature known as the Pugalug. You are to design your display following the details of the two surviving accounts of the creature. The first account is taken from the diary of the great biologist, Charles Darnit, who witnessed the creature while on an expedition into the rain forests of Borneo on June 7, 1852.

Read the following story.

> Today while studying the complex social behavior of the Lesser Brown Striped Log Dwelling Nocturnus Mushroom, I caught a glimpse of a most fascinating creature. This creature, which I have named Charles' Greater Plug Resembling Fuzziful Lug-nut Nose Bearing Iguana, or Pugalug for short, is unlike anything I have yet witnessed. I temporarily classified it as an iguana, not because it particularly resembles an iguana but because "Iguana" follows "Nose Bearing" rather nicely. My best description of the Pugalug is as follows: It was multi-colored, it was low to the ground, it had a round, bloated belly, and its head and tail were located at opposite ends of its body. Due to the short nature of the encounter I can give no better description than this except that soon after it left, I heard a high, warbling whistle ring through the forest followed by a series of deep grunts.

The second account is a testimony given during Farmer Brown's trial by Farmer Brown himself. Although some have questioned the validity of this account, the Smithsonian has found no basis for doubt.

Read the following dialogue.

> Excerpt from Farmer Brown's trial, Aug. 5, 1813:
> Lawyer: Farmer Brown, could you please tell us your account of what happened the night of July 15th?
> Farmer Brown: I have already told you a hundred times. What, are you, dense? Why, my cows could have the story memorized by now. Do you have chicken feed in that head of yours or what?
> Lawyer: Please Mr. Brown, could you just tell the story to the court.
> Farmer Brown: Okay. Okay. On the night of July 15th I had just finished a days work — a real days work, not a day trying to muddle people's minds with twisted laws and rules and regulations and . . . well, anyway, I went to bed. Then I woke up to this high-pitched whistle. I figured it was that darn factory again. I tried to roll over, but then I heard this deep grunting and I thought, "One of the cows is having her baby, probably Betsy. She always has to have 'em in the middle of night." So I grabbed the lantern and headed out to the field. And there, to my great astonishment, I saw a herd of these colorful little creatures with tails. They was whistlin' and gruntin' up a storm. So I just sat and watched 'em. There seemed to be something familiar about them. Something wrong. Then it hit me: Thems creatures are made out of pipe cleaners! Pipe cleaners just like the ones they make at the factory over there. The same factory that's trying to put me out of business so they can take my land. The land my father gave me. The land his father gave him. Now my mind was really racing. These creatures must be mutants from the factory

and the factory wants my land so they can grow more and use them to take over the world or something. Once I realized this, there was only one thing left to do, and well, I'm sure you all know the rest of the story.

Divide the class into small groups again. Each group should make a Pugalug out of the balloons, yarn, pipe cleaners, construction paper, and tape provided. They should also reproduce its call.

During the activity, students should identify the intelligences that they are using. The purpose of these activities is to help students integrate the intelligences and use them more effectively.

Questions

Which intelligences are easiest for you to use? Which ones are harder? Why is it good to use more than one? How could you use Multiple Intelligences to help you learn math better? How could you use Multiple Intelligences to help you learn reading and writing better?

Closure

During the first class, students stated what they believed about being smart. Ask them about this belief again. When they think of "smartness," of what intelligences do they think? Do they consider having a lot of kinesthetic intelligence to be a part "smartness"? Explain that the brain becomes more effective by making connections between its different parts. Using Multiple Intelligences to learn is a way to integrate different parts of the brain so that as a whole, it becomes more powerful. We can be "cooking on more burners," so to speak.

Assignment

Keep the "Multiple Intelligences Focus Log" on page 113 for a week.

DIAGRAM 7-1

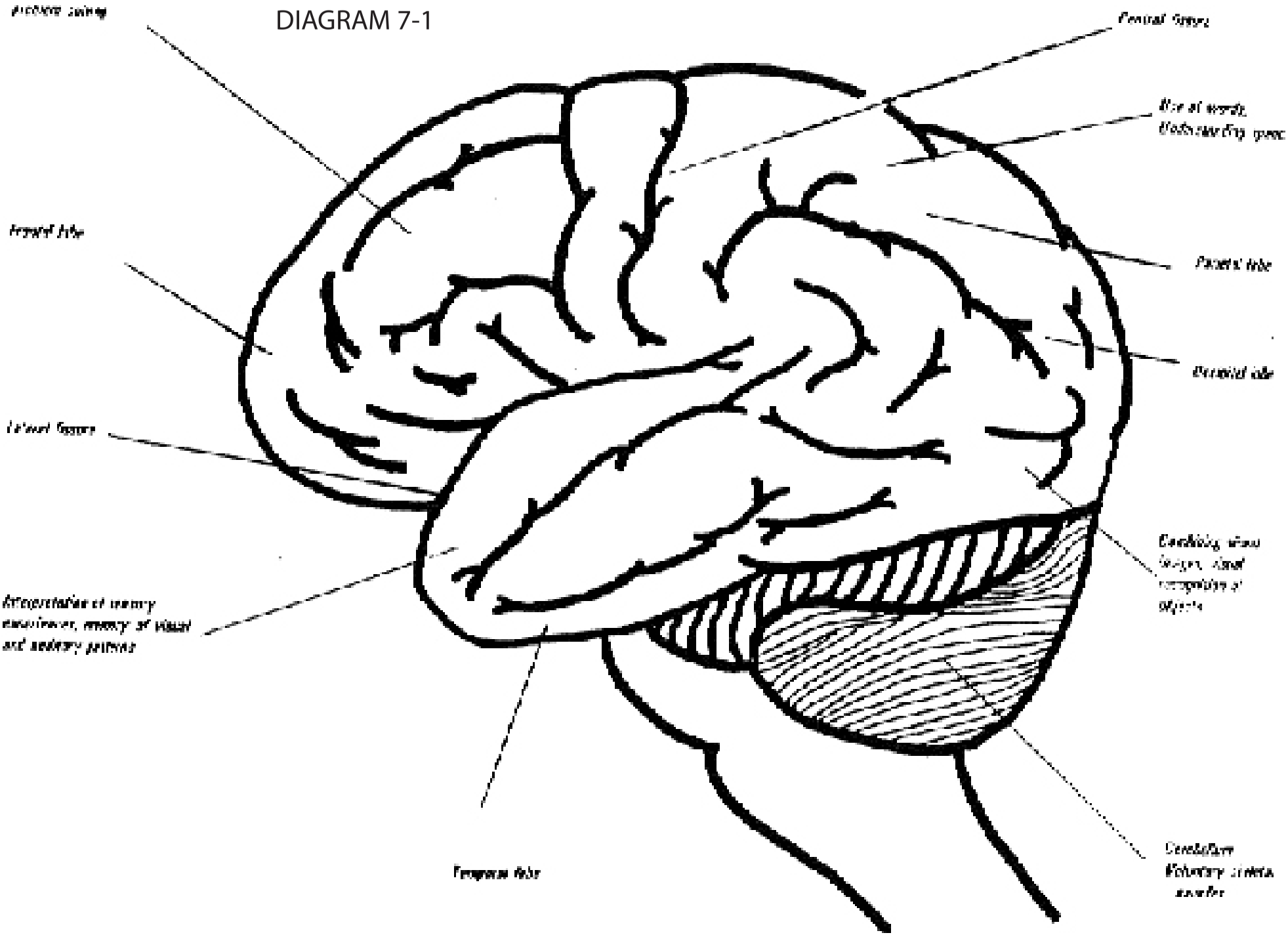

DIAGRAM 7-2

Frontal Lobes	Motor areas control movements of voluntary skeletal muscles. Association areas carry on higher intellectual processes such as those required for concentration, planning, complex problem-solving, and judging the consequences of behavior.
Parietal Lobes	Sensory areas are responsible for the sensations of temperature, touch, pressure, and pain from the skin. Association areas function in understanding speech and in using words to express thoughts and feelings.
Temporal Lobes	Sensory areas are responsible for hearing. Association areas are used in the interpretation of sensory experiences and in the memory of visual scenes, music, and other complex sensory patterns.
Occipital Lobes	Sensory areas are responsible for vision. Association areas function in combining visual images with other sensory experiences.

Seven Intelligences

o VERBAL/LINGUISTIC
This intelligence deals with words and language, both written and spoken.

o MUSICAL/RHYTHMIC
This intelligence deals with the recognition of tonal patterns, including various environmental sounds, and a sensitivity to rhythm and beats.

o LOGICAL/MATHEMATICAL
Often called scientific thinking, this intelligence deals with deductive thinking/reasoning, numbers, and the recognition of abstract patterns.

o VISUAL/SPATIAL
This intelligence deals with the sense of sight and being able to visualize an object and create mental images/pictures.

o BODY/KINESTHETIC
This intelligence deals with physical movement and the knowledge or wisdom of the body, including the brain's motor cortex, which controls bodily motion.

o INTRAPERSONAL
This intelligence deals with inner states of being, self-reflection, Metacognition, and awareness of spiritual realities.

o INTERPERSONAL
This intelligence operates primarily through person-to-person relationships and communication. It relies on all the other intelligences.

Self-Report Card

Write information about yourself after each intelligence, such as, "I play the guitar well," next to Musical/Rhythmic.

1. Verbal/Linguistic

2. Musical/Rhythmic

3. Logical/Mathematical

4. Visual/Spatial

5. Body/Kinesthetic

6. Intrapersonal

7. Interpersonal

Multiple Intelligences focus log

Assignment: Pick one intelligence to focus on each day for a week. Be aware of when you use the intelligence of the day, how you use it, and how easy it is for you to use it. Each night, write an entry in the log which describes your thoughts about using the intelligence of the day. Bring the log to the next class.

DAY ONE

DAY TWO

DAY THREE

DAY FOUR

DAY FIVE

DAY SIX

DAY SEVEN

Mind Mapping: Using Symbols

At birth, the human brain has many more neurons (cells) than it is going to need to be fully organized. Normal infants are born prepared to cope with early injury and development which will take place in the next fifteen to twenty years. One part of this development is the formation of connections between cells. The more elaborate systems of connections make more effective and intelligent brains.

Connections are formed as a natural part of development and can be seen in the brain's ability to move from simple to more complex functions as it matures. In addition, medical scientists believe that stimulation and activity promote brain development not just through childhood and adolescence, but throughout life. The process of aging in people over sixty-five, for instance, accelerates when mental activity is reduced by disengaging from the environment.

In the ordinary course of development, the increased complexity of connections makes it possible for the brain to work faster and complete more complex tasks. For instance, the brain develops symbol systems because it is faster to think in symbols than in separate or isolated bits of information.

Jerome Bruner, a developmental psychologist, describes the initial part of this process as "representational thought," or how the brain represents internally what exists externally:

- enactive representation: children's first representations of external objects (people); demonstrated in body imitation where they "act out" what they see.
- iconic representation: the appearance of the ability to visualize an image.
- symbolic representation: a single mental event represents or symbolizes a much more complex and abstract set of ideas, activities, or other mental operations.

A word, for example, is a symbol. Our spoken and written language is a symbol system because each word represents some external information (object or objects). Other familiar examples of symbols or symbol systems include math symbols where a single symbol (+,÷, ∫, -, x) represents a more complex multi-step process. Other examples of symbols include religious or civil ceremonies, statues, and memorials.

The use of symbols is the brain's way of accelerating its abilities. This is a natural process coincident with maturation. Similar to other mental skills, there are many indi-

vidual differences. Some students have an easier affinity with symbols while others are more likely to have difficulty. And, like many other mental abilities, every student can enhance his or her ability with training.

Children Are Ready To Use Symbols in Learning

Until recently, most psychologists took the perspective of famous child development researcher Piaget that children begin to use symbolic representations only when they reach approximately eighteen to twenty-four months of age and can interact with the outside world through actions: physically moving, imitating, or play-imagining with objects (Bjorkland 1995).

In recent years, however, considerable evidence has surfaced that even small infants have the rudimentary skills necessary for symbolic understanding and that in the first few years of life, symbolic understanding develops much more rapidly than previously thought. The implication is that it is human nature to seek for and use symbolic representations in our cognitive processes.

Preparation from Infancy

Even the newest infants can integrate information from different physical senses into a single representation, a cognitive behavior sometimes referred to as "intermodal mapping," which facilitates the multi-dimensional nature of symbolic thought. Two examples illustrate how babies integrate stimuli. First, infants only two to twenty-one days old are already capable of the enactive (bodily imitation) representation mentioned earlier — which Bruner said was the first stage of symbolic thought. In contrast with Piaget's (1962) original assumption that children could not imitate facial expressions until twelve months of age, Meltzoff and Moore (1983, 1985) have demonstrated facial imitation in babies two to twenty-one days old who open and close their mouths, or stick out their tongues after seeing the same done by an adult experimenter. Second, four-month-old infants can appropriately match sounds with visual displays, as in the experiment in which children were shown movies on two screens. One screen showed a woman playing peekaboo, the other showed a hand drumming. A sound track was played for only one of the displays, and the infants spent more time watching the appropriate visual display (Spelke 1976).

Besides being able to integrate multi-sensory information, by four months of age, infants already have a grasp on the reality of the permanence of tangible physical objects. They show surprise (through heart rate and extended staring) when researchers manipulate objects to show an "impossible event" (such as one object passing through another one without collision) (Baillargeon & De Vos 1991). This understanding of object permanence apparently extends early on to an infant's understanding of basic number concepts, which is in itself a building block of symbolic thought. Five-month-old babies were shown a toy which was then hidden by a screen, and then saw

experimenters placing another toy behind the screen before lowering the screen. The babies demonstrated a rudimentary understanding of number concepts (i.e., 1+1=2), because they did not stare unusually long when the two toys appeared together as they expected. Indeed, in cases where the lowered screen revealed only one toy instead of the expected two, infants stared much longer, presumably in surprise over the unexpected outcome. Babies were also shown (2-1=1) and stared in surprise when a removed screen showed more or less than the single toy they expected to remain (Wynn 1992).

Children's Early Symbol Use

Judy DeLoach and her colleagues (1987, 1991) have shown that two- to three-year-old children understand that one thing can represent another. In DeLoach's experiments, children were asked to find a toy in a room. First, however, they were shown a representation of both the toy and the room, either in the form of pictures, or in the form of a miniature model. For example, if the real toy were hidden under the desk in the room, then children would be shown either a picture of a toy under a desk, or a miniature replica of the toy placed in a scale model of the room.

Upon being shown the hidden location either with the photo or miniature toy, three-year-olds successfully used the representation to find the real hidden toy. This capacity is the forerunner of more complex cognitive ability to recognize and create symbolic representations in such things as maps and art. The two-and-a-half-year-olds demonstrated a developing capacity, for although they could not successfully use the scale model to find the real toy, they did recognize and utilize the photo of the toy to find the real one.

Children's natural and early symbolic capacity develops even long before we are taught reading, writing, and outlining skills, and therefore can be a valuable tool, especially for students who may still favor early-developed visual and symbolic skills over school-trained linear and analytic ones.

Using Symbols in Addition to Linear Thinking

For a long time, psychologists believed that we thought in linear patterns, that our thoughts moved in an orderly progression from A to B to C. They believed this because most of our recorded thoughts followed this fashion: words are spoken one at a time in logical sentences, and we write usually in straight lines, either left to right, right to left, or up to down (as in Chinese culture). Because language and writing appeared to follow a straight sequence, they assumed we must and should think in the same way. Schools, then, idealized this sort of straight linear thought by teaching us that the best way to mentally digest new information would be to organize it into an outline: a series of Roman numerals, headings, subheadings, etc.

The problem with this traditional school method, though undoubtedly useful for many specific tasks, is that most of us don't think that way naturally. In fact, rather than

following a laid out thought pattern, the brain most often works primarily with associated concepts, clustered together in an interlinked, integrated manner. Neural networks are complex and circuitous. We tend to think in flashes of visual images and quick related clusters of ideas that our brain has stored all together as potentially relevant to one another. Hence, if we limit our notetaking and brainstorming to a linear outline form, we fail to take advantage of the brain's marvelous capacity to create neural networks of loosely associated items. When we access this mental capacity, our creative output will be greater. Also, when we turn abstract ideas into visual representations, the result can be magical. This happens because more space in our brains is devoted to the visual sense than to any other (Swede 1993).

Mind Mapping Uses Symbols To Enhance Learning

Mind Mapping is a learning and retention strategy that utilizes the brain's natural ability with symbols. In addition, it is a technique which integrates many parts of the brain's operations while helping students organize large quantities of information. In that sense it is a powerful learning technique as well as an activity which promotes cognitive growth.

Most students learn by one basic way of organizing and thinking about information: the "outline." Students usually use outlines to take notes, to organize a research paper, to understand a textbook chapter, and to think in a logical, sequential manner. This method works well for some students (left brain, verbal/linguistic, logical/mathematical students) but not for others.

Mind Mapping is a technique for organizing information that uses both sides of the brain. It invites use of all Learning Modalities and employs more of the Multiple Intelligences. Mind Mapping encourages students to use symbols. In the case of Mind Mapping, symbols require the brain to integrate other information such as a visual image, an emotional response, and written words. Integrating these into a symbol system stimulates the brain to use higher level functions. For this reason, mental abilities are improved through use of the Mind Mapping System.

Students who learn to use the Mind Mapping technique can benefit by having an alternative to outlining. For certain students, a Mind Map will work far better than an outline. Students may be more interested in using it because it is creative and unusual.

Here is how students can create a mind map instead of an outline to represent concepts. (A summary of mind map basics is included in the activity section.) Start with a large sheet of paper laid length-wise, and a lot of colored markers. In the center of the page chose a visual way to represent the main idea or topic you want to display. Have fun with the colors. Most ideas can be represented by simple and fun pictures or images but when specific names or words are needed, a single word may be placed alongside an image.

Next, branching out from the central topic, draw connecting lines and then start smaller representations to show whatever free associations your mind makes when thinking about the central topic. In this way sub-topics, side points, or surrounding issues will be simply and visually connected to the center and perhaps to each other in meaningful and memorable ways. When needed, write a few meaningful key words on attached branches. There are no concrete rules about mind mapping, so experiment with ways to show relationships between concepts and images.

This Mind Mapping approach has provided the following distinct advantages to students (from Buzan chapter 4, section B: "Mind Maps for Recall and Creative Thinking").

- Maps show clearly the main topic, which is always in the center
- Maps reinforce the relative importance of subordinate ideas and tangents (most relevant toward the center, distantly related and incidental ideas near the edge)
- Key links between concepts can be immediately recognized by proximity and connection
- Always easy to add new information
- Different topics will have entirely dissimilar maps which will aid students in recalling a specific lesson or topic
- In more creative areas of note-taking (like essay preparation), the open-ended nature of the map enables the brain to form connections more rapidly
- Mind Maps use the whole brain not just left side
- Many children will find working with images and colors more fun!

Effects on Beliefs

Making a Mind Map helps students organize large quantities of information for better retention and better achievement. If the Mind Map helps a student to be more successful at something, then that resulting success may change his or her beliefs by increasing optimism and confidence. Sometimes just one successful experience can change a student's opinion about his or her learning abilities.

Mind Mapping gives teachers an alternative way to help students retain information while helping them apply the concept of symbols. Some students who cannot otherwise recall sufficient information to have adequate reading comprehension, for example, will be successful with Mind Mapping. Mind Mapping gives teachers an addi-

tional tool to add variety to their instruction and more adequately respond to a student who may have difficulty learning.

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LEARNING ACTIVITIES: MIND MAPPING

OBJECTIVE: Teach your students the Mind Map basics, how to use Mind Maps to organize information, and specific ways Mind Maps can be used in school. They should draw two Mind Maps during class.

MATERIALS: Copies of: "Mind Map Basics" (p. 124) example Mind Maps (pp. 125-126), "Mind Mapping Assignment" (p. 127); dry erase board with colored markers or some large sheets of white paper, unlined legal size paper, and markers (broad and fine tip).

Activity #1

Check off assignments from last class. Allow students time to talk about what they did and what they learned.

Activity #2

Draw some symbols on the board (9 ☠ ☺ ☯ ∞ ♥ ≥ # $ %). Ask students to guess what the symbols represent. Next, have each student invent and draw five symbols. Have everyone guess what each student's symbols represent. Talk about other symbols we use.

Explain

Today, you will learn a specific way of using symbols for organizing information, taking notes, planning projects, writing papers and other things. It's called Mind Mapping.

Activity #3

Hand out copies of "Mind Map Basics" on page 124 or write them on the board. Draw a Mind Map (which describes you) on a dry erase board or on a large sheet of paper. (See Example Mind Map #1 on page 125.) As you draw, explain what you are doing. Also, explain that you do not have to be a good artist to make a good Mind Map.

Mind Map Basics

- Use a central image — simple but fun and representative of the main idea
- Use lots of smaller images — simple, colorful, meaningful, and memorable
- Branch out — lines branch out from a main idea to sub-ideas
- Use key words — few and meaningful

•Use colors — relates ideas, enhances images, improves appearance

•Include all ideas — draw what comes to mind using free association

Activity #4

Pass out markers and unlined paper. Have students draw a Mind Map which describes themselves. (Divide the class into small groups which can share materials.)

When they finish, have the students demonstrate to you (or to another student) how they used the Mind Map Basics.

Activity #5

Question

What is the advantage of using Mind Maps instead of just writing a list, an outline, or taking notes?

Mind Map the responses. Use something related to "Why Use Mind Maps" or "Advantages of Mind Maps" as the central image. (See "Example Mind Map #2" on page 126.)

Some Advantages of Mind Maps

•Mind Maps use the whole brain — not just left side

•Mind Maps are fun

•Mind Map images are more memorable than the words in an outline

•Mind Maps, like our brains, are non-linear. Ideas do not come from our brain in an A, B, C, or 1, 2, 3, manner.

•Mind Maps are quicker and easier than an outline

•Mind Maps can help you organize information effectively by helping you see an overview of the information and connections between ideas

Demonstrate the last advantage by using dashed lines, arrows, or circles to show connections between advantages.

Activity #6

Have students read and draw a Mind Map of a short (one page) story you have selected. Ask them to demonstrate the Mind Mapping Basics, using dashed lines, arrows, or circles to show connections between ideas.

Activity #7

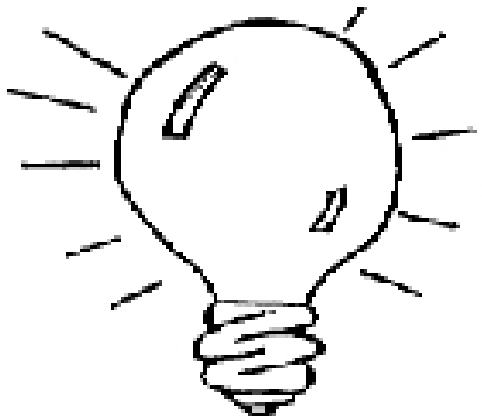
Have students draw mind maps of "The Uses for Mind Maps": note taking, writing papers, studying, reading a textbook, brainstorming, and planning projects.

Closure

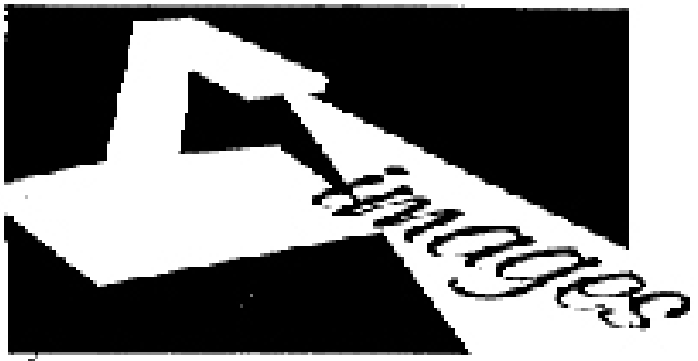
Explain that Mind Mapping is a tool you can use to improve your learning. The only way to find out if Mind Mapping will work for you is to try it. You may find that Mind Mapping does wonders for you. Also, explain that because Mind Maps use symbols, they stimulate the more complex levels of your brain. This results in higher-level thinking and greater knowledge.

Assignment

Hand out the"Mind Mapping" assignment sheet on page 127.



ideas

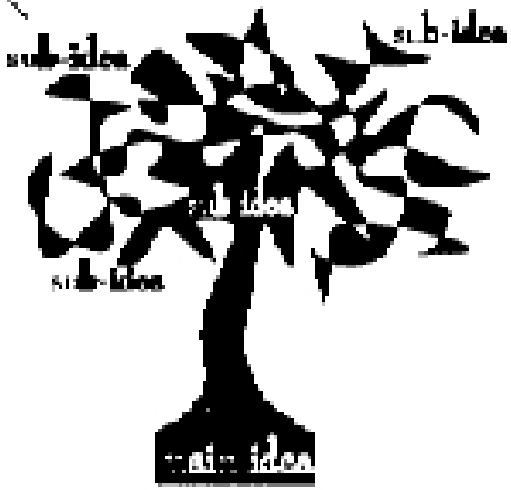


Mind Map Basics

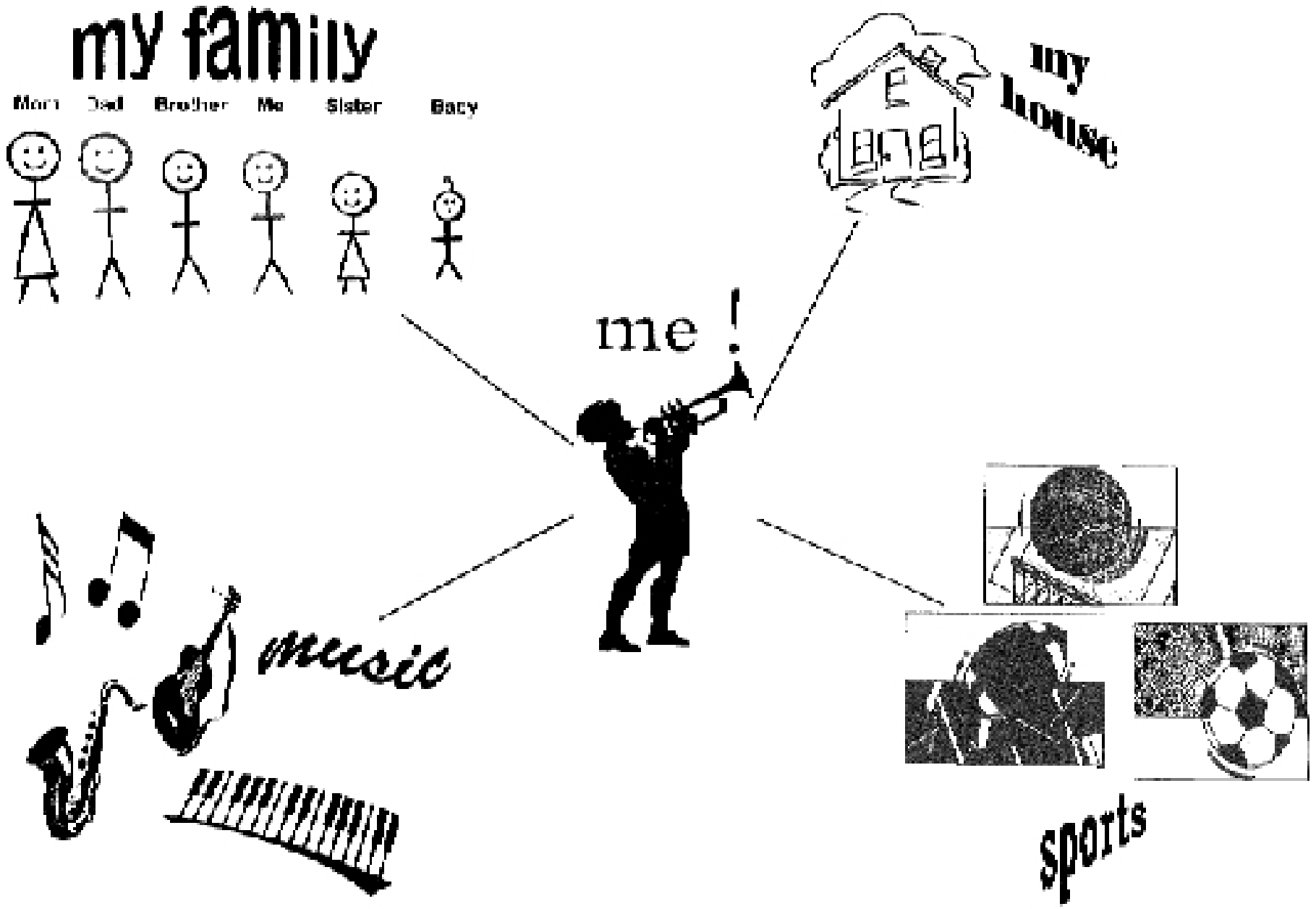
COLORS

key words

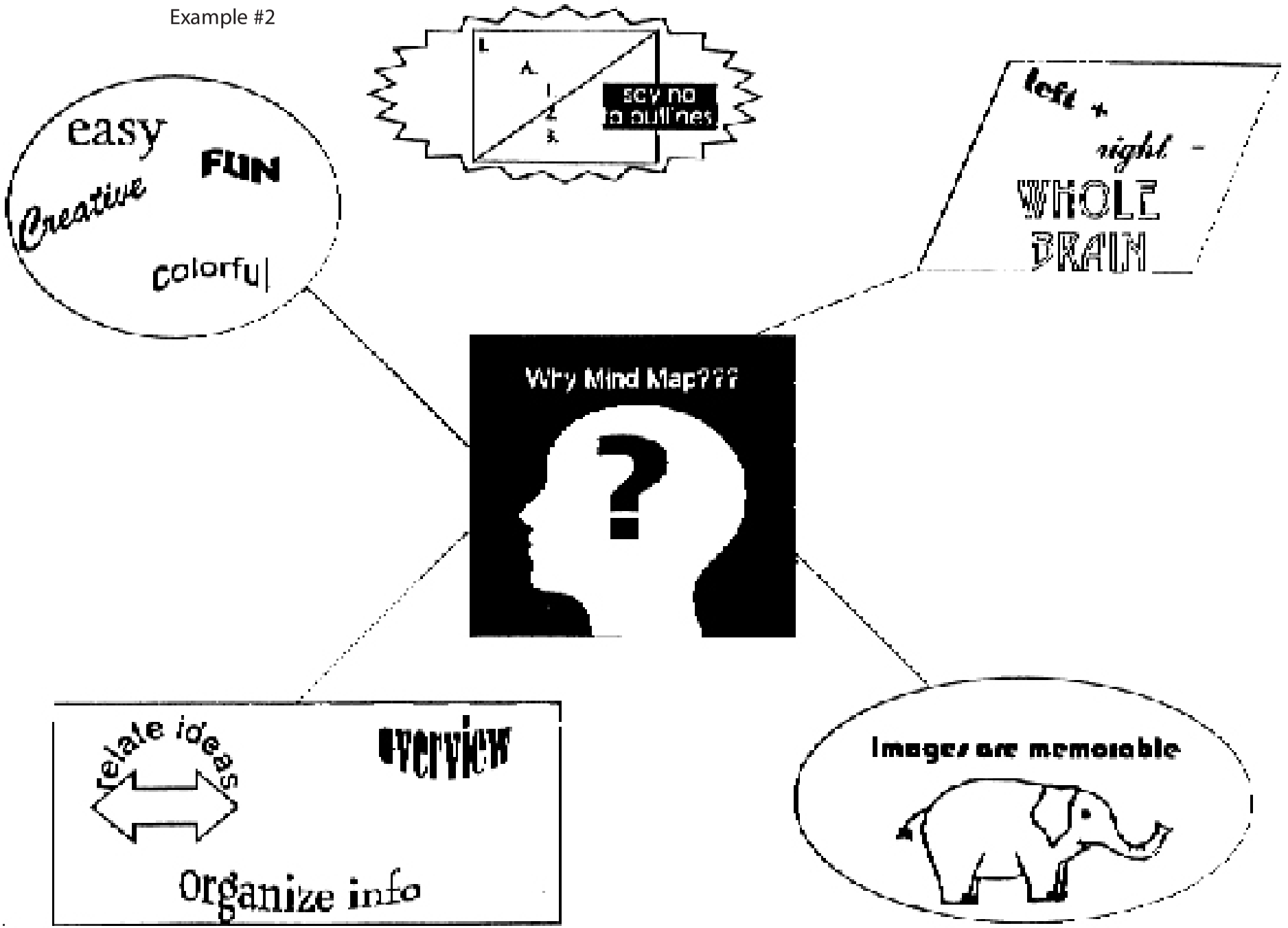
branch out!



Example #1


my family
Mom
Dad
Brother
Me
Sister
Baby
my house
me !
music
sports

Example #2


easy
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to outlines
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WHOLE
BRAIN
Why Mind Map???
?
relate ideas
overview
Organize info
Images are memorable

Mind Mapping Assignment

Assignment: Use a Mind Map in any of the following ways:

(1) To take notes

(2) To organize information from a reading assignment

(3) To plan out a paper, or any activity (such as a family trip, activity with friends, a date, etc.)

Creativity

Creativity is often thought of as an inherited gift bestowed upon a few special people. It is also thought of as the ability to do something unique or unusual. In reality, creativity is a function of the brain just like logic or memory. However, it is a higher-level function because it results from the brain's integrative functions. Researchers have discovered several locations where networks of cells exist simply for the purpose of integrating or combining the brain's functions.

Every healthy person can combine sound, smell, vision and other senses with thought and action commands such as movement or speech. Since it is natural, we often take this process for granted. For some individuals, especially those we consider very creative, these integration or association areas of the brain are enhanced so they play a major rather than basic role in human thought.

The creative process involves the use of acquired factual knowledge (fluent, flexible, original, and elaborate thinking) and intuition. All of these functions can be developed, even though our brains vary in their natural abilities to perform them.

In our effort to teach we sometimes neglect creativity because creativity is often difficult to judge and to grade. However, it is important enough that it should be considered an outcome of education. For example, students will benefit from learning the creative process. Students who can think creatively have an advantage in the real world which continually demands new solutions, insights, methods, points of view, and ways of behaving. The real world is a very different atmosphere from a classroom which usually demands only the regurgitation of given facts.

Many teachers, as well as students, can remember times when a demonstration of creativity appeared to be contrary to class rules and was stifled instead of rewarded. When this happens, it is typically a signal that the classroom environment is not organized to promote creativity as a learning outcome. It is one of those mental abilities which has lasting positive possibilities because it improves a person's ability to develop the operations of their brain.

Creativity is a mental process that can be recognized and used under a variety of conditions. As such, any time a person is using it, the process can be self-observed, evaluated, and strategically employed. For example, sometimes writers feel like their creative ideas seem to flow onto the page. An artist may describe the "knome of the brush" when it seems like the painting is the result of his hand movements rather than of logical thought. Studies of creativity describe how people can give their brains parts of a complex problem and go on to another task while the brain appears to be working on the solution by itself.

Such experiences are so rewarding for people who have them that they are highly protected and valued. Biographies of certain creative people report that they thought this mental process was a gift from God and often lived in fear that it would disappear. Many thought they only had so much of it and worked frantically to make the best use of it while it still lasted.

Creativity is a mental process which appears to have a life of its own and produces some of the greatest rewards life has to offer. This should mean to us that teaching creativity increases the reward value of learning.

Important Ideas from Research on Creativity

Before talking about some factors of the creative process, let us emphasize that EVERYONE is capable of creativity. From infancy, we must discover new things to survive, and the brain's primary function is to create new associations and solutions daily. P. K. Engelmeier once asserted: "It would appear that genius is not at all a divine and rare gift...but is the destiny of everyone who has not been born a complete idiot" (Altshuller 1984).

Creativity expert Robert Weisberg, who has traced the origins of a wide range of creative accomplishments from the arts to sciences, rejects the view that most creative accomplishments are made by geniuses whose minds work in flashes of brilliant insight different from ordinary minds. His research demonstrates that whether painting or discovering DNA, the key is deliberately applying previously acquired knowledge — not depending on some mysterious, unobservable process. Creativity is a deliberate process.

Even if you consider yourself a very left-brained person, do not assume that limits your creativity. While the right brain does seem strongly associated with multi-context integration, it is not solely responsible for creativity. Every activity, verbal or visual, receives input from both sides of the brain (Myers 1982). In fact, artists who suffer brain injuries on the right side still continue to work, albeit with some reduced capacities (Corballis 1980).

Left-brain activities provide the base from which creativity can jump. As Weisberg said above, the process starts with previously acquired knowledge. Let's take an example (Ward, Finke & Smith 1995). College students were asked to design and draw an imaginative extraterrestrial — any life-form not known on earth. When the drawings were collected, nearly every one included familiar physical features such as eyes (located on a distinct head) and either two or four legs. Most were also symmetrical. The students had, almost without exception, begun by modifying or combining the familiar structures of animals on earth. Incidentally, almost all popular aliens from television and movies follow suit. Thus, structured imagination can provide a very useful starting point. It can, however, be a limitation also. In the above experiment, when

students were told that the alien should have feathers, they automatically included things like wings and beaks, and when told that the alien should be furry, they ignored the possibility of fins gills or wings.

An important element of creativity, then, can be the logical review in which we ask ourselves, "Does it have to be this way? Is this tradition or form or association necessary, or can it be changed?" The creative process can start with the simplest forms of Metacognition. Suspend your knowledge and doodle with visual forms before trying to interpret them. Or, take two wholly unrelated concepts and try to connect them in some fashion. Reviewers of the experiment above suggested, "sometimes, gloriously unpredictable novel ideas spring forth from combining even mundane words such as tree and car. What after all is a tree car?" (ibid).

Besides individual Metacognition, what circumstances contribute most positively to the development of creativity? Three significant aspects are:

(1) cooperative rather than competitive atmosphere.

(2) relaxed mental state.

(3) diligent patience over time.

Though certain individuals may find competitions a beneficial source of motivation for the creative process, most research points toward the conclusion that competition and extrinsic rewards are harmful to the quality of creative output. When subjects in one experiment were assigned to make paper collages or write poems, fostering competitions and offering external rewards actually reduced their creativity significantly (Amabile 1979, 1985). After reviewing hundreds of studies, researcher Alfie Kohn concluded that creativity is more likely to be achieved by individuals working in cooperative circumstances rather than competitive ones (Kohn 1986).

A possible reason for the desirability of non-competitive surroundings is the small but growing number of studies linking creativity with a relaxed mental state (Swede 1993). The billions of neurons in the brain are constantly emitting electrical energy. The amount and type of this energy varies depending on the brain's state of alertness. In other words, the more alert you are, the greater the electrical emission, as measured by an instrument called the EEG (electroencephalogram) and shown below (Graves & Schlesinger 1979):

Deep sleep:	1-4 cycles per second	delta waves
Dreaming/waking:	5-7 cycles per second	theta waves
Relaxed wakefulness:	8-13 cycles per second	alpha waves
Focused attention:	14+ cycles per second	beta waves

Though you might expect highest creative output to occur at moments of most-focused attention (beta waves), some scientists believe that the calm, yet alert state involving alpha waves is more conducive because the mind is aware of reality but roaming freely (Myers 1982).

Perhaps this is the reason for the familiar "writer's block" in which individuals under pressure and with desire and necessity to produce, feel their "creative juices" stifled. Many would agree that ideas came to them, not in the initial period of concentration, but in a relaxed moment afterward.

This reference to relaxation should not be unduly construed to undermine the importance of diligent application to a problem. In fact, without consistent effort and output, highly-creative results are not likely. A study of life-long creative contributors in many fields noted that over the years, the overall ratio of their major to minor accomplishments remained roughly the same. The years in which they produced the most creative contributions were simply the years in which they were putting out the most total work (Swede 1993). In other words, they didn't suddenly have inspiration that pushed them from mediocre creators to famed contributors. They just kept creating a lot until certain combinations or applications achieved the desired result.

In summary then, creativity is part of everyone's potential. If, over time and with considerable patience, we consciously strive to reevaluate the structure and knowledge we already possess, our capacity to creatively make new connections will increase.

Effects on Beliefs

Many students have misconceptions of what learning is because they are evaluated on the accumulation of content rather than on the demonstration of mental abilities. A typical student thinks that simple recall is a demonstration of "smartness." In this case, creativity is not related to "real" learning because creativity is rarely rewarded.

In contrast, when students understand what creativity really is and know how to use the creative process, they will discover the rewards of creativity. One reward is the increased sense of responsibility for one's learning which results when a person can observe and manage his or her own mental processes. Another is the pleasant emotions which result when someone constructs his or her own mental product.

For teachers, promoting creativity is a way to help students use more responsibility for what happens in a learning environment. You may, for instance, be able to observe that the tasks which invite creativity are often responded to with more initiative and interest than those which do not. If, therefore, we employ a developmental perspective and help students recognize and improve their own creativity, they will become more mature learners.

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LEARNING ACTIVITIES: CREATIVITY

OBJECTIVE: Students should learn how the creative process works, how to use each element of the creative process, and how to use creativity in school and other settings.

MATERIALS: A colorful fantasy poster of your own selection, a large poster size version of the "Creative Process" (p. 138), copies of: outline of goblin (p. 139), outline of fish (p. 140), Assignment Sheet (p. 141); paper, pencils, and markers.

Activity #1

Check off assignments from last class. Allow students time to talk about what they did and what they learned.

Activity #2

Display your colorful fantasy poster.

Question

What is creativity? (Mind Map the answers)

Activity #3

Discuss

There are different models or ways of representing creativity. In this class, you will learn about one of these models. Display your poster size version of the "Creative Process" from page 138 or write it on the chalkboard.

Explain

Creativity can be thought of as the process of meditating upon past knowledge and then letting ideas grow.

Activity #4

Explain

All creative ideas come from past ideas. Without any past knowledge, it is impossible to think up new ideas.

Question

Einstein was a creative genius, but what past knowledge did he need to create new theories of the universe?

Explain

A haiku is an unrhymed three line poem. The lines have five, seven, and five syllables respectively (explain how to count syllables if necessary). Now ask the students to write a creative haiku.

Questions

How did that little bit of knowledge help you to be more creative? How could more knowledge help you to be even more creative?

Activity #5

Explain

Creativity usually comes as we meditate upon our past knowledge and the present activity or problem. There are four specific way to meditate:

- Fluency.
- Flexibility.
- Originality.
- Elaboration.

Divide the class into small groups to practice using each of the four ways to meditate.

Fluency

This is generating a quantity (large number) of ideas. Tell students that they are each to pretend they are an Egyptian Pharaoh. Have them list all the items they would have buried with them. Have students read their lists if they are willing. Ask them what methods if any they used to think up ideas. Talk about good brain storming methods such as Mind Mapping.

Flexibility

This means viewing an idea in different ways. Assign a character from Little Red Riding Hood to each student in a group. Have students take turns telling the story from the viewpoint of his or her character.

Originality

Coming up with unusual ideas is called originality. Have each student come up with a unique and unusual way to answer the phone.

Elaboration

Expanding an idea with details shows an ability to display elaboration. Hand out the sheets with an outline of a goblin and fish on pages 139-140. Have students choose an outline and elaborate on the picture by adding details, colors, patterns, clothes, etc.

Activity #6

Point out the fantasy poster again. Ask students to identify parts of the poster that required use of the different aspects of meditation. (For example, if the poster is very detailed, the artist must have used elaboration.)

Question

What prior knowledge did the artist need in order to do create this poster?

Activity #7

Explain

Just as eggs take time to hatch, ideas often take time to emerge. Creative ideas cannot be forced — they come in their own due time. Sometimes they come almost immediately, but other times it takes days, weeks, or even years. So, after you've spent much effort meditating, then it is time to let the ideas incubate. Incubation simply means to relax your mind. This can be accomplished in many ways such as daydreaming, exercising, or reading a fun book. Another method is taking a "Mind Journey."

If there is room, have the students get comfortable in their chairs. Tell them to close their eyes and not to cross their arms or legs. Starting with the toes and moving slowly toward the head, have students tighten their muscles and then relax them. Finish by having students tighten and relax each of their face muscles. Now, tell students the following story (or make up your own).

> Imagine that you are standing on top of a mountain. The wind is blowing softly across the sparse grass and into your face. A solitary little blue flower sways back and forth in the breeze. The sun is behind you. You can feel its warmth on your neck and shoulders. Now, the wind picks up and you feel warm air rushing across your body and into your lungs. You take a deep breath of the air and slowly let it out.
>
> Then, you raise your arms until they are fully extended at your sides. The wind becomes stronger, and it gently lifts you from the mountain and carries

you into the sky. As you sail through the air, the ground floats by beneath you. Fields and farms drift away into the distance as a forest of pine trees marches up to meet you. You skim over the trees and glide into a lush green valley. A sparkling stream parts the alpine meadow full of wild flowers. You fly along the meandering stream up into the head of the valley. The stream becomes steeper and quicker now, tumbling over smooth rocks.

You follow it up a mountain side to where it emerges icy cold from a snow field. You follow the snow field up to the base of a cliff, and then you rise abruptly up along the cliff face until you enter the clouds. For a moment all is cool and gray, and then you pass through the top of the clouds into the bright sunlight.

To your right is the very tip of the mountain and sitting on the mountain is an old man with a long, white beard. He beckons you to join him. You glide over and sit beside him.

"Tell me what worries you," the old man says.

"I have a problem to which I cannot find the answer," you reply.

"Ah," says the old man, "have you meditated upon this problem yourself?"

"Yes I have. Long and hard. But no answer comes."

"Yes," replies the old man. "I see that you have meditated on the question. And I see that the answer is inside you, waiting. Ah, but even now, it is coming out. Go now. Return to your home and your answer will find you."

With that, the wind again lifts you into the air. You fly away from the mountain and drift through the valley. Soon the farms and fields appear far below you. Then cars, buildings, and the other signs of the city become visible. You begin to float downward into the city. You come to your school. You float down through the ceiling and into your chair.

Questions

If you had a chance to do the meditation activities again, after your Mind Journey, would you have any new ideas? Can you think of more things you would want to have buried with you in the Egyptian tomb? Can you think of better ways to tell the story of Little Red Riding Hood? New ways to answer the phone? Better details to add to the fish or goblin picture? (Give students time to share their new ideas.)

Closure

Explain that gaining past knowledge is a convergent activity. Convergent means things come together such as two lines that angle toward each other. Gaining past knowledge involves learning a lot of facts and drawing specific, logical conclusions from them. Meditation is a divergent activity. Divergent means that things spread apart.

During meditation, we look at our past knowledge in many new, different, and original ways. Incubation is the process of tapping into our intuition, an often neglected part of our minds. Creativity requires that many parts of the brain work together. The right (divergent) and left (convergent) sides must work together, and most of the Multiple Intelligences are active. As a result, doing creative activities is one of the best ways to help the brain grow and become integrated. Perhaps it was because of Einstein's amazing creative ability that his brain was able to function so well.

Assignment

Hand out the assignment sheet on page 141.

The Creative Process

PAST
KNOWLEDGE

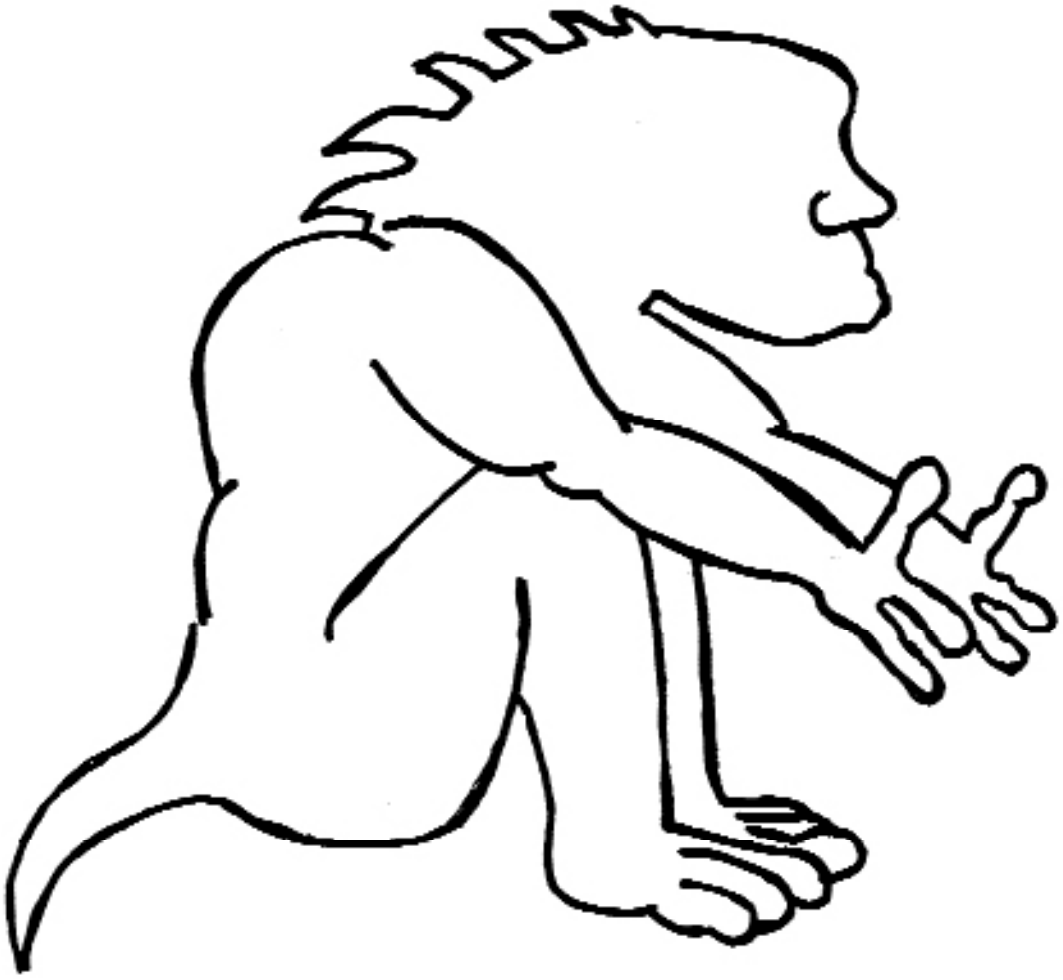
+

Meditation
(Fluency, Flexibility, Originality, Elaboration)

+

INCUBATION

=



Assignment

Complete a creative project using each part of the creative process. Bring your project, or a description of it, to the next class. Be prepared to describe how you used each part of the creative process. Here are some ideas for your project:

- Write a creative story or write about an experience you had.
- Draw a picture of a fantasy world, an alien, a sea creature, or a dinosaur.
- Make up a dance or song.
- Do a school report or homework assignment in a creative way.
- Plan a creative date, activity with friends, or family activity.
- Make something out of cardboard, clay, or balloons.

MEMORY

Of all the mental skills required and developed in traditional educational programs, memory receives the most attention. In nearly every class, students are required to memorize vast amounts of information: vocabulary terms, grammar rules, math formulas, chemical elements, rules of physics, historical dates, famous battles, articles of the Constitution, states, capitals, countries, foreign language words, and so on. Since the ability to store information is one of the most basic and important functions of the brain, these activities appear to be matched with natural brain processes. However, in the middle of all these activities, many students fail to learn how to memorize and some who have learning disabilities may not recognize that they should be remembering at all. This typically happens because many teachers do not teach what memory is, how it works, how to develop it, or what specific techniques could make memorization a little easier. This problem exists even though teaching memory skills is fairly easy and can be used in a parallel condition with many subjects.

The following lesson is designed to teach students about memory and how to use specific memory techniques. There are several types of memory and several specific memory strategies. Teaching these to students can achieve two simultaneous goals:

(1) improved memory increases achievement.

(2) improved memory increases students' awareness, and therefore their ability to manage their own mental abilities. This creates increased confidence in their abilities to learn. Contrast this to a student who fails to remember well and who fears anything which requires him or her to recall information. Such students typically avoid learning opportunities rather than approach them as an opportunity for success.

What Memory Is

Memory is not an isolated intellectual skill. It is really just ordinary cognitive processes applied to a number of different skills (Flavell 1971). We remember faces differently than we remember telephone numbers, and we recall scientific ideas using different thought processes than we do when we learn to play a piece of music by heart. In other words, a person with a so-called "good memory" is actually just someone who successfully applies varied ways of thinking and recall which are called memory strategies. When we talk about memory (or mnemonic) strategy we don't mean to imply difficult or complex thoughts; rather, strategic thinking is simply planned, goal-oriented thinking. So, using memory strategies just means planning our thought patterns around the goal or problem we are facing.

How It Works

Some simple mnemonic strategies develop naturally with age. Rehearsal is a good example of a simple mnemonic strategy (cognitive process) in which a person repeats over and over the item(s) to be remembered. Like any strategy, rehearsal may be applied at simple or complex levels. If asked to memorize a five digit number, you might simply repeat the digits in your head until asked to recall it. A higher level of rehearsal could include chanting or singing the digits until the repetition stuck in your head, or repeating an action associated with each digit such as a finger count. Rehearsal is one of the basic memory strategies developed by children according to age. Flavell, Beach and Chinsky (1966) found that only ten percent of five-year-olds verbally rehearse items they want to remember, whereas sixty percent of seven-year-olds and eighty percent of ten-year-olds do it naturally without coaching, with the older children able to rehearse and recall more items than the younger ones.

Memory strategies can be divided into two categories: storage and retrieval.

- Storage strategies are things we do to try to store or encode information in our brains such as underlining, outlining, or categorizing related items for group associations.

- Retrieval strategies help us to recall what we have already learned, for example, by trying to generate category names first and then individual items afterward, or by looking at a visual reminder such as a string tied on the finger. Some children may have good storage strategies, but need help developing retrieval strategies, or vice-versa. Generally, the more complex the stimuli, the more elaborate strategies will be needed to store and retrieve the information.

How To Develop Memory

Though a few memory strategies develop gradually with time, many strategies simply need to be demonstrated, taught, and practiced. Strategies can be taught! Sixth graders who were learning foreign languages were shown how to associate the foreign word with an image that would tie its meaning to a similar sounding English word. For example, the spanish word for "letter" is carta, so students practiced creating mental images of a shopping cart filled with letters. The sixth graders who were shown this technique and given time to practice it recalled twice as many words as children of the same age who received no similar instruction (Pressley and Levin 1978). Eighth graders were taught a similar keyword strategy to remember the accomplishments of fictitious individuals. Those who learned the strategy recalled seventy-six percent of the accomplishments, compared with only thirty percent for students who had not been taught the keyword approach (Shriberg et.al. 1982). Young children taught rehearsal skills doubled in recall and afterward maintained the strategy by using it spontaneously on

seventy-five percent of similar tasks presented on later trials (Flavell, Beach and Chinsky 1966).

It is important to understand that research indicates that simply offering rewards for good memory performance does NOT improve students' recall in many cases because students often cannot spontaneously generate the appropriate strategy (Gelabert et. al. 1980). Students must be taught!

Specific Techniques for Teaching Memory

When teaching any strategy to full classrooms of students, three techniques are especially important and effective (Jones and Hall 1982; Levin et. al. 1979):

1) demonstrate the power of the strategy compared to not using it.

2) give extensive examples of ways to use it (i.e., multiple keywords).

3) allow students extensive practice (i.e., generating their own keywords).

It is also important that students exercise some form of metamemory This simply means that they are consciously identifying the task, how hard it will be, and what strategy would be appropriately applied to it. Thus, teachers might name different memory tasks and ask children what memory techniques would be effective for each situation.

Young children tend to have misconceptions about memory which can be overcome. They often do not realize that difficult or unlearned material requires more time to learn, so some experience which allows them to perceive this may be valuable. Also, young children especially tend to overestimate their own ability to remember things, which may be a reason why they do not more often resort to strategies on their own (Kail 1990). When children are given practice trials, however, in which they can see their own recall limitations, their assessment of their own abilities does become much more realistic, which may provide more motivation for them to apply the strategies shown by the teacher.

Effects on Beliefs

As pointed out in "The Parable of the Nintendo Player" (p. 40), people can feel like failures because no one taught them the techniques necessary to succeed. Like the computer guru who assumes that his student already understands the techniques necessary to play the game, teachers sometimes assume that students already know how to memorize. Under this condition, only those students who have natural memory abilities will be favored. Those whose memorization skills are undeveloped will struggle.

Fortunately, there is a promising way to help these students change their beliefs. They can be taught how to memorize and then be given the opportunity to experience success. Once they experience success, their beliefs about their ability to learn will significantly improve.

It is important that students learn to measure themselves by some criteria in addition to those imposed by formal learning environments. Measuring themselves on subjective criteria such as improved memory gives them a sense of control and self-management. When it exists, this condition is a principle cause of high motivation to learn. It is no accident that a majority of students who pursue more education are typically those who have higher levels of memory ability.

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LEARNING ACTIVITIES: MEMORY

OBJECTIVE: Students should learn the difference between taxon and locale memory. They should learn how to make use of locale memory by using such memory techniques as Meaning, Organization, Association, Visualization, Chunking, and Mnemonics.

MATERIALS: Copies of: Nonsense Words (p. 152), Familiar Words, (p. 153) Number Sequence (p. 154), Lists (p. 155), Pairs (p. 156), Story Words (p. 157) Groups (p. 158) and Assignment Sheet (p. 159).

Activity #1

Check off assignments from last class. Allow students time to talk about what they did and what they learned.

Activity #2

Ask students what they had for lunch yesterday. Make them give very specific details of what they ate. Then, ask what they learned yesterday in Math or English. Again, make them give very specific details such as formulas, equations, vocabulary words, grammar rules, etc. You will probably find that the students remember what they had for lunch much better than what they learned in class.

Question

Why do you think you can remember unimportant details like what you had for lunch better than facts you are trying to memorize?

Activity #3

Explain

Our brains actually have two types of memory or two methods of memorizing information.

- Taxon Memory consists of isolated pieces of information. This means that the facts which are memorized are related neither to the physical surroundings nor to other pieces of information. The facts must be memorized through practice and rehearsal. And they are quickly forgotten.

- Locale Memory consists of information that is part of a spatial or thematic map. This means that the information is either related to the physical sur-

roundings (such as remembering where the pencil sharpener is) or other information (such as remembering the details related to the plot of a movie). Information is naturally stored in locale memory. Effort is still required to memorize information, but extensive rehearsal is less necessary and the information will be remembered much longer.

Activity #4

The following activities demonstrate the difference between taxon and locale memory. They also teach specific techniques (Meaning, Organization, Association, Visualization, Chunking, and Mnemonics) that help students use locale memory and thus memorize information more efficiently.

MEANING

Familiarity

Give students ten seconds to memorize the nonsense words found on page 152. Then ask for recall. Give them ten seconds to memorize the familiar words on page 153 and ask for recall.

Discuss

Why are familiar words easier to memorize than nonsense words? Which task used locale memory? How could you use familiarity to help you memorize in school?

Explain

Familiar words are related to our experiences. They are not isolated bits of information.

Patterns

Give students about thirty seconds to memorize the numbers on page 154, and then ask for recall. Have students look for a pattern in the numbers. When they have found it, have them try to memorize the numbers again.

Discuss

Which task uses locale memory? How? How could you use patterns to help you memorize in school?

Explain

Individual Christmas lights would be easily lost if they were not all connected together by a cord. Likewise, individual pieces of information are easily lost in our memory. A pattern functions like the cord to connect these pieces of information together.

ORGANIZATION

Have the students try to memorize List #1 on page 155. Have students organize the words in List #2 and try to memorize them.

Discuss

Which task used locale memory? How? How could you use organization to help you memorize better in school?

Explain

If all of your shirts, pants, dresses, socks, shoes, ties, and jewelry were just thrown together into a big box, many items would be lost. Drawers and closets organize things and keep them from being misplaced. Likewise, information that is just thrown into our brains is quickly lost. Organizing the information gives it some structure and prevents it from being lost.

ASSOCIATION

Have students memorize the first four pairs on page 156 (O and boy, X and girl, etc.) Ask students what method they used to memorize the pairs. Teach students how to make associations such as M being related to the m's in "summer." Have students memorize the last five pairs using associations.

Discuss

Which task uses locale memory? How? How can you use associations in school?

Explain

In many cars, the key that unlocks the doors and the key that starts the engine are different. If these keys were not linked together by a key ring, they would be easily separated and lost. Likewise, pieces of information are easily separated in our brains and lost. Associations are like key rings that keep the information together.

VISUALIZATION

Question

How many of you, when you start to read a book or play, have a hard time keeping track of who is who, and what everyone's name is?

Explain

The names and characters are both unfamiliar, isolated bits of information. One way to make them more meaningful is to visualize the character and associate an image with the name.

Have students visualize Huckleberry Finn. They should use the following principles:

•Vividness: Have students give a very detailed description of Huck right down

to his toenails and how he smells.

- Exaggeration: It can be helpful to exaggerate the character. Bizarre images are often remembered best.

- Association: Have students associate the name with the image. Perhaps Huck has purple huckleberry stains on the corner of his mouth, and the tailfin of a catfish is sticking out of his bag.

Discuss

How does visualization help us use locale memory? How could you use visualization in other subjects at school?

Explain

A dot of paint on the wall is insignificant and annoying. However, a dot of paint in a painting is part of a whole scene. It shares the importance of the whole painting. Likewise, a bit of information that is part of a visual image becomes important and is not so easily lost in our memories.

CHUNKING

Read the following numbers. After each number, students should write down the ones they remember. Read the numbers slowly and only once.

2357 37859 247049 49273059 395840692

Explain

Our short term taxon memory can only memorize about 7 pieces of information at a time. Large numbers like the last one can only be memorized by breaking it up into chunks such as 395-840-692. Now you have just three pieces of information to memorize. Chunking itself does not create a locale memory. However, it can be combined with other techniques to create locale memories.

Discuss

How could you use chunking in school?

Explain

It is much easier and efficient to keep track of four quarters than one hundred pennies. Likewise, it is easier and more efficient for our brain to keep track of four chunks of information than one hundred separate pieces.

MNEMONICS

Story Mnemonics

Give students a copy of the list of words on page 157 and have them make up a story using the words. The words do not have to be used in order and the story does not have to be written down. Visualization is helpful. Remove the words from sight.

Have students tell the story to you while you check off the words. Now, have students repeat the story in their mind and only say the words out loud.

First Letter Mnemonics

Have students memorize the groups of words on page 158 by making a sentence using the first letter of each word being memorized. (For example, the order of planets from the sun is MVEMJSUNP. "My very educated mother just served us nine pizzas.")

Discuss

How do mnemonics make use of locale memory? How could you use mnemonics in school?

Closure

The brain has the natural ability to memorize vast amounts of information. However, in order to use the full potential of our memories we must memorize information in context. This means the information must be part of a mental map. The information needs a place where it "fits" in relation to physical surroundings or other information. The techniques you learned today all create a place where the information can fit so that it does not become lost.

Assignment

Hand out copies of the homework assignment sheet on page 159.

rif

fod

kip

rul

dur

vah

jeb

run

cat

pit

log

bus

hat

jet

581215192226293336404347

List #1

bus
tulip
pencil
sock
shirt
rose
notebook
carnation
desk
coat
truck
car

List #2

rice
crayon
dog
cow
red
apple
rabbit
black
milk
green
pencil
marker

O boy
X girl
M summer
8. cat
+ white
8 dog
U frog
* good
$ tree

Words To Use in Stories

5 words
baby
lunch box
yellow kite
truck
banana

20 words
jacket
computer
grease
gorilla
taco
fire engine
homework
milkman
alarm
rose bush
apple
winter
window
stereo
baby lotion
principal
computer
basketball court
Little Mermaid
ruler

10 words
Ernie
fireplace
football
Pizza Hut
airport
hairbrush
van
floppy disk
black marker
printer

7 words
planet
lake
turtle
closet
dragon
fireplace
lamp

15 words
pizza
building
swamp
stapler
window
leaf
sugar
jeep
swing
light
feather
typewriter
mailman
barber
rusty nail

Classification of Organisms

kingdom
phylum
class
order
family
genus
species

Planets

Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto

Great Lakes

Huron
Ontario
Michigan
Erie
Superior

Memory Assignment Sheet

Taxon Memory

This is the type of memory which stores isolated pieces of information. These facts must be memorized through a lot of practice and repetition.

Locale Memory

This is the memory which stores information as part of a mental map the information has a place where it "fits" in relation to other information such as physical surroundings, patterns, rhymes, songs, stories, images, associations, etc.

Assignment

In the following week, use five of the memory techniques you learned today.

Chapter 11

Learning Disabilities

For many years, educators and medical scientists assumed that learning disabilities were caused by sensory deficits. Therefore, the principle measure of learning disabilities was a test of visual or auditory acuity. In the last two decades, researchers have conclusively demonstrated that learning problems may result when children have a sensory handicap but learning disabilities are not caused by sensory problems.

Learning disabilities are a result of structural abnormalities of the brain. They are likely inherited and, while compensations for them may be learned, individuals do not grow out of them. At one level, the most correct definition of a learning disability is the brain's inability to integrate multisensory information with reasoning processes. This inability may result from difficulty in focusing attention on learning material or it may result from other integration deficits.

Learning disabilities often appear when students are attempting to learn subjects which require significant cognitive integration such as reading and mathematics. These subjects are so difficult for children with learning disabilities that many researchers describe only math, reading, attentional, and reversal types of learning disabilities. Classroom teachers are aware of the consequences of getting behind in the basic skills of reading and math. Failure to read, for example, obviously hinders learning in many other areas. There are many reasons why children fail to learn these basic skills: some are slow developing, some missed an important aspect, some will not try to learn, some have emotional or family problems, and some have learning disabilities. In order for these students to succeed, they must receive help which corresponds to the reason for their failure.

Unfortunately, the reason for a child's failure is often misunderstood. Many teachers cannot tell the difference, for example, between a child with low intelligence, a child exhibiting conduct problems, and a child with a learning disorder. In fact, many teachers are surprised to learn that most students with learning disabilities have an average or above average I.Q. When learning disorders are not correctly understood and not correctly identified, students are often given ineffective strategies, which not only fail to provide help, but may even compound a child's problem.

Suzanne H. Stevens, in her book The Learning-Disabled Child: Ways That Parents Can Help, has provided a list of fifteen symptoms which parents or teachers can use to recognize a learning-disabled child. These symptoms and a brief description of them are listed below. When watching for these symptoms, it is important to remember:

- No student will have all fifteen symptoms.

- Although some symptoms are more common than others, no symptom is common to all learning-disabled students. Each of the fifteen symptoms below are listed as either typical, common, not common, or rare.

- All people have one or two of the symptoms. Learning-disabled students will have a group of symptoms.

- Young children may have many of the first nine symptoms and still not be learning-disabled.

- The number of symptoms possessed by a student is not an indicator of the severity of the disability.

Mixed Dominance (Common)

Most people have a dominant side of their body. For example, a person may prefer to do things with her right hand, right foot, and right eye. Those with mixed dominance don't have a dominant side. In fact, a person may even draw with one hand, but write and throw a ball with the other hand.

Directional Confusion (Typical)

Many learning-disabled people have difficulty with left and right. Even as adults they have to concentrate to remember which is left and which is right. They can easily point out directions but have a very difficult time labeling them as left or right.

Similar Learning Problems in Other Family Members (Typical)

Researchers are still debating whether learning disabilities are inherited; however, every learning-disabled child usually has some family member or close relative with a similar learning disability. In large families, it is rare to see just one learning disabled child.

Extreme Difficulty with Sequencing (Typical)

People with learning disabilities usually have a very hard time remembering a list of things in order such as the alphabet or months of the year. Even in high school or adulthood, a learning-disabled person may not be able to relate the alphabet or months of the year correctly.

Slow or Delayed Speech Development (Not Common)

Learning-disabled children may learn to talk and form sentences at a later age than most children. They may have other language problems as well such as a lisp, pronunciation problems, or slow speech.

Difficulty with Time or Time Relationships (Typical)

Most learning-disabled youngsters have a very hard time learning to read a clock and comprehending time relationships such as before and after, sooner and later, yesterday and today. As adults, they still cannot glance at a clock and know the time. They also express time relationships incorrectly quite often. The learning-disabled

also seem to lack an inner sense of time. Most people can estimate how much time has passed by, whether five minutes, half an hour, or three hours. Learning-disabled people cannot do this. They do not have a mental clock like most people do.

Retrieval Problems (Rare)

Students whose learning disabilities involve verbal skills, may have great difficulty expressing themselves. They may know what they want to say, but cannot find the words to say it. They have to live with the frustration of always having words or phrases "on the tip their tongues." As a result they always lose arguments and appear lazy at school because they may understand a reading assignment but have a hard time speaking or writing about it.

Poor Motor Control (Common)

Learning-disabled people may have poor control of their large muscle movement, fine motor movement, or both. Poor large muscle movement shows up in the playground or during sports activities. The person appears awkward and clumsy. Poor control of fine motor movement shows up in handwriting, drawing, or other activities that require precise movement of the fingers.

Problems with Attention

Short Attention Span (Typical)

Nothing in books, math problems, conversations, ball games, even television programs holds the attention of many learning-disabled people for long. They cannot seem to stick with an activity and they think in short spurts.

Distractibility (Typical)

Learning-disabled children are easily distracted by anything that is around them. They seem to notice everything that can be seen, heard, smelled, or felt. Their attention is constantly drawn away by the distractions in the environment.

Hyperactivity (Common)

Some learning-disabled people may be overactive. They wiggle and bounce in their seat or wander around the room. They are always on the move.

Inability To Focus Attention (Rare)

A few learning-disabled children simply cannot focus their attention at all. Their minds seem to wander aimlessly. They may wander off in the middle of a game or at the climax of an exciting show.

Tendency toward Reversals (Typical)

A person with a learning disability will sometimes read some of the letters backwards or upside down. For example, the letter b, may be read as either d, p, q, or g. A learning-disabled person may also mix up the order of letters in a word or the order of words in a sentence. For example, was may be read as saw, and lisp may be read as lips or slip. The phrase "Was he really?" may be read as "He was really" or even "He was early".

Poor Oral Reading (Typical)

It is common for people with learning disabilities to have a hard time reading orally. Even though they try hard, they appear to make lots of careless mistakes. Learning-disabled people may become good silent readers, but still have great difficulty reading out loud.

Poor Handwriting and Dysgraphia (Common)

Learning-disabled students may experience problems at different stages of handwriting. First, they may have great difficulty remembering what a letter looks like. Next, they may have difficulty remembering how to make the letter even when they know what it looks like. They may see an f before them, but still be unable to remember how to draw it with a pencil. Finally, some students are plagued with "stubborn hand." This is a frustrating condition where a student can remember what an s looks like and can remember how to form an s, but when he tells his hand to make an s, out comes a v or some other letter. The papers of learning-disabled students are often messy and covered in eraser marks or crossed out words.

Inability To Copy (Common)

The learning disabled have a very hard time copying something, whether it's a math problem in a book, a word on the board, or the rough draft of a report. They often leave out numbers, letters, or misspell words. They have constant problems with phone numbers, addresses, dates, and times.

Poor Spelling (Typical)

Almost all people with a learning disability are poor spellers. Some individuals may learn to be adequate, but most struggle with the problem all their lives.

Trouble Getting Ideas onto Paper (Common)

Many learning-disabled people are good at expressing themselves orally, but once you put a pencil in their hand, they cannot think of a thing to write. These students appear lazy because they hate to write and complain that they cannot think of a thing to write. For some reason, what they say is true, they simply cannot express themselves in writing. Even when these students can think of something to write, their ideas often slip away before they can write them down. This problem, along with the other writing and spelling problems, is one of the reasons why a learning-disabled person may break down or explode into a rage while trying to write a small report.

Effects on Beliefs

Learning disabilities can be extremely detrimental to a student's faith in his learning ability. Most learning-disabled students do not realize that they have a specif-

ic disability. Rather, they interpret their symptoms — inability to write, spell, read, keep track of time, express themselves, or pay attention — as sure signs that they are "stupid." This is not surprising because most parents, peers, and teachers also interpret these symptoms in this way. Parents and teachers need to recognize the learning disability and accept it. A student is not stupid or lazy because he cannot write. He has a disability in that area. He needs to learn how to adapt and he needs people who are willing to patiently help him overcome this problem if possible. He may learn to write well, but if he truly has a learning disability in this area he will probably never learn to write as neatly and easily as others.

Perhaps the best way to look at a learning disability is the same way you look at a person with a physical handicap. If someone is confined to a wheelchair, she will not be able do all the physical things that another can do. This does not mean that she cannot have a successful, happy life. She just has to work harder and do things differently. She can still drive a car and get around, but in a different way. Likewise, people with learning disabilities can still be successful, but they have to work hard and adapt. Learning-disabled students need to recognize their disability for what it is, and then learn to adapt instead of using it as an excuse. Teachers are very important because they are in a position to recognize the disability and rescue students from the debilitating belief that they are stupid.

IDENTIFICATION ACTIVITIES: LEARNING DISABILITIES

OBJECTIVE: The teacher should learn to identify students with learning disabilities.

MATERIALS: A ball and a tube (such as a toilet paper tube) if you have younger students.

Activity #1

Have students write a sentence, throw a ball, kick a ball, and look through a tube (such as a toilet paper tube). Observe the students and note any students with mixed dominance. With older students, you can just ask them if their dominant hand, foot, and eye are on different sides of their body. If they do not know their dominant eye, have them make a tube with one fist and look through it with one eye. The eye which they prefer to use when looking through the fist is the dominant eye.

Activity #2

Play a game of "Simon Says." Note students who have a hard time keeping right and left straight. Add some commands that require students to demonstrate control of large muscles. For example, you say, "Simon says, Hop on your right foot." Note students who seem very awkward or clumsy.

Activity #3

Have students write the alphabet and months of the year in order. Have the students fold their paper in half and turn it in. Older students who cannot do this will be very embarrassed about it. Try to make the activity sound less threatening by telling students that it is okay if you do not do it perfectly because some people have a hard time remembering the alphabet and months in order. Also, explain that all of our brains are different. You can be very smart and still have a very hard time with sequences.

Activity #4

Demonstrate (or have a student demonstrate) a series of physical movements. Have students close their eyes and try to repeat the movements in order. Note students who have a hard time remembering any of the sequence. Also look for students who appear very awkward or clumsy.

Activity #5

Have students write a two paragraph story in class. Give the students a topic such as "My worst day was . . ." or "Yesterday I did . . ." Look for students who cannot think of anything to write, erase a lot, complain a lot, or who look frustrated. After they turn in their papers, look for poor handwriting, many misspelled words, and reversals.

Activity #6

Write a word, sentence, or paragraph (depending on the age of your students) on the board. Have the students copy down the information and then turn in their paper. Look for students who make lots of mistakes copying the information. In a math class, you can write math problems on the board or look for students who often copy problems from the book incorrectly.

Activity #7

After completing a class activity, have students estimate how long it took. They shouldn't give their answer out loud. Instead, they should write it down on a piece of paper and pass it in to you. Note students whose estimates were way off. You may want to repeat this activity a few times.

Closure

If you believe a student may have a learning disability, then ask the parent if any family members or close relatives have learning problems. Also, ask if the student was slow developing language skills. If parents get defensive, explain that a learning disability has nothing to do with I.Q. or intelligence, and identifying a learning disability can be the most helpful event in a student's school experience. During normal classroom proceedings look for students who have attention problems. They usually are not hard to find. Look for students who concentrate for limited periods of time, are easily distracted, cannot sit still, or cannot focus at all. These activities and a sharp eye should allow you to identify any learning-disabled students in your class. The next step is to find someone who can help the students with their disabilities.

If the disability is mild and does not affect the student, it can be ignored. Remember, learning-disabled students are not stupid. They are no more likely to have a low I.Q. than you are. They simply have a weakness in an area that may show up dramatically in the school environment. Find out who in your school or district works with learning-disabled students. Contact this person and find out what he or she wants you to do with any learning-disabled students you identify in your class. Then follow the guidelines to help the students you identify.

Conclusion

Education has long needed to recognize and respond more effectively to the unique characteristics of individuals in any group of students. So far our efforts, such as ability grouping, have helped but have been limited in their usefulness. This is usually because the attempts to individualize education are determined and limited by the availability of space, teacher time, and financial resources.

Brain-based education provides perhaps the only real effective effort to individualize our attempts to educate because it can be applied by any individual teacher who first learns about it and then uses it without having to make large logistical or financial adjustments. The better a teacher can discriminate between individual students and make useful adaptations to them, the more likely education will realize this goal.

In addition, brain-based teaching provides the means to more effectively promote mental growth which is the underlying purpose of all education. Where teachers usually rely on several forms of subject matter to indirectly promote cognitive development, use of this approach enables a teacher to directly impact and influence students' mental abilities. In addition, this will likely produce an added benefit. A curriculum which includes both interesting ideas and knowledge of how the learner's brain learns will typically create added interest and fulfillment for the teacher.

Lastly, consider the student. Imagine seeing students acquire better memory and improve their creativity and logic. Think about what might happen if students understand their own learning style and apply it with confidence instead of making inaccurate judgments about their adequacy or inadequacy. When we help students successfully perform in the learning environment we create the more likely they are to stay in it and use it effectively.