

**LEARNING STYLES
IN THE CLASSROOM**

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Abstract

One of the major problems facing the educational system today is one of optimizing the learning of each individual student. Many researchers and educators in the field of education believe that the educational system is succeeding with only some of the students. They do not believe that the educational system is as effective as it could be and should be for all students. They believe for an educational system to be effective it must be responsive to the needs of the individual student. They do not believe this can happen by simply changing the curriculum, or by providing separate help for some students, or by increasing the length of the school day, or by decreasing the class load of teachers.

Many researchers believe that attention to the learning style of a student is important in making learning and instruction more responsive to the needs of the individual student. They differ however on how to use learning styles within the classroom. Rita and Ken Dunn believe teachers should identify the learner's preferred learning style and then modify their approach to teaching to match the student's learning style. Other researchers such as Bernice McCarthy believe that all students should be exposed to all major learning styles. She does not believe in identifying the student's learning style and then teaching to that style.

It is important for teachers to be knowledgeable about the various learning style theories developed by Carl Jung, David Kolb, Bernice McCarthy, Isabel Briggs Myers and Katherine Briggs and others. As teachers we need to be aware of and understand the wide variety of learning style theories and to accept the fact that all children do

not fit neatly into one learning style.

The "key" to an effective education is to provide a flexible learning environment, one which does not favor any one learning style and does not expect all students to learn in the same way.

A learning environment should be structured so that each student has an opportunity to explore and discover their best learning style. The lesson plans and learning centers presented in the second section of this project serve as examples of how easy it can be to design a program that will help each student to develop their learning skills in the best possible way.

This project is based on the belief that we are all different; we all have our own unique ways of learning therefore attention to learning styles is important. However attending to learning styles means much more than individualizing education. By attending to learning styles we are honoring and respecting the diversity of the learning styles of the students. We are also promoting equality in education by not choosing who will succeed and who will not. All students are being given an equal opportunity to learn.

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Introduction

Alberta Education implemented a policy on "program continuity" in 1988. The policy focused on the fact that children are all different, and we as teachers should not attempt to teach them all in the same way. The degree to which children achieve success at school is often dependent upon their background experiences, their physical attributes, their home situations and how they prefer to learn. There are so many needs to be met that trying to make student learning individual in nature is difficult. One area to be explored is that of learning styles, or preferred modes of learning, that students bring with them to school. Research clearly proves that children learn in distinctly different ways. They enter the educational system with an already-developed learning style. Learning environments, situations or experiences that operate according to a learning theory that is dissimilar to a child's preferred style of learning are likely to be rejected or resisted by that child. As teachers it is our responsibility to develop a learning environment that provides a variety of learning experiences which will permit children to learn through their preferred styles of learning.

As teachers we need to have an understanding of the variety of learning styles and their implications for learning and teaching within the classroom. We need to be able to modify our approaches to teaching in order to provide a variety of learning experiences to accommodate the different learning needs of children. Furthermore, we have so many children within our educational system who are experiencing difficulty with learning that as teachers we need to become aware and knowledgeable about how children learn. The learning style

theories are only one area which can be looked at but it is a very important area if the unique educational needs of all children are to be met.

As teachers we have tried many ways and used many different programs to help children learn and still many children are frustrated and experiencing difficulty in school. Instead of choosing one program and assuming that the program will meet the needs of all children we should be looking at how children prefer to learn. If we are to respect the educational needs of children we must respect how they learn.

The purpose of this project is to examine learning style theories and what they have to offer children and teachers. In the first section, various models of learning styles developed by researchers such as Isabel Briggs Myers, Dr. David Kolb and Bernice McCarthy will be presented. Recent research on the relationship between learning styles and teaching styles will also be discussed.

The second section of this project will be an integrated language arts unit on the sea based on McCarthy's learning style theory. The introduction to the unit will include four lessons. These lessons will follow McCarthy's 4MAT System Model. The lessons will move through the learning cycle in sequence, which to McCarthy is a natural learning progression. All four styles of learning will be utilized in an effort to expose the children to all styles of learning and to help increase their awareness of their preferred learning styles. The objective is to not only help children become aware of their own learning styles but also to help them become aware that each learning style has its own unique qualities that need to be valued in order for complete learning to take place.

The remainder of the unit will demonstrate how learning centers can be utilized. Each of these centers will have activities that correspond to the four learning styles developed by Kolb and McCarthy.

Learning is an individual matter, education must be flexible enough to meet the needs of children within the classroom. A personalized program of instruction is one way of meeting the needs of children. Learning centers are one means by which to personalize and individualize instruction. They can provide children with a variety and choice of learning alternatives thereby giving them the opportunity of choosing how they want to learn and capitalizing on their learning strengths. Children need the opportunity to learn through a style they are strongest in and learning centers will provide them with this opportunity.

Review of the Literature

Introduction

Each individual is unique and different from everyone else. Each is a product of his or her environment with different interests and values (Briggs Myers and Myers, 1980, p. 1) and each has their own unique way of learning.

We all learn by feeling, reflecting, thinking and doing, but we all differ in terms of which mode of learning we prefer. Our preference for one mode over the other determines our learning style preference. Style being "any pattern we see in a person's way of accomplishing a particular task." (Schmeck, 1988, p. ix). This has important implications for the teaching of children.

Children approach learning in many different ways. They have their own personal preference in how to go about learning. Different learning styles suit different children. Left to themselves, they tend to use these styles across a whole range of different situations (Cashdan and Lee, 1971, p. 15-16).

Education is about people and people are different. However the educational system often ignores this diversity, and restricts learners and teachers to specific modes of learning, and teaching. As teachers, we are encouraged (required) to help children become thinkers --- to be rational, theoretical and abstract. However as teachers we know children learn differently. The problem is to fit this knowledge into a system that's not set up to accommodate individual differences (O'Neil, 1990, p. 9); a system that at times believes everyone learns in the same way (by thinking and watching), a system that has produced classroom teaching methods which appeal only to

a single learning style while handicapping those who would prefer to learn another way (Kolb, 1984, p.202).

Piaget (1969) studied how children learn. He studied the development of intellectual awareness through the successive stages of childhood and found that growth toward abstract reasoning is a series of age-related stages. He did not stop there however. He concluded that children learn in their own way all the time by a process of interaction with the environment. However, some educators have tended to look at Piaget's findings narrowly. They only looked at Piaget's 'levels' or 'stages' to determine what children of various ages should or should not be able to attain. Educators have tended to focus on Piaget's age-related stages (the ladder) and neglected the process of how children learn (McCarthy, 1987, p.58).

It is not the fault of the curriculum that some children have difficulty in learning. They are having difficulty learning because the educational system is not as effective as it could be. When a child's learning style does not correspond to specific learning tasks, the educational system expects the child to adapt; it does not adapt or respond to the many different ways in which children learn. The question for educators is whether schools should adapt to the many learning ways of the student or should students adapt to the way schools present the curriculum (Guild and Garger, 1985, p.78). Researchers, themselves, are divided on this issue. Some feel that the students should adapt their styles to the demands of the curriculum so they will receive the skills required for success. Others feel that schools and teachers must adapt and provide a wide range of learning opportunities to reach more students. Attending to style is one way to expand teaching methods and curricula to reach

more students. Children learn almost any subject matter when they are taught in a way that allows them to learn through their strengths --- their own preferred learning styles (Dunn, 1990, p.18; O'Neil, 1990, p.5; Dunn and Griggs, 1988, p.2).

The educational system is accountable for educating every child. However, an educational program cannot be successful without attending to the personal learning needs of individual students, and this is very difficult to do unless they take into account the type differences among children. A single approach to teaching, whether traditional or innovative, simply does not do the job (Keefe, 1987, p.34; Lawrence, 1984, p.94). The concept of learning styles fits in with a "personalized" view of education appropriate to an increasingly diverse student population (O'Neil, 1990, p.5).

There are many learning style models (Kolb, 1983, Lawrence, 1982, Jung, 1976, Simon and Bryam, 1977, Gregorc, 1979, Hunt, 1964, Merrill, 1976 and McCarthy, 1979). All these models advocate acknowledging and honoring diversity among individuals (Dunn, 1990, p.15).

There are, however, critics of learning styles theory. Some see learning styles as being impractical, as simply a way to individualize learning. Others feel a learning style could become a learning disability if cultivated at the expense of other ways of learning. Their fear is that teachers may label individuals as being certain 'types' of learners and present materials in a way that complements individual learning styles to the exclusion of others (Schmeck, 1988, p.278). Torrance is concerned that students who are informed of the results of a learning style assessment will form self-limiting views, and they may assume they are incapable of learning any other way (Schmeck, 1988, p.279).

Some critics of learning styles theory feel the problem with learning styles is the difficulty of conceiving general laws or categories for describing human individuality that does justice to the full array of human uniqueness (Kolb, 1984, p.63) and the confusion created because there are so many competing models and definitions of learning styles (Curry, 1990, p.51). However, Guild feels the variety of models is an asset. She encourages teachers to learn a variety of models in order to learn about the field of learning styles. Learning about the many models of learning styles can provide a wealth of resources from which teachers can choose appropriate approaches. As teachers we can not focus only on one model and make everyone fit into it because everyone is different (Brandt, 1990, p.12).

How educators and researchers encourage the use of learning styles differs. Gregorc (1979) encourages educators to understand their own and other's perspectives. His emphasis is on personal awareness, focusing on the individual: know thyself and the person with whom you're interacting. He feels that teachers will burn out if they attempt to teach to all students' various styles. Team teaching, grouping teachers of different styles, is ultimately the best way to avoid harm to students and their teachers (Brandt, 1990, p.10 and O'Neil, 1990, p.6). He and Witkin however feel that direct accommodation to style at various times is important and a conscious mismatch at other times should be encouraged in order to help individuals to stretch themselves (Guild and Garger, 1985, p.88). Dunn and Dunn (Brandt, 1990, p.10) follow a more diagnostic/prescriptive approach. They believe that when students are taught through the methods each prefers, they do learn more effectively therefore they encourage the identification of key elements of an individual's learning style,

and then match instruction and materials to those individual differences. They want teachers to meet the needs of the individual learners as often as possible. Rita Dunn (1990, p.16) maintains that three fifths of learning style is biologically determined therefore students with strong preferences for specific learning style conditions/environments/approaches cannot flex, they need to be matched to instruction and materials. McCarthy (1987) advocates adapting instruction to the major learning styles. She does not think teachers should identify an individual's learning style and teach only to that strength. If teachers do that then the students will become very good in their own learning style but they will not develop other learning skills that are needed in life (McCarthy, 1987, p.53). McCarthy feels teachers have a duty to stretch outside their own styles and that planning lesson content and activities with several broad style "types" in mind is best. Teachers have a responsibility as professionals to go out of their own style (Brandt, 1990, p.10 and O'Neil, 1990, p.6).

I believe, as Guild and Garger do (Guild & Garger, 1991, p.83) that knowledge of the various learning styles and how these learning styles can be used in the classroom is important. People are different and everyone will not fit into one learning style model. If we are to respect and honor individual differences then we need to be aware of various models of learning styles.

As teachers, we need to be aware of our own dominant learning style and how this affects not only our teaching, but also how it affects the students' learning. This knowledge can only strengthen our approaches to teaching. Knowing the students' learning styles can also be important if we are to help those students at risk. By knowing and understanding their preferred learning styles, teachers

can help these students achieve success in the classroom. This does not mean as teachers we need to assess each individual student's learning style and then accommodate each individual. However, as teachers we should be providing students with a wide range of learning opportunities. As teachers we need to adapt our teaching to all learning styles if we are to provide an education which respects individual differences. By attending to all learning styles we would be providing all students the opportunity to fulfil their potential and we would be creating an educational system that does not discriminate by picking and choosing who will succeed and who will not.

Various Types of Learning Styles and Their Characteristics

How individuals learn differs and these differences give rise to many individual styles of learning. Researchers have devised many different models of learning styles. These models of learning styles vary from four to sixteen types of learners.

The four learning styles of Jung to the sixteen learning styles model of Katherine Briggs, Isabel Briggs Myers and Peter Myers.

According to Jung's theory of psychological types, "all conscious mental activity occurs in two perception processes (sensing and intuition) and two judgment processes (thinking and feeling)" (Lawrence, 1984, p. 12). Those who perceive through sensing see the world through their senses - vision, hearing, touch and smell. They observe what is real, factual, actually happening. Others perceive through intuition by focusing on and reacting to images created by their minds. They attend more to the abstract dimensions of reality. According to Jung the judgment processes are thinking - reaching decisions in a logical way, and the feeling function - approaching a decision through a subjective, perceptive, empathetic, and emotional perspective. Jung feels everyone uses both kinds of perception processes and both kinds of judgment processes, but we each tend to be more comfortable and skilled in one type of perception and judgment than another (Guild and Garger, 1985, p.17-18).

Jung also claims that the four styles or types - sensing, intuition, thinking and feeling - can be expanded to eight types because extraverted and introverted people express these functions differently. Extraverted people operate comfortably and successfully by interacting with things

external to us - other people, experiences, situations. Introverted people are more interested in the internal world of their own minds, hearts and souls (Guild and Garger, 1985, p.20).

Briggs and Myers (1980) also states that variation in human behavior is a result of basic differences in the perception and judgment processes. She also contends that individuals perceive either by sensing or intuition. She describes individual differences in judgment as arising from contrasting ways of coming to conclusions. One way is by the use of thinking (a logical process) and the other is by feeling (by appreciation) (Briggs Myers and Myers, 1980, p.2-3).

Briggs and Briggs Myers expanded upon Jung's theories by adding another dimension. They are of the opinion that each individual has a preference for either a judging function or the perceptive function, which expanded their learning style model to sixteen styles.

Briggs Myers and Myers feel that as soon as children exercise a preference between the ways of perceiving and ways of judging a basic difference in development begins. They believe that children have enough command of their mental processes to be able to use the favorite processes more, developing them and trusting them more, often times neglecting the processes they enjoy less (Briggs Myers and Myers, 1980, p.2-3).

However, Briggs Myers and Myers argue that one process alone is not enough. For individuals to be balanced, they need to adequately develop a second process which does not need to be equal to the dominant process only an auxiliary process. If the dominant process is a judging one, the auxiliary process will be perceptive: either sensing or intuition. If the dominant process is perceptive, the auxiliary process will be a judging one: either thinking or feeling (Briggs

Myers and Myers, 1980, p.12).

The following is a summary of the sixteen types and their characteristics developed by Isabel Briggs Myers combined with the relating type instructional strategies developed by Margaret K. Morgan.

ESTP

With thinking as auxiliary

They like to make decisions with their thinking rather than their feeling and tend to be more aware of the logical consequences of an act or decision. They have more grasp of underlying principles, which helps with math and theory. They get tough when the situation calls for toughness.

They are linear learners who need help in organizing. They like to know why before doing something. They tend to like group projects, class reports, team competition, direct experience, audiovisuals and many like lectures.

ESTJ

With sensing as auxiliary

They look at things with their sensing rather than their intuition. They are interested in realities perceived by their five senses, which makes them matter-of-fact, practical, realistic, factually-minded, concerned with the here and now. They tend to be curious about new things rather than new ideas. They want ideas, plans and decisions to be based on solid fact. They like work where they can achieve immediate, visible and tangible results. They are good at business, industry, production and construction. They enjoy administration and getting things organized and done.

They are linear learners with a strong need for structure. They need to know why before doing something. They like direct experiences, group projects, class reports, team competition, audiovisuals, practical tests, and may like lectures.

ESFP

With feeling as auxiliary

They like to make decisions with their feeling rather than their thinking. Feeling gives them tact, sympathy, interest in people, ease in handling human contacts. They tend to be too easy as disciplinarians. They have artistic taste and judgment, but not very good at analysis.

They are linear learners who need help in organizing and they need orderly, well-defined goals. They need to know why before doing something. They like group projects, team competition, class reports, direct experiences, audiovisuals, and practical tests.

ESFJ

With sensing as auxiliary

They look at things with their sensing and tend to be practical, realistic, matter-of-fact, concerned with the here and now. They appreciate and enjoy their material possessions and details of direct experiences. They base plans and decisions upon known facts. They are attracted to nursing and the health professions in general.

They are linear learners with a strong need for structure and well-defined goals. They need to know why before doing something. They value harmonious group projects, team competition, class reports. They like audiovisuals, practical tests and direct experiences.

ISTJ

With thinking as auxiliary

They like to make decisions with their thinking, stressing analysis, logic and decisiveness. They make an effort to understand and appreciate others, do not override people less forceful than they are.

They are linear learners with a strong need for order. They like well-defined goals, practical tests, direct experiences and audiovisuals. They enjoy lectures and like working alone.

ISFJ

With feeling as auxiliary

They like to make decisions with their feeling, they stress loyalty, consideration and the common welfare. They tend to be sympathetic, tactful, kind and genuinely concerned. They are attracted to the health care professions.

They are linear learners with a strong need for order. They like direct experiences, audiovisuals and practical tests. They like to listen to lectures and enjoy working alone.

ISTP

With sensing as auxiliary

They see the realities and they have a great capacity for facts and details. They tend to be good at applied science and at mechanics. They may be analysts of markets, sales, securities or statistics of any kind. They tend to be patient, accurate, good with their hands, fond of sports and outdoors and have a gift for fun.

They are linear learners who need help in organizing. They like direct experiences, lectures and audiovisuals. They enjoy working alone. They want logically-structured, efficient materials.

ISFP

With sensing as auxiliary

These people see the realities. They can pay close attention for long periods. They are gentle, considerate, retiring but consistently underestimate and understate themselves. They work well at jobs requiring devotion.

They are linear learners who need help in organizing. They like direct experience, well-defined goals, audiovisuals, and practical tests. They need harmony in group projects. They enjoy working alone. They need sensitive instructors.

INTJ

With thinking as auxiliary

Of all the types these people are the most individualistic and most independent. They are organized, logical, critical, decisive, determined, often stubborn. They have a tendency to ignore the views and feelings of those who don't agree with them. They can be efficient executives.

They can be global or linear learners. They want to consider theory first, then applications. They enjoy working alone. They prefer open-end instruction and are good at paper-pencil tests.

INFJ

With feeling as auxiliary

Not as individualistic as **INTJ**, they tend to win cooperation rather than to demand it. They are sympathetic in their handling of people. They can be successful executives where affairs can be conducted on a personal basis.

They can be global or linear learners. They want to consider theory first, then applications. They prefer open-end instruction. They enjoy working alone but when working in a group they need harmony.

INFP

With intuition as auxiliary

They see the possibilities. They are understanding, tend to have insight and long-range vision. They are curious about new ideas, fond of books and language. They are skilled in expressing themselves. They tend to enjoy counseling and teaching. With high ability, may excel in literature, art, science or psychology.

They are global learners and may need help in organizing. They want to consider theory first, then applications. They prefer open-end instruction. They need harmony in group work. They like autonomy and enjoy working alone.

INTP
With intuition as auxiliary

They see the possibilities. They value facts mainly in relation to theory. They are good at pure science, research, math, and the more complicated engineering problems. They tend to have insight, ingenuity, quick understanding, intellectual curiosity, fertility of ideas about problems. They are more interested in reaching solutions than in putting them into practice.

They are global learners that need help in coming to closure. They like reading and listening, consider theory first and then applications. They prefer open-end instruction, and are good at paper-and-pencil tests. They value autonomy and enjoy working alone.

ENFP
With feeling as auxiliary

They tend to be more enthusiastic, more concerned with people and skillful in handling them. They are drawn to counseling, may be inspired and inspiring teachers, scientists, artists, advertising or sales people.

They are global learners. They need choices and deadlines and they need help with organizing. They like autonomy. They like seminars and reading. They enjoy harmonious group projects, team competition and class reports.

ENTP
with thinking as auxiliary

They tend to be more independent, analytical and critical of their inspirations, more personal in their relations with people. They tend to be concerned more with how others will affect their projects rather than with how their projects will affect others. They tend to be the inventors, scientists, trouble-shooters, or promoters.

They are global learners who need choices and deadlines. They like autonomy. They enjoy reading and listening and they prefer open-end instruction. They want to consider theory, then applications. They are good at paper-and-pencil tests.

ENFJ

With intuition as auxiliary

They tend to look at things with their intuition rather than their sensing, and are mainly interested in seeing the possibilities beyond what is present or obvious or known. Intuition heightens their understanding, long-range vision, insight, curiosity about new ideas, love of books and tolerance for theory.

They can be global or linear learners. They like seminars, reading (if they can settle down long enough), harmonious group projects and class reports. They like listening, pencil-and-paper tests and prefer open-end instruction. They want to consider theory, then applications.

ENTJ

With intuition as auxiliary

They tend to look at things with their intuition rather than their sensing, hence are mainly interested in seeing the possibilities beyond what is present or obvious or known. Intuition heightens their intellectual interest, curiosity for new ideas, tolerance for theory, taste for complex problems, insight, vision and concern for long range consequences.

They can be global or linear learners. They like seminars and enjoy reading (if they can settle down long enough). They enjoy group projects, class reports, team competition. They like listening and pencil-and-paper tests. They prefer open-end instruction and want to consider theory, then applications.

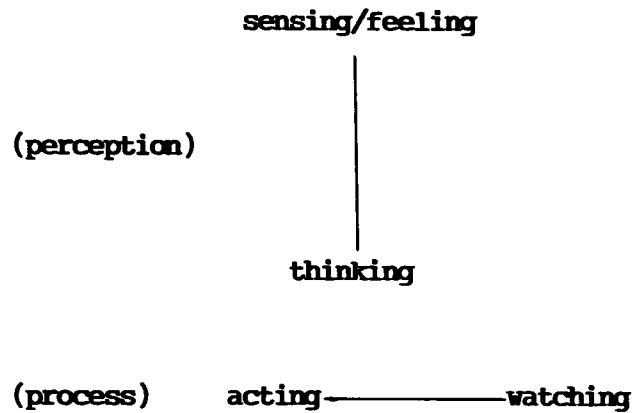
(Lawrence, 1984, p.52-53, p.A-9 - A-16)

Kolb's four quadrant model.

Kolb developed his four quadrant learning style model based on the belief that there are two major differences in how people learn: how they perceive and how they process (McCarthy, 1987, p.3-9). Those who perceive in a sensing/feeling way, project themselves into the reality of the now. They rely on actual experiences, will immerse themselves directly, and perceive through their senses. On the other hand, there are those who think through experiences and attend more to the abstract dimensions of reality. They analyze what is happening, so it is their intellect and reasoning that makes first appraisals. They approach experiences logically. Kolb believes that people hover on a continuum between these two poles at their most comfortable place.

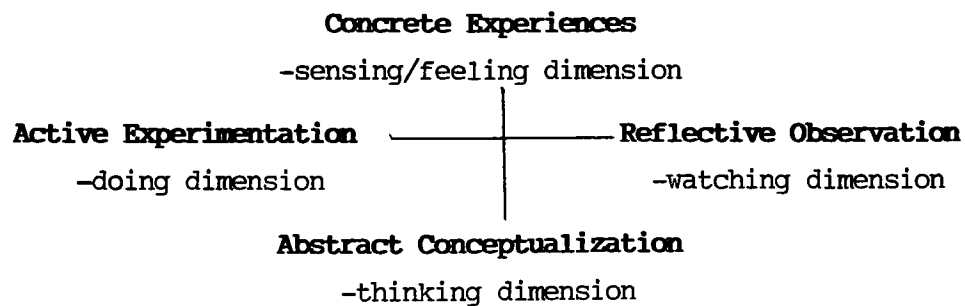
Perception by itself does not equal learning. The second major difference in how people learn is how they process experience and information, and how they make new things part of themselves. Some people are watchers first, others are doers first. The watchers reflect on new things; they filter them through their own experience to create meaning in a slow, deliberate choosing of perspectives. The doers act on new information immediately. They reflect only after they have tried it out. They need to do it, to extend themselves into the world, in order to make it theirs. This processing of information and experience is also a continuum that ranges from the need to internalize to the need to act.

The two continuums look like this:



(McCarthy, 1987, p.20)

It was when Kolb, in 1971, combined these two continuums of major differences in learning, that he created a four quadrant model by placing the continuum of perception on the vertical axis and the process continuum on the horizontal axis. By doing this he ended up with the following:



(McCarthy, 1987, p.21)

Kolb contends that "our dominant learning abilities are the result of our hereditary equipment, our particular past life experiences, and the demands of our present environment." (McCarthy, 1987, p.26).

Kolb believes that some people experience or take in information concretely, and then process what they take in reflectively. They are sensors/feelers and watchers. He calls these people **divergers**.

Other people take in experiences abstractly, and then they process what they take in reflectively. They are thinkers and watchers. Kolb calls them **assimilators**.

The people Kolb calls **convergers** are the thinkers and doers. They take in experiences abstractly and then process what they take in actively. They need to try things out for themselves.

The fourth style are the **accommodators**. They take in experiences concretely and process what they take in actively. They are sensors/feelers and doers.

The chart on the following page summarizes the learner characteristics in each of the four quadrants.

Quadrant Four:
ACCOMMODATORS

Kolb also found that some people take in experience concretely and then process what they take in actively. These are the accommodators, or otherwise called the sensors/feelers and doers. They don't start with ideas, but they see, hear, touch and feel. Then they plunge right in and try it out in action. These people are very adaptive, for they rely on intuition and utilize trial and error in their problem solving. Accommodators tend to rely on others for information, and are generally at ease with other people. They, like the Convergers, are practical in nature. They are influenced by their peers, and are often perceived as pushy or impatient.

Quadrant One:
DIVERGERS

Kolb found that some people experience or take in information concretely, and they process what they take in reflectively. These people can be described as sensors/feelers and watchers. They study life as it is lived. They start with what they see, and then they generalize. They are holistic in their thought processes, in that they concentrate on the whole rather than the parts. They possess imaginative abilities. They tend to be emotional, and are people persons. Perhaps because of this, they are easily influenced by peers. These people tend to excel in the humanities and in the arts.

Quadrant Three:
CONVERGERS

Kolb found that other people take in experience abstractly and then they process what they take in actively. These are the thinkers and the doers. They like to try things out for themselves. They start out with an idea, and try it out. They may conduct experiments to test hypotheses to see if things work. They are deductive in nature. They are searching for the single correct answer, and are always looking for a practical application for their ideas. Convergers tend to prefer things to people. They have narrow interests and set goals for themselves.

Quadrant Two:
ASSIMILATORS

Kolb found that other people take in or perceive experience abstractly, and they process what they take in reflectively. These are the thinkers and watchers. They tend to start with an idea, play with it, and it can then take a variety of shapes. They move from theoretical to abstract. They like to set goals, and are systematic planners.

(McCarthy, 1987, p.22-23)

Findings of other learning style researchers.

McCarthy combined the findings of several theorists: Kolb (1971), Lotas (1979) and Fischer & Fischer (1979), and devised her own four styles of learners:

- 1) **Imaginative Learner** - seeks meaning through personal involvement and learns through discussions. They need to be personally involved. They are divergent thinkers. They perceive information concretely and process it reflectively.
- 2) **Analytic Learner** - perceives information abstractly and processes reflectively. This type thrives in a traditional classroom. They value facts and need to know what the experts think.
- 3) **Common Sense Learner** - wants to know how things work and seeks relevance. They perceive information abstractly and process it actively. They integrate theory and practice. They like to experiment and tinker with things.
- 4) **Dynamic Learner** - risk taker, interested in hidden possibilities, good problem solver and likes to make things happen. These learners integrate experience and application. They learn by trial and error. They perceive information concretely and process it actively.

(McCarthy, 1987, p.37-43)

Gregorc identified learning styles of individuals as being either:

- 1) **Concrete Sequential** - this type of person is persistent, careful with detail.
- 2) **Abstract Sequential** - this person is evaluative, analytical, logical and oriented to research.
- 3) **Abstract Random** - sensitive, aesthetic, aware and spontaneous.
- 4) **Concrete Random** - intuitive, experimenting, creative, and risk taking.

(Schmeck, 1988, p.277)

Torrance described individuals as being right, left or integrated in their learning styles. Right or left styles reflect their corresponding brain hemisphere dominant characteristics, and each hemisphere processes information differently.

- 1) Speech resides in the left brain hemisphere. The left brain specializes in analytical, abstract, temporal and digital operations.
- 2) Right brain hemisphere specializes in nonverbal, holistic, concrete, spatial, creative, intuitive and aesthetic function.
- 3) Integrated - the learner uses both hemispheres equally.

(Schmeck, 1988, p.278)

Torrance and Rockenstein state that every person with a normal, healthy brain has the potential for developing the abilities inherent in every learning style. They emphasize not only a need for a learning style that uses the fully functioning brain but for an educational system that teaches to the whole brain (Schmeck, 1988, p.281 & 289).

However, McCarthy contends the educational system favors left brain individuals therefore these types tend to love school, while right brain individuals are often neglected by the educational system and tend to "hang around school and hope they catch on" (McCarthy, 1987, p.73).

According to Kolb, the combination of how we perceive and how we process forms the uniqueness of our own learning style, or our most comfortable way to learn (McCarthy, 1987, p.25). However, our educational system for the most part asks children to watch, listen and reflect. It encourages the thinkers. This makes it difficult for the doers and feelers. A destructive conflict could develop between the educational system and the child when the system will not allow and encourage a child to use and refine his/her own learning style but in fact constantly demands the use of alternate learning styles.

Briggs Myers and Myers state that learning preferences are inborn and no attempt should be made to reverse them otherwise successful learning could be hindered. The successful development of type can be greatly hindered or helped by the environment from the beginning (Briggs Myers and Myers, 1980, p.175-176). When children's immediate environment encourages their native capacities then type development will result, however when an environment forces children to use unnatural processes then it robs them of the opportunity to develop and frustrates them (Briggs Myers and Myers, 1980, p.189). A learning environment should give children the opportunity to explore, discover and develop their preferred learning style.

McCarthy argues that the educational systems validate the way the analytic learners learn (by thinking and watching). She contends

that about seventy percent of the children don't prefer to learn in this style (McCarthy, 1987, p.51). Most educational systems give the advantage to some types of learners while it handicaps others. All children have a right to an educational system that will offer them their best opportunity to develop; an educational system that will appreciate and honor their way of learning.

The educational system must recognize that children have different means of learning and it must be willing and able to deal with these differences. It will require a fundamental change in thinking; a way of thinking that realizes there is no one right answer to issues and problems in education; a way of thinking that will accept diversity as the norm.

Learning Styles and Their Relationship to Teaching Styles

Types of teaching styles and their characteristics.

The term "style" refers to a pervasive quality in the behavior of an individual. This is not to be confused with method, for people tend to infuse different methods in their own styles. For example, lecturing is not a style, but a method. People with distinctive styles will infuse their respective lectures with their unique qualities (Fischer and Fischer, 1979, p.245).

Teachers, like other people, have a preferred way of perceiving and processing information. They have their own unique way of learning. It seems reasonable to believe that they will bring their own unique way of learning to the way they teach. Research in this area indicates that teaching style is heavily dependent on the learning style of teachers.

Dunn and Dunn (1979, p.241) state that teachers teach the way they learned not necessarily the way they were taught. Their research into individual teaching styles found that teachers believe that the way they learn is the "easy" or "right" way, and that they therefore teach their students in much the same manner.

Lawrence contends that the learning styles of teachers affect how they teach, what they prefer to teach, and the level of schooling which they prefer to teach (Lawrence, 1984, p.78). Heikkinen, Pettigrew and Zakrajsek of the University of Idaho performed a study using their education majors as subjects. They found students majoring in different subjects had strong preferences for some learning variables. They also discovered a difference in learning styles between prospective elementary and secondary teachers (Heikkinen, Pettigrew, Zakrajsek,

1985, p.85). Gephart, Strother and Duchett, 1980; MacNeil, 1980, and McDaniel, 1982, also suggest that one's learning style preference influences one's teaching style (Heikkinen, Pettigrew, Zakrajsek, 1985, p. 80). Bennett (1976) examined teaching style and student progress in Great Britain, and found a strong relationship between teacher aims and opinions, and the way they actually taught (Kuckinskas, 1979, p.271).

McCarthy (1987, p.37-43) summarized teachers' characteristics based on how they learn using the four quadrant model and the findings of learning style researchers such as Kolb, Lawrence, Jung, Gregorc, Hunt and Merrill.

QUADRANT FOUR: DYNAMIC LEARNERS

AS TEACHERS THEY:

- * are interested in enabling student self-discovery
- * try to help people act on their own visions
- * believe curricula should be geared to learner's interests
- * see knowledge as a tool for improving the larger society
- * encourage experimental learning - like to use a variety of instructional methods
- * are dramatic teachers who seek to energize their students
- * attempt to create new forms, to stimulate life and to draw new boundaries
- * tend to rashness and manipulation
- * **STRENGTH:** action and presenting challenges
- * **FAVORITE QUESTION:** What if?

QUADRANT ONE: IMAGINATIVE LEARNERS:

AS TEACHERS THEY:

- * are interested in facilitating individual growth
- * try to help people become more self-aware
- * believe curricula should enhance the ability to be authentic
- * see knowledge as growth in personal insight and encourage authenticity in their students
- * like discussions, group work, and realistic feedback about feelings
- * are caring people who seek to engage their students in cooperative efforts
- * are aware of social forces that effect human development
- * able to focus on meaningful goals
- * tend to be fearful under pressure and sometimes lack daring
- * **STRENGTH:** imaginative ideas
- * **FAVORITE QUESTION:** Why?

QUADRANT THREE: COMMON SENSE LEARNERS

AS TEACHERS THEY:

- * are interested in productivity and competence
- * try to give students the skills they will need to become economically independent in life
- * believe curricula should be geared to this kind of focus
- * see knowledge as enabling students to make their own way
- * encourage practical applications
- * like technical things and hands-on activities
- * are exacting and seek quality and productivity
- * believe the best way is determined pragmatically
- * use measured rewards
- * tend to be inflexible and self-contained and lack team-work skills
- * **STRENGTH:** practical application of ideas
- * **FAVORITE QUESTION:** How does this work?

QUADRANT TWO: ANALYTIC LEARNERS

AS TEACHERS THEY:

- * are interested in transmitting knowledge
- * try to be as accurate and knowledgeable as possible
- * believe curricula should further understanding of significant information and should be presented systematically
- * see knowledge as deepening comprehension
- * encourage outstanding students
- * like facts and details and organized sequential thinking
- * are traditional teachers who seek to imbue a love of knowledge
- * believe in rational use of authority
- * sometimes discourage creativity because of their dominating attitude
- * **STRENGTH:** creating concepts and models
- * **FAVORITE QUESTION:** What?

(McCarthy, 1987, p.37-43)

Knowing where we are as teachers is an extremely important part of the process to becoming a better teacher. Teachers must understand their own learning style. Once they have a knowledge of their own style - its strengths and weaknesses - they can then begin to develop more diverse strategies to help their students succeed in learning. Whether or not a teacher can develop more diverse strategies will depend upon not only their knowledge of their teaching style but also their ability to understand and accept why one teaching style cannot be effective with all students.

Does congruence between the teacher's teaching style and student's learning style mean higher achievement and attitude?

There are mixed reviews with regard to this question. On the one hand, studies have concluded that matching learning style with teaching style results in improved achievement and attitude. However, other studies suggest the opposite.

Roland Barth (1980) in his book "Run School Run" believes that when "teachers are teaching in ways consonant with their own personal style and professional philosophy, both they and their students appear to benefit." (Guild and Garger, 1985, p.35).

Dunn and Frazier (1990, p.348) have documented that when student's learning styles are congruent with complementary teaching strategies, increased academic achievement is evident. Enthwistle, Gregorc and Ward (Dunn and Frazier, 1990, p.357) state that teacher styles apparently affect student achievement. Dunn, Beaudry and Klaves (Davidson, 1990, p.36) offer statistical evidence that matching teaching style and student learning style may lead to improved student performance.

In a slightly different approach, Kolb found a strong positive correlation between the learning style of students and their ratings of the teaching style of the teacher who had influenced them the most. These correlations show a strong similarity between the student's learning style and that of the style of the teacher who influenced him/her (McCarthy, 1987, p.85).

Saracho (1981, p.3) suggests matching teaching styles and student's learning styles influences student perceptions, rather than actual achievement. Students perceived a higher degree of satisfaction and performance when teacher-student compatibility was high.

In contrast, several studies suggest there is little support for the practice of matching teaching methods with student's preferred learning styles. Cronbach and Snow (Davidson, 1990, p.36) concluded that such matching may not improve learning, but instead lead to its detriment. Cohen, Hyman, Ashcroft and Loveless (Davidson, 1990, p.36-37) conducted an Eric search on learning styles which yielded more than eighteen hundred references. However, only thirty of these articles were research based, and the analyses of these did not support the notion that matching learning style with teaching style improved learning (Davidson, 1990, p.36).

In 1977, a group of teachers at Parkway Elementary School in Greenwich, Connecticut formed a committee to research the possibility of matching teaching and learning styles in their school. Their goal was to find ways to improve the process by which students at Parkway were assigned to a particular teacher. After eight months of study, they concluded that the problem confronting them was extremely complicated, and that their efforts yielded further questions, rather than solutions (Ellis, 1979, p. 275).

Among these questions were:

- 1) Which learner characteristics are most important in attempting to match with a particular teacher?
- 2) How do you measure conceptual level, or maturity, or motivation?
- 3) How would you decide what to do if you could accurately measure learning style? (Keeping in mind that students do not nicely fit within one neat category.)

And if these first three questions can be answered adequately,

- 4) What happens to all your matching if a teacher moves, takes a leave of absence, or retires?

The question of whether matching teaching style with student's learning style is very much a point of debate. Doyle and Rutherford (1984) may have the compromise, in that they suggest that no single preference of learners should dictate an instructional prescription. Instead, a well balanced variety of teaching styles should be presented to all students (Davidson, 1990, p.36).

Davidson's findings support McCarthy's belief that students should be exposed to a variety of learning styles, thereby "granting each the opportunity to refine her/his best style while experiencing and developing alternative styles." (McCarthy, 1987, p.64).

Use of Learning Styles in a Classroom

The primary goal of education is to produce complete and well-rounded learners. According to McCarthy (McCarthy, 1987, p.86), it is essential that a variety of teaching styles are implemented in order to produce well-rounded learners. To allow and encourage children to refine their strengths and at the same time develop the less used ways of perceiving or processing is to believe in excellence (McCarthy, 1987, p.19).

Students need to be allowed to refine their preferred style of learning while at the same time experience and develop alternative styles (McCarthy, 1987, p.64). In order for students to be able to do this McCarthy developed her 4MAT System. The 4MAT System is an eight step cycle of instruction that not only capitalizes on individual learning styles but also alternates left-right brain dominance processing preferences through the learning style cycle.

Teachers need to develop teaching methodologies which will not only teach to the various learning styles but also to both right and left modes of thinking (McCarthy, 1987, p.71). The functions of the right and left hemispheres of the brain are different. Speech resides in the left brain and spatial capability in the right brain. The left hemisphere does a lineal, sequential type of processing. The right hemisphere uses a global process in which data is perceived, absorbed, and processed even while it is in the process of changing (McCarthy, 1987, p.70).

McCarthy (1987, p.82-84) contends that the educational system is strongly biased in favor of left-mode structures and teaching methods. Her survey of 1,886 teachers and administrators found a

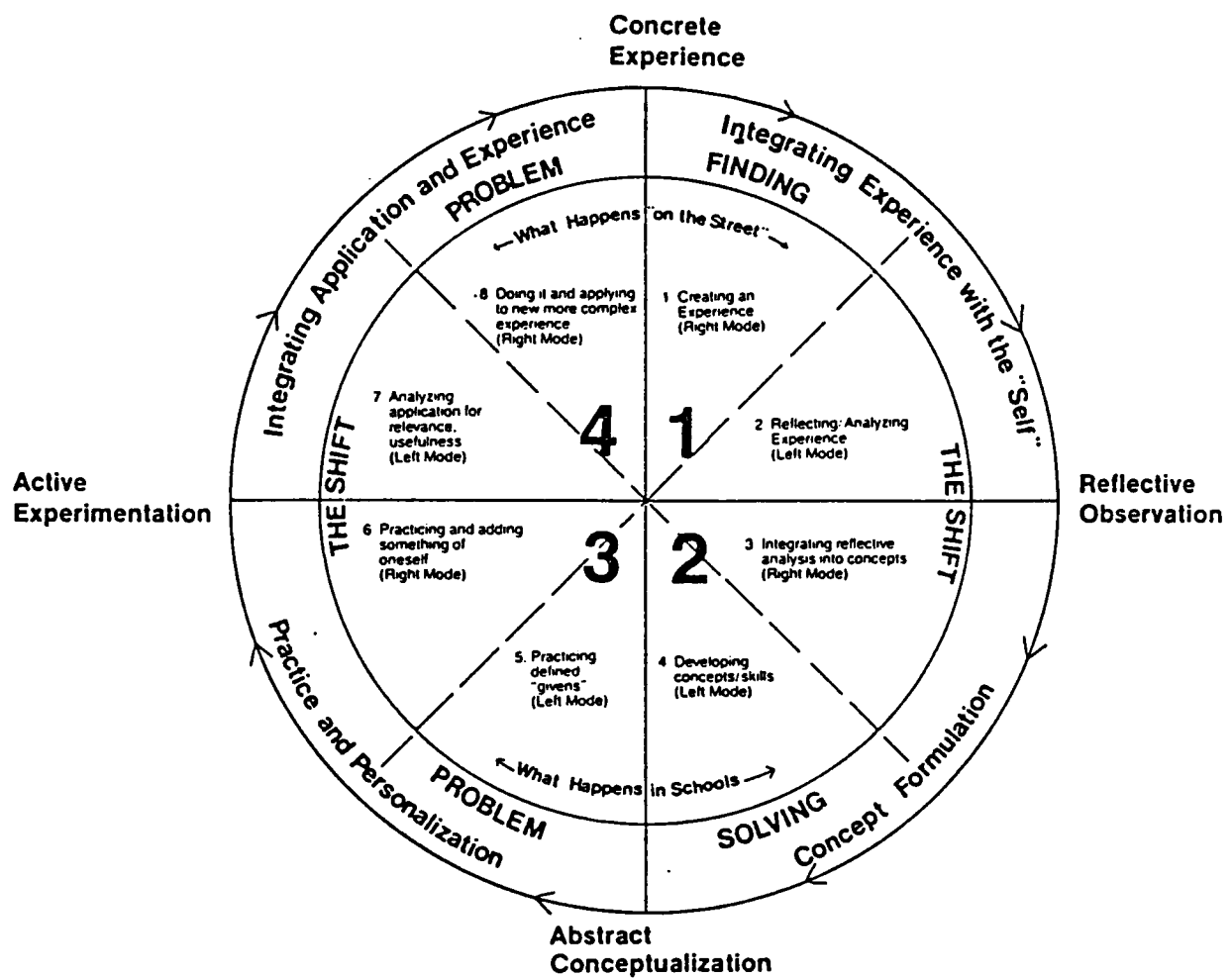


Figure 1: The Complete 4MAT System Model

(McCarthy, 1987, p.122)

strong tendency toward left mode in Quadrants Two and Three and a strong tendency toward right mode in Quadrants One and Four.

Quadrant	Ones	Twos	Threes	Fours
Learning Style Totals	23.4%	30.8%	17.5%	28.2%
Right Mode Totals	59.2%	14.7%	20%	74.6%
Left Mode Totals	28.2%	79.8%	73%	18.6%

Her findings have led McCarthy to speculate that "schools primarily teach at the bottom of the 4MAT circle, Left Mode, Quadrant Two and Left Mode, Quadrant Three, giving information to passive receivers and requiring the completion of workbooks and questions at the ends of chapters in order to get to the next chapter." (McCarthy, 1987, p.84). This style of teaching is like a pendulum, swinging back and forth across the bottom of the circle, rather than going from experience, to reflection, to conceptualization, to experimentation (McCarthy, 1987, p.84).

It is crucial that all four styles of learning are taught to students, as well as equally valued (McCarthy, 1987, p.86). Students need to develop skills that don't come naturally, while at the same time refine their innate gifts. McCarthy contends this can happen if we allow for a natural progression "around the circle", and allow the students the opportunity to choose their most comfortable places - their own best learning styles. She feels this way students will be able to "shine" at least 25% of the time, and will be exposed to other styles as well (McCarthy, 1987, p.47).

Torrance, however, states that the progression "around the circle" may look like an improvement for the students who rarely shine in the traditional classroom but points out all students are still at

a disadvantage 75% of the time (Schmeck, 1988, p.278).

Many researchers agree with McCarthy that students do need to be exposed to a variety of learning styles. She does not believe in matching students to their preferred learning styles. She feels this may be more destructive in the long run because by teaching to one mode of learning we are neglecting the other three. Future life experiences of students will present them with many types of learning situations, and unless they have been exposed to all types of learning students will be at a disadvantage (McCarthy, 1987, p.86).

Heikkinen, Pettigrew and Zakrajsek (1985, p.80) also believe there is a great need for a more eclectic approach to teaching - one that provides for a variety of learning styles. Teachers need to encourage students to be "eclectic learners", or students who can shift learning styles and function profitably in a variety of situations.

Jung does not feel all four processes should be developed equally because he believes it will actually keep all of the processes relatively undeveloped. He argues that if a person is to be really effective one process must be given the opportunity to reach its full development (Briggs Myers and Myers, 1980, p.12).

Briggs Myers and Myers (1980, p.202) agree with Jung that the supremacy of one process is essential but argue that full development of type is needed. The full development of type involves getting to be expertly skilled with the dominant process, skilled use of the auxiliary type and learning to use the two less-favored and less-developed processes appropriately. The development of only the favorite process is not healthy, safe for society, or ultimately satisfying to the individual, because it lacks balance. The full development of type creates balance. In order for full development to happen the teacher

needs to provide a variety of learning styles for the student to use.

It is important to keep in mind that styles are not entirely exclusive to each other (Fischer and Fischer, 1979, p.254). Although a learning style may be the dominant mode of a learner or teacher, there are still benefits achieved from the other modes. For example, the hands on learner still gains some benefits from lectures or oral reports, and the intuitive learner does not always avoid step-by-step incremental learning.

Another factor to take into consideration is that student choices of learning styles reveal their most comfortable penchants at that place, and at that time in their level of development, and in some particular situation (McCarthy, 1987, p.86).

Another argument in support of exposing students to all learning styles rather than matching learning and teaching styles is that we should not deny students the benefits of learning from each other, and experiencing the learning styles of other students (McCarthy, 1987, p.86).

It is important to have an understanding of all learning styles for several reasons: 1) to act as a basis of a convenient framework to capture the cognitive and affective diversity in students; 2) an awareness of learning styles will encourage the use of more versatile teaching techniques; 3) informing students of their particular learning style may help them to learn, since learning efficiency may increase when students understand their styles and preferences (Gregorc, 1979; Dixon, 1992; Cornett, 1983); and 4) by observing a diversity of styles, students and teachers may broaden their awareness and increase their acceptance of differences among people in general (Davidson, 1990, p.37).

All ways of learning need to be made available in the classroom so students understand that there are not just many valuable and interesting things to learn but that there are many ways to learn them. By exposing students to all learning styles we can help them develop in all the learning styles thereby making certain that the avenues of education will not be closed to them because of their learning preference.

Conclusion

The virtue of schools is that students do experience a variety of teaching styles (Turner, 1979, p.257). This is a natural occurrence over the years. However, students require that that variety occur daily.

The implementation of all learning styles in the classroom can help us as teachers find ways for every student to be successful. It focuses on the strengths rather than the weaknesses. It makes learning and instruction more responsive to the needs of individual students. It focuses on the realization that there is no best way to learn, but instead there are many right ways to learn.

The best education we can give our students is an education that teaches them how to learn. Attention to learning styles can help us do this. At the very least, we owe it to ourselves and to our students to be open-minded about the learning styles theories and be willing to learn from them.

Introduction

The second section of this project is an integrated Language Arts unit to be used at the grade four level, and centers around the theme of the "Sea". The unit is intended to be about five weeks long depending upon the interest and availability of the resources.

The unit is made up of four lessons. Each lesson caters to one of the four major learning styles developed by Bernice McCarthy and follows her cycle of learning model. Each lesson will include a brief description of the role of the learner and the teacher, and what it offers the learner in terms of what they need as learners. The lessons have been designed to each be about one hour in length and each has their own set of objectives. Each lesson contains activities related to the Language Learning components of Exploring, Constructing and Communicating meaning.

A classroom atmosphere can be established by setting up an aquarium. A fresh water aquarium is easier to maintain and much cheaper than a salt water aquarium. However with a salt water aquarium animals found in the ocean (starfish, sea anemones) can be displayed. Pictures, books and other artifacts should be displayed throughout the room.

The unit also contains seven learning centers to be done after the lessons are completed. The learning centers will contain activities that relate to the four learning styles developed by McCarthy. The learning centers have been designed to be an intricate part of the unit, and each has its own set of objectives. Each activity in the learning centers will contain a brief introduction about the type of learner it is targeted at. The learning centers are intended to give students the opportunity to choose how they would like to learn

and to allow them to experience other ways of learning. They will be asked to complete four of seven learning centers.

The students will also be asked to keep a Learning Center Log about their learning center experiences. Their responses in the log should include the reason why they chose that center, and whether or not they liked that particular activity and why. It is important for the students to keep this log because it will give the teacher some insight into the learning style preference of the student and it is also hoped that it will bring the students to some realization of how they prefer to learn.

The students will also be asked to keep an Ocean Dictionary/Encyclopedia containing important words or information learned in the centers.

The unit begins with four lessons, and continues with the learning centers. It will culminate with research projects done by the students on one sea animal of their choice. Students will be given the choice of doing it individually or with a partner. The research projects **do not need** to be in the form of a research paper. Students, after consulting with the teacher, may develop any means of presenting a research project to their classmates. As teachers they will now be allowed to teach what they have learned to their classmates in the quadrant they are most comfortable in.

Skills such as paragraphing, sentence structure, punctuation, figures of speech, spelling and phonics will be dealt with as the need and opportunity arises. The skills will be taught within context rather than in totally separate and isolated lessons. It is the teacher's responsibility to be observant and knowledgeable about such skills and to deal with them when the need and opportunity arises.

The "Sea" unit has been designed to be a complete unit and ready

to use in a classroom. The unit was designed to create a learning environment which will be facilitated by a wide variety of learning experiences appropriate for the wide variety of learning styles of the children in the classroom.

Although students are expected to gain some knowledge from each center they complete, the main purpose of these centers is to give students a chance to experience different learning styles and to allow them to choose the learning style they wish to learn from.

LESSON PLANS

(based on Bernice McCarthy's 4MAT System Model)

Lesson One: Sea Animals and Their Characteristics

Lesson one emphasizes Quadrant One of the learning cycle developed by Bernice McCarthy. It creates an experience and allows the students to reflect upon that experience. In this lesson students will observe/experience a variety of sea animals. The teacher acts as a motivator creating an experience and interacting with the students by asking leading questions when necessary.

This is the quadrant where discussion between the students and the teacher is important for motivation and learning. It is hoped that the brainstorming that will go on between the students and the teacher about the sea horses will motivate the students to learn about other sea creatures.

To help create the experience for the students many pictures and specimens will be on hand for children not only to look at but also touch. The teacher will further help create an experience by going through step by step a process of observing through the senses, showing the children that by using their senses they can obtain information about the sea animals.

McCarthy suggests that teachers concentrate on the question "why" to help students create personal meaning - to create a reason for learning. The "why" question acts as a motivation to learning.

Objectives:

- a) The students will demonstrate the willingness and ability to work cooperatively with others to achieve a common goal.
- b) The students will demonstrate an increasing ability to "pool" and compare observations to arrive at commonalities and differences among sea creatures.

- c) The students will demonstrate an increasing ability in utilizing as many senses as possible to enhance their observational skills.
- d) The students will demonstrate an increasing understanding of a variety of sea animals, their characteristics, and special adaptations they possess in order to survive.
- e) The students will demonstrate a willingness to share the knowledge they have acquired.

Exploring:

1. Using the seahorse as an example, ask the students how they can use their senses to make observations about seahorses. Refer to questions that have been put on the blackboard or chart paper ahead of time.
 1. How many body parts does it have?
 2. Sketch and label them.
 3. Does it have fins? If so, where?
 4. Does it have legs? How many?
 5. What does it eat? How: suck, bite, swallow?
 6. What environment does it live in?
 7. Does light or darkness affect it?
 8. How does it move?
 9. How does it breathe?
 10. Sketch your whole animal and name it?
 11. Other observations?

Record answers

2. Divide the students into groups. Assign each group one animal to observe (resources could include pictures, models or figurines) - each group should have more than one picture or object to observe.

Constructing:

1. Students make their observations about their sea animal (referring to questions) and record information gathered. Students then add any additional information they may know about their sea animal.

Communicating:

1. Using the concept of a Venn diagram, students, as a class, offer answers to questions and instruct the teacher what to record in relation to the differences and commonalities.
2. The Venn diagram should be recorded on large chart paper.
3. When all the questions have been discussed and recorded, the diagram will be reviewed in broader terms.

Lesson Two: Classification of Sea Animals

Lesson two emphasizes Quadrant Two of the learning cycle. In the quadrant two section of the learning cycle the teacher is the most active participant. The teacher's role becomes that of information giver. It is in this quadrant that the teacher takes on the traditional role of teaching.

In this lesson the students will use what they learned through experiences in lesson one and group information according to similarities. The teacher will then teach a lesson on categories of sea animals and the characteristics of each.

Objectives:

- a) The students will demonstrate the willingness and ability to respect the opinions of others.
- b) The students will demonstrate a positive attitude towards learning by watching and listening.
- c) The students will demonstrate an increasing understanding of the categories of sea animals and their characteristics (similarities and differences).
- d) The students will demonstrate an increasing ability to use the pattern of a cinquain to precisely express their ideas.
- e) The students will demonstrate the ability to categorize various sea animals.
- f) The students will demonstrate the willingness and ability to work cooperatively with others to achieve a common goal.

Exploring:

1. Using the Venn diagram from lesson one, discuss the commonalities/differences of the sea animals. Have students focus in on the similarities, and decide if any sea animals can be grouped together and why.

Constructing:

1. After the students have contributed their knowledge the teacher will introduce the categories of sea animals and discuss the characteristics of each. The teacher will make use of an overhead copy of categories and characteristics but will not show the animals in each.
2. Students divide into small groups, each group is assigned one category of sea animal.
3. Students as a group decide what animals fit the categories (collect appropriate pictures and specimens - use last lesson's resources). Students should be able to give reasons for decisions.
4. Students come together as a class and share their decisions with the rest of the class.
5. The teacher records the results on the chart.
6. The teacher supplies any additional information to the chart.

Communicating:

1. Students will use their information on sea animals to write a "cinquain" about their choice of sea

animal.

2. Brainstorm as a class on one sea animal to teach or review this type of writing pattern.

Title for all students is "Sea Animal"

e.g.

Sea Animal

Huge, mammal

Swimming, diving, leaping

Breathing through a blowhole

Whale

Cinquain:

Line 1: One word (title)

Line 2: Two words (describes title)

Line 3: Three words (tell action)

Line 4: Four words (tell feeling or description)

Line 5: One word (refer to title)

Once students have completed a cinquain and illustrated it, they can share it with the class by reading all of their cinquain except the last word and let the class see if they can guess the identity of the sea animal.

MAMMALS

- warm-blooded
- live breeders
- have lungs to
 breath air
- skin is usually
 covered with
 hair or fur
- they have a
 backbone
- teeth
- some do not
 have teeth
- some have
 flippers
- whales, seals
- dolphins (whales)
- otters, manatees,
- walrus

FISH

- most lay eggs
- they have gills
- fins
- body covered
 with scales
- cold-blooded
- tails
- no hair
- many types of
 fish - porcupine
 fish;
- sharks,
- sea horses

ECHINODERMS

- very thin
 skin covering
- under the skin
 is the skeleton
- the meat of the
 animal is under
 the skeleton
- there are spines
 on the skeleton
- grows from a
 central point
- starfish,
- sea urchin,
- sand dollar,
- sea cucumber

BIRDS

- feathers
- beaks
- wings
- lay eggs
- warm-
 blooded
- penguins

MOLLUSKS

- soft body
 - with no bones
 - or skeleton
 - covered with a
 - mantle of skin
 - the mantle
 - sometimes secretes
 - a substance to
 - make a shell
- snails, oysters,
squid, octopus,
clams

CRUSTACEANS

- hard shell
 - covering on top
 - with a small
 - abdomen underneath
 - jointed legs
- crabs, lobsters,
crayfish

ANTHOZOANS

- flower like
 - grows by
 - themselves or
 - in colonies
- coral, jellyfish,
sea anemones

Lesson Three: Adaptations of Sea Animals

Lesson three emphasizes Quadrant Three of the learning cycle. This is the quadrant in which the teacher is the facilitator or coach. The teacher needs to step back and be available as a coach and stabilize the activities of the student. In this quadrant the students are the more active participants. As teachers we need to let them experiment, try things out, manipulate and tinker around. It is through this "messaging around" that the students are able to add something of themselves and create something of their own. It is in this quadrant that the students practice the defined "givens" from quadrant two.

In this lesson the students will create an imaginary sea animal (using plasticine) using the "givens" from the quadrant two lesson, and add something of themselves. They need to ask and answer the question "How does this work?"

Objectives:

- a) The students will demonstrate the ability to share resources and respect the opinions of others.
- b) The students will demonstrate a knowledge of animal adaptations for specific purposes.
- c) The students will demonstrate a willingness to ask questions to further understanding.
- d) The students will demonstrate the ability to support and defend their ideas about the adaptation characteristics of their sea animal.
- e) The students will demonstrate the ability to categorize information and ideas about their sea animal.
- f) The students will demonstrate the ability to draw

conclusions and make generalizations about their own and classmates' sea animals.

- g) The students will demonstrate the ability to express personal ideas, opinions and viewpoints.

Exploring:

1. Review the categories of sea animals and their characteristics using the chart created during lesson two.
2. Discuss a possible imaginary sea creature (loche ness monster) - what might it look like - what characteristics would it have, what would these characteristics be used for. Draw the creature on the board, labeling the parts suggested by the students.

Constructing:

1. Students (using plasticine or clay) create their own creature, it could be a combination of two or three real creatures, or something totally imaginary.
2. The creature they design must have specific adaptations and the students should be prepared to tell how these adaptations help the animal to survive.

Communicating:

1. Students are to list their sea creature's characteristics and describe how these characteristics help the animal, or are necessary for the animal's survival.
2. Students may sketch the sea animal they have created labeling parts if they wish.
3. Students divide themselves into groups of five or six and share their creations.

4. Meet as a large group and discuss any general observations made. The observations could also be recorded on chart paper for future use.

Lesson Four: Adaptations of Sea Animals To Their Habitat

Lesson four reflects the characteristics of Quadrant Four of McCarthy's learning cycle. Quadrant four children prefer to learn by doing and sensing/feeling. As teachers we have to let them teach it to themselves by encouraging them to ask questions of themselves: "What can this become?", "What can I make of this?" and "What if?".

Students are the main participants in this quadrant. Through interaction with the students the teacher acts as an evaluator and remediator by creating a climate where there is freedom to discover by doing. This is the creative part of teaching where the teacher challenges the students to look at what has happened, analyze it for relevance and originality. The teacher's role is to help the students plan and work systematically, to increase their ability to complete what they begin and to give them the opportunity to explain what they have learned for themselves.

Objectives:

- a) The students will demonstrate the ability to categorize the information and ideas.
- b) The students will demonstrate the ability to draw conclusions and make generalizations.
- c) The students will demonstrate the willingness to ask questions to further understanding.
- d) The students will demonstrate the willingness to participate in the discussion of the topic.
- e) The students will demonstrate the ability to experiment with ways of presenting their ideas.
- f) The students will demonstrate the ability to recognize

the meanings of words and use them appropriately.

- g) The students will demonstrate the ability to organize ideas for their projects.

Exploring:

1. Using the chart from lesson two, review the characteristics and classifications of sea animals.
2. Introduce the concept of adaptations to habitats (special characteristics of animals which allows them to live in certain ocean habitats). Topics that should be discussed are: camouflage, special body features, and partnerships. Begin by discussing how humans adapt to their surroundings.

Constructing:

1. Discuss as a class how various characteristics of sea animals might help the sea animals adapt to their environment (use various pictures of sea animals such as the octopus, clown triggerfish, four-eye butterfly, penguin, lionfish, puffers, starfish, jellyfish, anemone and crab, making sure these pictures show various adaptation features).

For more information on the various characteristics refer to the information sheet: Various Adaptation Features. This sheet is found at the end of the lesson.

Communicating:

1. Students construct a project to share with the class that features one or more sea animals, showing a knowledge of classifications, and adaptation characteristics.

Examples for projects:

a) Riddle booklets featuring sea animals

e.g.

I have many arms called tentacles with
suction cups on them. I can swim
backwards and sometimes my body changes
color to hide me from enemies. I am a
_____. (mollusk).

b) Card games for one or more students.

Matching name of sea animal to a card
with correct classification.

c) Crossword puzzles or word searches

d) Camouflage pictures

e) Dioramas

Various Adaptation Features

Camouflage: Camouflage coloration helps animals blend in with their surroundings. The octopus changes color instantly from black to grey to red to match its background. It can also change the texture of its skin, becoming bumpy or smooth to blend in with rocks and seaweeds. In coral reef fishes like the clown triggerfish have different colored spots and stripes which breaks up their body shape and helps to conceal them in their backgrounds. The false eye spots on a four-eye butterfly helps to protect its vulnerable body parts. A predator will be confused and may attack in the area of the false eye spots near the tail thus allowing the fish time to escape. Some animals like penguins have dark backs and light stomach areas. The dark back when viewed from above blends in with the darkness of the ocean. From below the white stomachs blend in with the bright sunlit surface waters.

Body Shape: The barracuda's shape helps it to be a fierce hunter. It's elongated shape helps make it fast. It can remain motionless in water and then lunge out with lightning speed to catch a victim. Puffers and balloonfish can fill their bodies with water or air, becoming too big to swallow. Some also have spines all over their bodies for added protection. Some fish, like the wolffish, are shaped like a snake

and can move easily through cracks and crevices, under rocks, around plants, hiding from predators or waiting for victims. Flattened fish, like angelfish, when viewed head-on almost seem to disappear. Their shape allows them to make quick turns and dart in and out of hiding places.

Helpful Appendages: Many fish which are not fast swimmers

have sharp or poisonous spines on their backs for protection (lion fish). Stingrays have a poisonous dart on their tail.

Sea urchins and starfish have sharp spines on their upper surfaces for protection. When the porcupine fish inflates itself like a balloon it becomes covered with spines.

Starfish and octopus have suction tubes on their arms for catching and holding their food. Lobsters and crabs have pinching claws on the ends of their appendages. Jellyfish and sea anemones have tentacles equipped with stinging cells to catch their food.

Information taken from:

Center for Marine Conservation. (1989).

The ocean book. New York:

John Wiley and Sons, Inc., p. 58-64.

LEARNING CENTERS

Learning Center One: The Importance of the Ocean

Learning Center One focuses on the quadrant one learner. These learners are the Imaginative Learners. The teacher creates a reason and a desire for learning about the ocean by showing how important the ocean is to our lives and it is therefore important for us to understand the ocean. The most important question for the Imaginative Learner is "why". This center helps these learners to answer the question of "why" the ocean is so important to us and "why" we need to learn about the ocean. It helps them to develop their own reason for learning about the ocean.

The Imaginative Learners prefer to learn through a combination of sensing/feeling and watching. The skills that are addressed in this learning center are observing, questioning, visualizing, imagining, inferring, listening, speaking and interacting.

The students are encouraged to use their imagination and generate ideas through brainstorming, listening, speaking and interacting with others.

Objectives:

- a) The students will demonstrate the ability and willingness to participate in a group discussion, asking questions and providing opinions.
- b) The students will demonstrate an increasing ability to record their own personal learning growth.
- c) The students will demonstrate the ability to categorize information and ideas on a particular topic.
- d) The students will demonstrate the ability to draw conclusions from oral discussions, and provided pictures.

- e) The students will demonstrate the ability to reflect on their personal experiences.

Exploring:

1. Students look through pictures of the ocean, beaches, fishing boats, sea food, world map (a globe should also be used) and discuss with other students at the center what they see in the pictures and how these items are related.

Constructing:

1. Students will discuss in small groups why the ocean is important to them, what the ocean provides them with.
2. Students will make a list of the reasons why the ocean is important to them.

Communicating:

1. Students will make a collage by gathering pictures from provided magazines (National Geographic, World, Canadian Living, etc.) of examples of what the ocean provides them with.
2. Students will write in their Learning Center Log any personal thoughts about the center - likes and/or dislikes.
3. Students will record any important information or words in their Ocean Dictionary/Encyclopedia.

Learning Center Two: A Whale of a Tail

Learning Center Two also focuses on the quadrant one learner. The teacher takes on the role of the motivator, creating the experience by providing the material (aquarium, video), questions and allowing the students to reflect upon what they learn.

To help create the experience many pictures of whales should be at the center. A video about whales should be set up for the students to watch. An aquarium should be set up in the room so the students can observe live sea animals. The Imaginative Learner needs to be given a reason to learn, they need to know why what they are asked to learn is important.

The ocean and the animals and plants that call it home are very important to our own survival. It is important to learn about the ocean and the animals that live in it. Students need to understand in order for animals to live in the ocean they have physical characteristics that are necessary for their survival. It is hoped that this experience will create a desire in the students to learn more about the ocean and the plants and animals that live in it.

Objectives:

- a) The students will demonstrate a knowledge of the physical features of a sea animal, and the importance of those physical features to the life of the animal.
- b) The students will demonstrate the ability to make observations and draw conclusions from those observations.
- c) The students will demonstrate the ability to recognize important words and information to add to their Ocean

Dictionary/Enclopedia.

- d) The students will demonstrate an increasing ability to record their personal learning growth in their logs.

Exploring:

1. Students will look at various pictures of sea animals (whales) and watch the video on whales, watching for specific body parts and what the whale uses these body parts for.

Constructing:

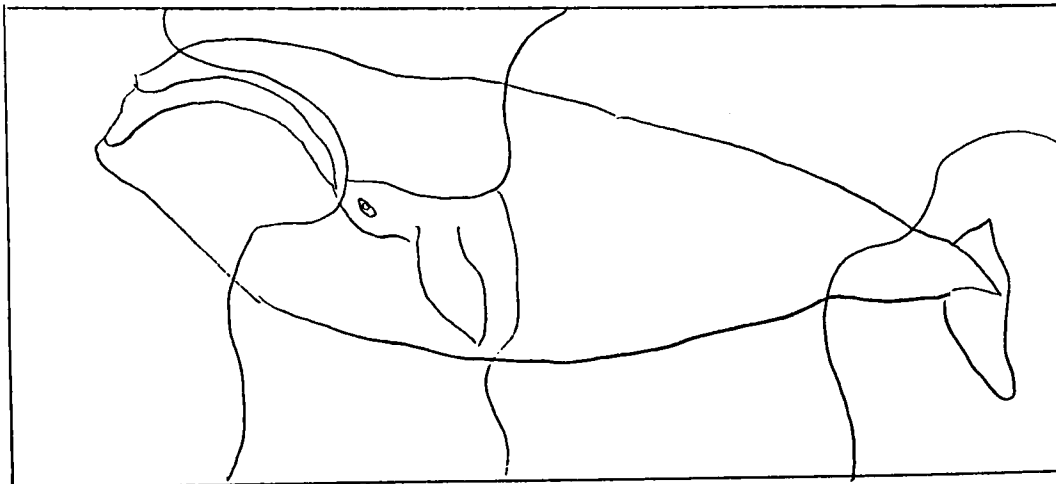
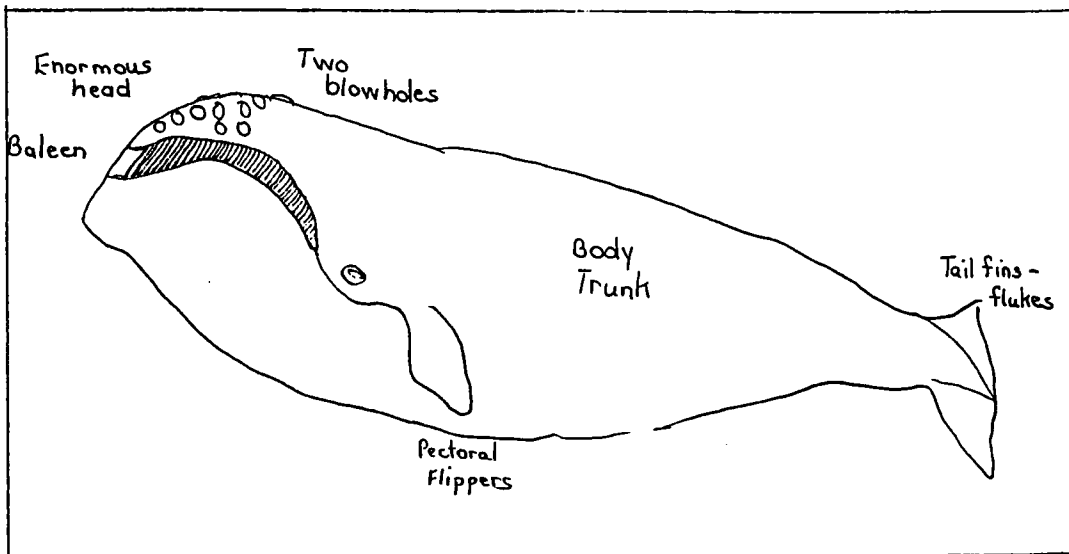
1. Students will put together the sea animal puzzle (that has been cut out ahead of time), and glue the pieces on to the labeled diagram.

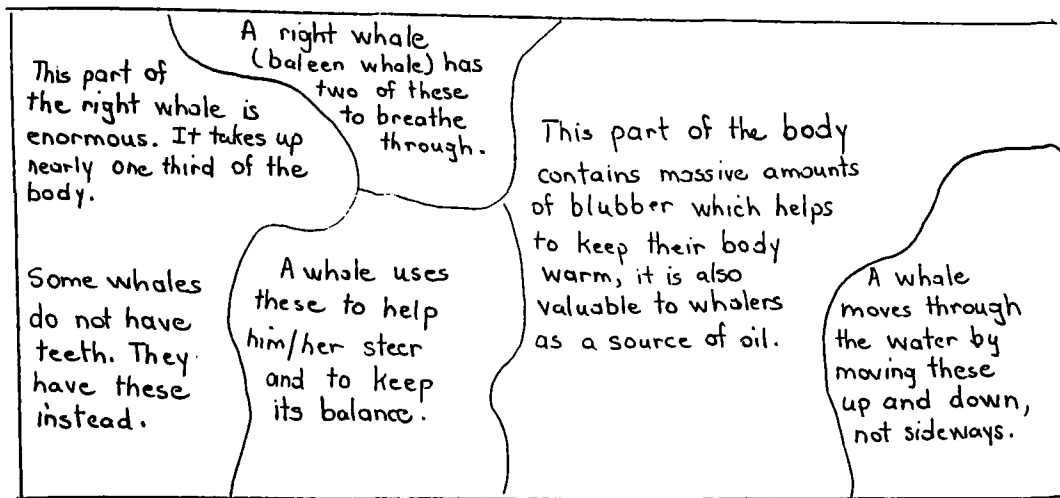
Communicating:

1. Students complete worksheet on marine mammal crossword puzzle.
2. Students add any new words or information to their Ocean Dictionary/Enclopedia.
3. Students write about their learning experience in their personal logs.

Extended Activity:

If there is an aquarium in the room the students can observe the animals in the aquarium looking for specific body parts and concluding what the parts are doing for the animal. They can then draw their sea animal, labeling the parts with a brief explanation about the importance of each part.





A Whale of a Tail Crossword Puzzle

Across

1. Whales breathe through their_____.
2. Whales resemble these sea animals, but they are not _____.
3. Baleen whales feed on small shrimp-like animals called _____.
4. Whales do not have gills, they have _____.
5. Whales have very poor _____.
6. The whale's body is very _____ for swimming.
7. Whales that do not have teeth are called _____ whales.
8. Whales have a good sense of _____.
9. Whales breath _____.
10. Whales are _____ animals.

Down

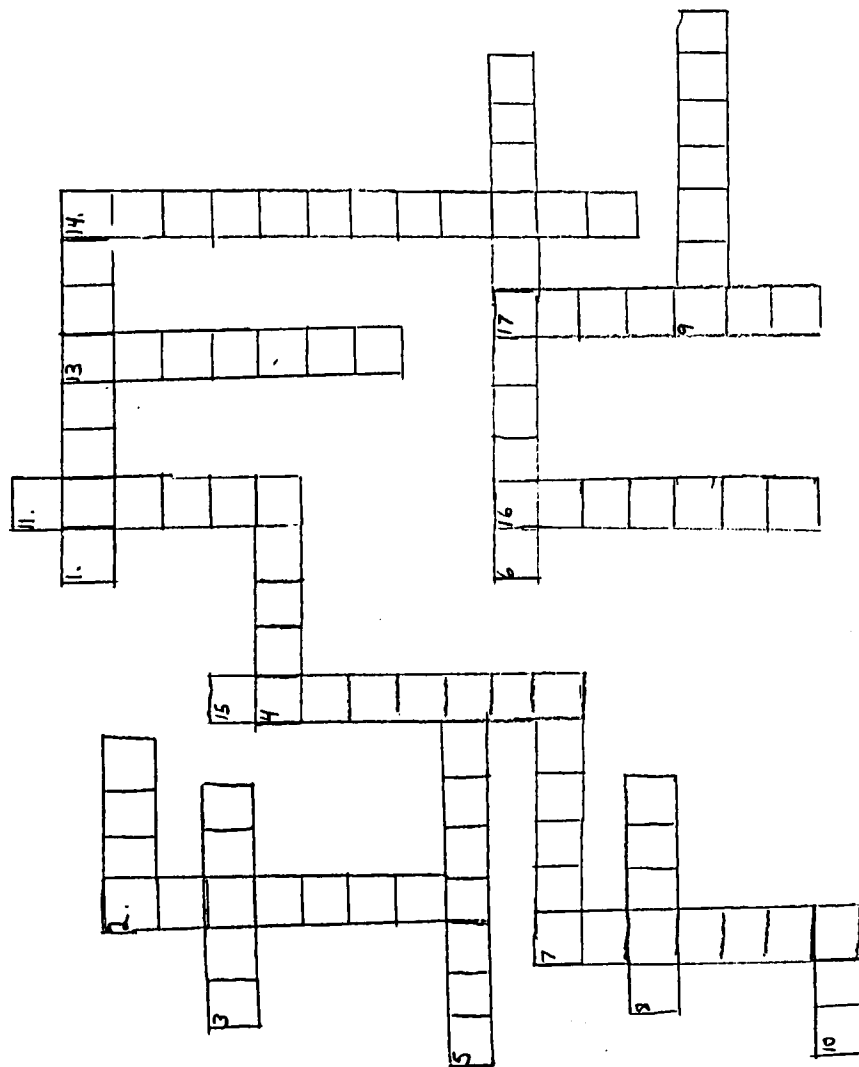
11. A whale moves its _____ up and down to help it swim.
2. A whale uses its _____ to help it start and stop, and to steer.
13. Whales have an excellent sense of _____.
14. Whales bounce sounds off of objects to find food. This is called _____.
15. Tiny plants and animals found floating in the sea are called _____.
7. Whales have a thick, fatty layer of _____ under the skin to keep them warm.

16. Whales with teeth are called _____ whales.

17. Whales are _____ that live in the oceans
around the world.

Words

fish baleen mammals eyesight flukes touch flippers
krill blubber echolocation lungs aquatic air plankton
blowholes hearing toothed streamlined



Learning Center Three: Ocean Environments

This learning center focuses on the quadrant two learner, the Analytic Learner. These learners want to know the facts; they want answers to the question "what".

It is in this quadrant that the teacher assumes the role of information giver, teaching the information to the students. The skills that need to be addressed include seeing relationships and interrelationships, identifying parts, ordering, classifying and comparing. The students already have had some experience with the concept of ocean environments in the four lessons presented at the beginning of the unit. This experience serves as a lead in to the information given on the tape and information card. In this center the tape and information card take the place of the teacher as the information giver.

Objectives:

- a) The students will demonstrate an increasing ability to see the relationship between the sea animals and their environment.
- b) The students will demonstrate the ability to classify animals according to the types of ocean environments.
- c) The students will demonstrate the ability to read and listen for information.
- d) The students will demonstrate the ability to ask questions to further understanding.
- e) The students will demonstrate the ability to work cooperatively with others to achieve a common goal.

Exploring:

1. Students will either listen to the tape or read the card

containing the information. If they wish they can also listen to the tape as they are reading the card.

Constructing:

1. Students as a group, or with partners (or by themselves if they prefer) brainstorm for sea animals and plants that live in each ocean zone.
2. Students are then to construct a chart and list as many animals as they can that are found in each ocean environment.

e.g. Surface layer (epipelagic) - tuna, kingfish,
sailfish, sea otter, angelfish

Bad light zone (mesopelagic) - hatchetfish,
octopus, snipe eel

without light zone (aphotic) - viperfish
anglerfish, fangtooth, blind octopus

Seafloor (benthic) - corals, sponges, clams,
sea stars, worms, anemones, crustaceans

Realms of the Sea, published by National Geographic, has a stratified picture of the ocean environments and the sea animals that live in each zone.

Communicating:

1. In their Ocean Dictionary/Encyclopedia the students need to enter any new words or information they have learned.
2. In their personal log students are to do an entry regarding their feelings about this activity.
3. The students then draw a stratified view of the ocean

environments including animals from their chart. Each zone or layer should be labeled as well as the sea animals.

Learning Center Three Information Card

The ocean is a multistoried environment, arranged in layers or zones. The uppermost layer is called the epipelagic, or good light zone. It begins at the surface and ends as deep as six hundred and fifty feet. It is here that phytoplankton (tiny plants responsible for photosynthesis) do their work. Small microscopic animals called zooplankton are also found here. This zone is a clear, well-lighted place where fish like tuna, kingfish, sailfish and marlin are found. The green sea turtle, porcupine fish, sea otter, sea lion, dolphins, butterflyfish, angelfish are also found in this zone. Whales and sharks are also found here but they will swim or migrate to the deeper zones in search for food.

Beneath this surface layer (from 650 feet to 3,300 feet) is the mesopelagic, or bad light zone. This is the transition zone. It is the floor of the zone of light, the ceiling of darkness. It is inhabited by creatures with exquisitely photosensitive eyes and bodies. Photoplankton do not exist in this zone but zooplankton do. Fish such as lanternfish, hatchetfish, snipe eel, dragonfish and octopus inhabit this zone. Hatchetfish are small thin fishes with arrangement of reflective scales and luminescent cells called photophores.

Between 3,300 feet and the bottom is the aphotic or without light zone. Here, the sea creatures look like bad dreams: viperfish, fangtooth, anglerfish, gulperfish and blind octopuses. A characteristic of many deep-sea fish is oversized jaws and undersized bodies. The feeding opportunities are few and far between so the strategy is to eat as much as possible at each sitting. The gulper eels have giant jaws attached to slim, snakelike bodies that enable them to swallow prey

larger than themselves. These deep-sea creatures have their own unique features. Their eyes tend to be small (the deep-sea octopus is blind), the swim bladder is absent or regressed, gills reduced, heart and kidneys small.

The benthic environment - the seafloor - occurs at various depths. On the seafloor diversity and abundance of sea creatures drops with depth and as you move outward from the continents. The complex society of the hard corals disintegrates with depth. In the sunlight at the top of the ocean, hard corals are colonial and build the enormous coral reefs. In the deep ocean, hard corals occur only in solitary form, and below 10,000 feet they do not occur at all. Few fish or sponges are on the floors of the deep-sea trenches but are in abundance in shallower ocean floors. Sea anemones are very adaptable sea animals and are found on the floors of tidal pools to the deepest ocean floors. Clams and various types of worms also do well on the floors of the deepest ocean.

Information taken from:

Brower, K. (1991). Realms of the sea.

Washington, D.C.: National Geographic Society, p.28-43.

Learning Center Four: Polluting of the Ocean Environments

This learning center focuses on the quadrant two learner, the Analytic Learner. The teacher's role is that of information giver providing the information card and tape containing information on pollution of the oceans.

This center satisfies the Analytic Learner's need to know what the experts say. They rely on their intellectual ability for understanding. It provides them with the known facts about ocean pollution.

Most students will have some thoughts about ocean pollution. They have probably been made aware of oil spills through the mass media. The pictures at this center will help to create an experience for the students, so they can see a reason for learning about ocean pollution.

Objectives:

- a) The students will demonstrate an increasing understanding of the effects of pollution of the ocean upon not only the plants and animals that live in the ocean but ultimately on us.
- b) The students will be familiar with three types of ocean pollution.
- c) The students will demonstrate an increasing ability to read and listen for particular purposes.
- d) The students will demonstrate an increasing ability through writing to summarize, organize and record information and ideas in chart form.

Exploring:

1. Students either read the information card or listen to

the tape. They can also read along with the tape. They will also look through the various pictures of oil spills and the effects of those spills.

Constructing:

1. Students make a chart listing the types of pollution affecting the oceans. Under each heading list the sea animals and plants that are harmed, and how each type of pollution can be prevented.

Communicating:

1. Students record in Learning Center Log, reflections about this center.
2. Students record in Ocean Dictionary/Encyclopedia any new terms or information.
3. Students are to pretend they are investigators for the Environmental Protection Agency. They are to write a report of what they see after a major oil spill and make recommendations on how to clean it up and how to prevent future spills.

Pollution of the Oceans

The activities of humans have threatened the ocean environments and the many plants and animals that live in the ocean.

Every year more and more wastes and garbage are being dumped into the oceans. Hundreds of sea animals like the seals and dolphins become tangled in plastic nets and ropes that have been discarded from fishing boats and left floating in the water. Many of these animals drowned.

Pesticides such as DDT have polluted the ocean waters. Factories along the coasts often dump the chemical into the sewer system. The wastes would then spread into coastal waters. The DDT in the wastes is then absorbed by tiny plants and animals living in the water. Fish that eat the plants or animals containing the chemical absorb the chemical into their own bodies, and eventually it makes its way up the food chain. The ocean currents and migrating fish spread the poisons for great distances. To help stop the chemical pollution of the oceans many countries like the United States have banned chemicals such as DDT.

Oil spills from tankers can be deadly. Each year thousands of seabirds, oysters, lobsters are killed and large areas of kelp growth are destroyed.

On March 24, 1989 the oil tanker Exxon Valdez struck a reef. The large gashes in the ship's hull allowed eleven million gallons of oil to spill into the ocean. The oil drifted 550 miles and ruined 1,200 miles of shoreline. Over 36,000 seabirds were killed. Oil spills are especially dangerous to sea otters. The otters spend most

of their time on the water's surface where the oil lies. The oil matts their fur allowing the cold water to reach their skin, causing them to freeze to death. Otters were also dying from poisoning. They were swallowing the poisonous oil when they tried to lick it off their fur.

Oil and water do not mix, therefore after a spill the oil floats on the top of the water but it is tough to remove. Many different tools and techniques go into the cleaning up of an oil spill. Booms, skimmers and pom-poms are often used. Booms, which look like floating lane dividers in a swimming pool, corral the oil. Skimmers, which are conveyer belts, pull the oil aboard a ship, then rollers squeeze it into containers. Plastic pom-poms pick up oil and shed water. Chemicals are used to break the oil into droplets. Nature continues to break down the droplets until the oil is no longer harmful.

Information taken from:

1. Staff (1991, September). Sea otter rescue.

National Geographic World, pp. 3-8.

2. Rinard, J.E. (1987). Wildlife making a comeback. Washington, D.C.: National Geographic Society, pp. 38-44.

3. Stuart, G.S. (1980). Wildlife alert: The struggle to survive. Washington, D.C.: National Geographic Society, pp. 64-72.

Learning Center Five: How Ocean Currents Work

Learning center five primarily deals with what causes ocean currents. However rather than simply giving the students all the information this center allows them to find out for themselves how temperature-density, and salinity cause ocean currents.

The third quadrant learner is the Common Sense Learner. These learners need to try things. They rely heavily on kinetic involvement to learn, they have to try things out to see how they work.

The teacher's role is to provide the materials to allow the students to try it out and see how it works. The teacher must allow the students to become actively involved in the learning process. In this center the students are allowed and encouraged to see through experimentation, to predict and record their findings.

Objectives:

- a) The students will demonstrate the willingness and ability to work cooperatively with others.
- b) The students will demonstrate an increasing understanding of what causes ocean currents.
- c) The students will demonstrate the ability to follow step by step instructions to carry out the experiment.
- d) The students will demonstrate the ability to make observations and draw conclusions from those observations.

Exploring

1. Students will read the information card on "Ocean Currents", and read the questions so they have an understanding of what they are looking for in

the experiments.

Constructing:

1. Students will read instructions for the experiments following those instructions step by step.

Communicating:

1. Students will make an entry into their Learning Center Log, concerning any feelings about this activity.
2. Students add new words or information to their Ocean Dictionary/Encyclopedia.
3. Students will complete questions found on the information card.

Experiment One

Materials

- two flasks (same size) with flat rims
- 3x5 index cards
- one-half teaspoon of table salt
- food coloring
- pan to catch the water
- paper towels or towels to clean up any spilled water

Procedure

- work with a partner
- Fill both flasks with water.
- Dissolve one-half teaspoon of salt in one flask and then add a drop of food coloring to the water.
- Place the flask with fresh water into a pan.
- Place a 3x5 index card on top of the flask containing salt water and carefully invert it.
- Place the salt water flask on top of the flask with fresh water.
- Remove the card and observe and record the results.
- Repeat the procedure, but this time lay the flasks horizontally. Remove the card and observe the results.

Experiment Two

Materials

- two flasks (the same size) with flat rims
- 3x5 index cards
- food coloring
- paper towels or towels to clean up any spills
- pan to catch any water that spills

Procedure

- Fill one flask with warm water and add a drop of food coloring.
Fill the other flask with cool water.
- Place the flask with cool water in the pan.
- Place a 3x5 index card on top of the flask with warm water and food coloring.
- Invert the flask and place it on top of the flask with cool water.
- Carefully remove the card and observe and record results.
- Repeat procedure but this time place cool water flask on top of warm water flask. Remove card. Observe what happens and record the results.
- Repeat procedure but this time place flasks horizontally.
Remove the card. Watch to see what happens and record results.

Experiments taken from:

Center for Marine Conservation. (1989).

The ocean book. New York: John Wiley & Sons, Inc., pp. 18-19.

Ocean Currents

Ocean currents are masses of water that flow in a definite direction. Ocean currents are very important. They affect the climate of the lands nearby. The best fishing is often found where two currents come together. Currents can help transport boats. They also transport fish and shellfish that are too young to swim great distances.

There are several types of currents. The ocean's surface currents are caused by the wind. Winds push the ocean surface along in currents. These currents are deflected by continents and flow in circular patterns.

The ocean's deep currents are caused by temperature-density-salinity. As water grows colder, denser, and more saline it sinks. The sinking of cold, dense, saline water drives the deep currents. As cold water sinks, it displaces bottom water, which has to move.

Both types of currents are very important. They interact with each other to circulate the oceans. The oxygen is carried to the deeps by the sinking water, and life-giving nutrients are brought to the surface in cold-water upwellings. These currents have an enormous influence on the fertility of the sea.

Information taken from:

Brower, K. (1991). Realms of the sea.

Washington, D.C.: National Geographic Society, pp.17-25.

Learning Center Five

Questions on Ocean Currents

1. Is salt water heavier or lighter (density) than fresh water?
2. What happens to river water when it flows into the ocean?
3. Is warm water heavier or lighter than cool water?
4. Is it easier for a human being to swim in salty or in fresh water?

Why?

This center will appeal to what we refer to as the Common Sense Learner. The activities focus on the quadrant three learning style with its emphasis on active experimentation. It allows the students to actively try and find out what methods can clean up oil spills and to try out any of their own ideas. The students are allowed and encouraged to use their skills of experimenting and manipulating materials, building on what they already know. The students are actively involved in the learning process, while the teacher is a coach/facilitator providing the materials necessary for active experimentation.

Objectives:

- a) The students will demonstrate an increasing ability to ask questions to further their understanding.
- b) The students will demonstrate an increasing ability to record their own personal learning growth.
- c) The students will demonstrate the ability to categorize information, and to draw conclusions and make generalizations.
- d) The students will demonstrate an increasing ability to present a point of view and develop persuasive arguments supporting that point of view.

Exploring:

- 1. Students will read the information card and instructions for experiments so they understand what they are to do and what they are trying to determine. They can also check to see that all materials are at the center.

Constructing:

- 1. Students will carry out the experiments following the step

by step instructions.

2. Students will make charts showing methods used and the results of each method.

Communicating:

1. Students will make an entry into their Learning Center Log, reflecting upon their feelings about the activity.
2. Students are to add new words or information to their Ocean Dictionary/Encyclopedia.
3. Students are to pretend they are consultants for an Environmental Protection Agency. They will write a report outlining their findings and make recommendations on the best way to help birds and otters, and the best way to clean up the spills.

Oil Spill

People today are using more oil than ever before, ships are carrying large amounts of oil from places where it is produced to places where it is needed.

With the vast number of supertankers carrying oil all over the world, there is always a chance of an oil spill. When there is an oil spill animal and plant life are subjected to the oil. Birds that dive into the water in search of fish have their feathers coated with oil. Because of the oil, the bird's feathers are no longer waterproof. Cold water begins to soak through its feathers and chill the bird. Without help the bird will die.

Companies and environmental groups have tried many different chemicals and detergents to clean the oil off the birds' feathers and the fur of the sea otter. Saving animals is only part of the problem, the oil spills themselves must be cleaned up. Many times more than one method must be used. Various devices are used to skim the surface of the water and lift the oil off, materials to soak up the oil are used, as are chemicals to disperse the oil.

Information taken from:

1. Staff. (1991, September). After a spill.

National Geographic Society, p.8.

2. Stuart, G.S. (1980). Wildlife alert: The struggle to survive.

Washington, D.C.: National Geographic Society, pp. 64-69.

Experiment One Oily Feathers

Materials

- water
- bird feathers
- motor oil
- detergent (dish soap)
- household cleaners such as pine sol
- sponges
- paper towels
- hair dryer
- bowl

Procedure

- Place some water in a bowl then add some motor oil to create your own spill.
- Observe to see what happens.
- Place the bird feathers into the bowl to cover them with the oil and water.
- Take a feather covered with oil and observe what has happened to the feather.
 - what does it feel like
 - what does it look like
- Try to clean as much oil as possible off using one of the cleaners. Then blowdry the feather.

Record results.
- Do the same with the other feathers using different cleaners.

Record each result.

- Make a chart showing the material used and what the results were when the material was used.
- Use the information on the chart to determine which cleaner cleans bird feathers the best.

Experiment Two Cleaning Up Oil Spills

Materials

- bowl
- water
- motor oil
- fish net
- paper towels
- sponges
- string
- dish detergent

Procedure

- Place some water in five bowls then add some motor oil to the water creating an oil spill. Observe to see what happens to the oil and the water.
- With each bowl of water and oil try various methods of removing the oil.
 - using a fish net skim the surface of the water
 - sponges and paper towels can be used to try and soak up the oil
 - use the string as a drag and try to corral the oil and pull it to one area
 - add one drop of detergent to the water.

What does the detergent do to the oil in the water?

- Make a chart telling the method used and what happened
- From the chart results determine which method worked the best
- Can you think of any other way to get rid of oil spills?
If you can, try it to see if it will work.

Learning Center Seven

Learning center seven focuses on the quadrant four learner, the Dynamic Learner. These learners combine knowledge gained from personal experience, the experts and experimentation and try to make something of it. These learners need to learn on their own and then show what they have learned in their own way. The teacher acts as a remediator, helping and encouraging when necessary.

For students who choose to do this learning center it should be the last one they do. In learning center seven the students are to choose one area from the other four learning centers they have done and develop a small project to complete and present to the class.

They may choose any way they wish to present the project.

Examples for projects:

1. A play or skit with other classmates about the dangers of pollution to the ocean environment.
2. Crossword puzzles, word searches including information from one or all four other learning centers.
3. Art project focusing on the Ocean Environments
(large mural for classroom display)
 - Brainstorm for sea animals found in each environment, then choose one animal from each.
List the animals from top to bottom zones.
 - First draw animals on large paper, then paint each animal (animals should be arranged on the paper like a totem pole. The animal from the top zone of the ocean should be at the top of the paper and the animal found on the floor

of the ocean should be at the bottom of the paper).
Colors should be bright and the animals need to be big.
Once the animals are done fill in with some background-
the ocean floor and some plants. The mural can
also show the different colors of the ocean waters.
The top layer of water can be a light blue, closer
to the bottom the water color could get a little darker
but not so dark that the animal can not be seen.
Be sure the blues blend together.

4. Produce a commercial about oil spills
5. Dioramas showing ocean environments

Objectives:

- a) The students will demonstrate the ability to select particular topics and develop plans to create a project.
- b) The students will demonstrate an increasing ability to experiment with different ways of expressing their ideas and knowledge.
- c) The students will share their knowledge with classmates.

Exploring:

1. Students will decide what area they will concentrate on, plan their project (how are they going to present it).

Constructing:

1. Students will work on their projects.

Communicating:

1. Students will continue to write in their Learning Center Log, describing their feeling about

this learning center.

2. Students will make any new entries into their Ocean Dictionary/Enclopedia.
3. Students will present their projects to the class.

Culminating Activity

Establish a Topic

Students will choose a sea animal to research. They may use any means to research their topic: books, magazines, films and resource people. They can choose how to present their research topics. It does not have to be in the traditional research paper format. They can work by themselves or with a partner. Before they begin their research, brainstorm as a class research questions which they can use as a guideline when looking for information.

What do I want to know about my topic?

- How and what do they eat?
- Where do they live? (what part of the world and in which environment)
- How do they swim?
- Do they sleep? If so, how?
- How do they breathe?
- Who are their enemies?
- Do they have legs or fins?
- How do they reproduce?
- Who are their relatives?
- How big are they?
- How do they communicate?
- Do they have teeth?
- Can they live on land?
- Can they survive in fresh water?
- Are they endangered? If so, why?

Identify Audience and Presenting Format

- How do I want to present my research?

Students may choose whatever way they want to to present their projects. They are now the teachers and will decide what to present and how to present it.

- Who will be my audience?

Will it be presented to the class as a whole or will it be presented as an activity that can be done in small groups or by individuals?

Objectives:

- a) The students will demonstrate an increasing ability to choose a learning style they are most comfortable in.
- b) The students will demonstrate an increasing ability to locate information in the library.
- c) The students will demonstrate the ability to develop questions and plan in order to guide reading and research on a particular topic.
- d) The students will demonstrate the ability to categorize information and ideas.
- e) The students will demonstrate the ability to share their projects with others, to present the findings of their personal research.
- f) The students will demonstrate the ability to respond to others and their ideas in a collaborative learning setting.

Exploring:

1. Students will choose a sea animal to research.

As a class brainstorm for research questions.

What do I want to know about my topic?

2. Identify the audience and presenting format.

Constructing:

1. Students will research their topic in detail and then develop a way to present it to the class.

Communicating:

1. Students will present their projects to the class.

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