Fractal Phantoms Kindergarten Inspectors

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Introduction

Perception in the kindergarten classroom is just developing because in this group of early childhood students they are exposed to new concepts daily. This is also their first formal school environment. This environment is rich with learning posters and other sensory information which are directly helping to teach the student. The word perception is defined as the process of using the senses to acquire information about the surrounding environment or situation. In psychological terms it is a neurological process of observation and interpretation. I will be using the later definition to explain why I and my students lack or have the ability to understand this concept of Fractals or Chaos. In my writing of this unit I chose to build on their natural instinct of being curious. This curiosity has assisted in shaping the exciting lessons within this unit. This will help build their perception of visual objects they use in the lesson. The title Fractal Phantoms was chosen because a phantom is something that is elusive that you can't seem to put your hands, eyes, arms on it. A fractal is somewhat like this. You have to look at it in several different ways to understand it. The fractal is a geometric shape that is repeated infinitely. My kindergarteners will inspect the basic believe about a fractal and chaos. They will look at fractals very closely. Chaos will be explored through an on going activity that will involve the student's family.

Overview

The famous quote from the educator Elizabeth Peabody is "I saw it but I did not realize it" encompasses the premise of this curriculum unit and what we as educators and as students often miss if not directed to it.

This unit will be a study of fractals and how they are considered to be repetitive and chaotic. It is being written for an early childhood population specifically kindergarten, but can be adapted for other grades. The basic lessons will involve exposing the students to science, technology and math subjects using different attributes, also doing simple patterns such as the Fibonacci series, counting by fives, twos and ten. These things will be used as an introduction along with the wonderful story A Look Closer. This story is about insects that you may not be able to see unless you look closer. Through these subjects the students will learn what a fractal is. I intend to introduce pictures for discussion, mathematical patterns and other examples of repetition. They will learn to use a camera noting how to focus and how focusing is a great part of a fractal image. So to start I will be looking at examples of patterns. This will give them some on hand experiences. As the unit progresses I will be using five specific instructional strategies to get the students thinking on a more scientific level and with using their skills. These skills will be brought to surface through these instructional strategies. When a fractal object is being discussed the strategies will be used. It will be an attempt to get a higher level thinking skills developed at the cement level since this grade level is not doing abstract thinking at this point. These thinking skills will help them to differentiate, extrapolate, estimate, integrate and observe. The properties of chaos will be explored through on hands activities by using a perennial plant (spider plant) and the structure of a snowflake. Then exploring some more activities such as water drops rippling on a pond will assist with the recursive concept. We will also look at computer generated fractals also known as "beautiful math". This will be directly linked to the story A Look Closer, also. After doing this we will be able to formulate our own because we will be learning how to take pictures and use a camera. The purpose of these activities is to enrich the current technology and science curriculums. I will pose some questions as we adventure through this on fractals. The questions are:

**** What is it that you really see?***
**** Does it have a specific shape?***
**** Is there any self similarity present?***
**** What happens in recursive behavior?***

And I have chosen this topic because in the past decade Fractals and Chaos has been up for a great deal of discussion and there are some examples and text books on this topic. That gives an explanation mathematically and artistically about it. When my students leave school they will use mathematics more than any subject. This is evident through the use of a schedule, comparing prices, collecting data and reading and interpreting data. This is just a small fraction of how they will use math. My approach to this topic, as you have read so far, will be slightly different. At the kindergarten level students are very curious about what is going on and I hope to capture this curiosity while exploring the fractals. I will also use the technology period to explore images of fractals on the computer. I will also look at the Mandelbrot Set. We will make our own fractal pictures as well. The Sierpinski's triangle should be an easy one for my students to do, thus it being a repetitive triangle.

With animation playing a big part in fractals I would hope to make a design that I can show to my students as an example of how a fractal is created. The use of technology will help them see actually what the studies of fractals are about. This unit will take about three months to complete and will take twenty minutes two days a week. The time may be more if the students seem to be having a difficult time grasping the concept. I will be relating my goals to NCTM- National Council of Teachers of Mathematics standards. I also will be infusing the arts into this unit; by letting the students pick a shape and continually paint it or mold it with clay or using another artistic medium.

This unit will take some funding and expenditures but it will be minimal. I would hope to provide a new experience for my students. Teaching in an urban setting and providing this type of math will assist in building my students self esteem about achieving in math. This will help them later on in perceiving information related to math. They have all been to the Science Center and participate in a Science curriculum weekly as well. They also have a technology period of forty five minutes daily. My students will enjoy something new and refreshing that is not in their current curriculum but closely models the instructional delivery that is set for them, by utilizing some of the strategies.

Fractal Phantoms is an interesting unit with take home activities. I would hope to make fractals so interesting that they will automatically look for them in most things that they see. My students will look at math in a different way and I will be promoting an interest in math and science throughout their education.

Current research concerning this topic has been mathematically explained through the example given by Dr. Richard Holman at Carnegie Mellon University in the cla Fractals and Chaos seminar. This explanation was through numerical literation.

For instance the Cantor Set

C0-- 0 _____1

C1-- 0_____1/3 2/3_____1

C3-- 0_____1/9 2/9_____1/3

This can go on infinitely and this is the explanation for how a fractal becomes a fractal and how it is considered to be being chaotic (infinite). Dr. Holman gave other algorithms as well. He went into great detail about how numerically this can go on forever. I found his example helpful and illustrative.

We will also look at dimension to explore the idea of infinite. This concept of space and length will be a challenge but a pleasant one. The challenge will be, understanding about space. I would like to do an art activity to illustrate this for my students. We will use the art work with painting the space of butcher paper on a roll to help assist with understanding this. My students will be receiving a perennial plant. So they can visualize each year the plant growing. The process of recurring will be explored as well as chaos of the branches of the plant.

Rationale

There are two prevailing factors for the rationale for this unit;perception and early childhood development. I will first discuss perception then I will discuss development of the kindergarten student. I will also write about why I chose this way to teach the concept rather than another way. When discussing development I will be looking at it in relation to culture, best teaching practices and gender. The best teaching practices are important because it has made this unit universal in the sense that it can be used by any early childhood classroom. I will go into further detail as I explain my decision. Early childhood is from birth to age eight. This unit can be used from kindergarten to third grade. You can also adapt the lessons to older students. Before I discuss perception I want to discuss technology. My students will be using the computers daily for their reading lessons, so using them to look at and observe fractals will be helping them to infuse the application of the use of them into this unit. If this was an older group of students more complicated technology could be used. My students will get to refine their use of these tools. Now let me explain my reasons for writing this wonderful unit about fractals.

Perception will play a significant part in understanding the concept of a fractal. To make my students aware of what's going on I will use a concept I learned in under graduate school about learning theories and did some more research and follow up work related to perception as it is related to the Gestalt psychology which is considered a learning theory. This learning theory has several laws and here are my examples as researched from *Dr. C. George Boeree's* paper on Gestalt psychology and the Encarta Encyclopedia to explain it. Based on this theory called the "phi-

phenomenon" it is that people normally see an effect of the whole not contained in the sum of the parts and the perception of movement when there is not (illusory movement). We have a tendency to see things that are what we want to see. People have a strong tendency to look at the whole of a thing. This is based on perception and there are several Gestalt laws related to this type perception. In these laws it is stated that they help organize the principles of perception and how people look at things.

The first is the law of *pragnanz*, this word is German meaning pregnant. This law states that we are innately driven to see things orderly, regular or simple. For instance, if you have an outline of dots in a shape as a circle you will see the circle other than unconnected dots. This is not or is it what chaos and fractals are? The law of *closure* this is if something is missing you will add it. Such as when there are three fourths of a circle you will add the rest in your mind to make it complete. The law of *similarity* this is when you group things that are similar together. Below is a typographic example:

s p p p p
p s p p p
p p s p p
p p p s p
p p p p s

We will see the s among the p instead of the other way around not the p among the s. Another law is *proximity*. This is when things that are close together are seen as belonging together. Such as demonstrated below:

You will most likely see four lines of dashes than twelve vertical collections of dashes. Then next is the law of *symmetry* this is that things look exactly the same on each side, but there is an issue of proximity. The law of *continuity* is when you see a line as continuing, the line that always continues instead of stopping.

Some of the other thoughts of Gestalt psychology are *figure ground* this is when you look at something and see one thing but of your attitude changes you might see something different. *Memory* also works with these laws and learning (cognition) is basically through relationships. This is when you use what you already know to help with something new you're learning. *Productive thinking* is attempting to answer something that you may not even know about. Productive thinking is something that we would want to happen. So simply, *"the world of our experiences is meaningfully organized to one degree or another. When we solve problems we are recognizing meaning that is already there for the discovering*."

The learning theory that I want to end this with is from the research of Kurt Lewin one of the founders and psychologist of Gestalt. He came up with the *topological theory*. It is that human dynamics is in the form of a map representing a person's *life space*. The premise is that people are unaware of something until it enters their life space. So my students will not be aware of anything going on until it enters their life space. Their life space will be invaded with beautiful fractal images and chaotic activities. This will be a hope to change their perception about the things around them.

Most human beings are unaware of what is around them except for what is brought to their attention and perception. After discussing these laws above it appears that we are inwardly driven to look at the whole of a thing. After a certain age perception is influenced by personal values and other outside factors that are learned from such things as family members, peers and society as well. These learned observations have assisted people with understanding the environment around them. At this very young age those factors are of a small importance because they are just at their first year in a structured academic environment. This structured environment will help with preparing their skills. Through exposing my students to Fractal Phantoms- Kindergarten Inspectors they will be getting a running start in science and math activities. The *American Association for the Advancement of Science* suggests that you expose students at as early age as possible to science activities. This is why I think it is so important to bring this to the kindergarten student. Just the whole inductive and deductive way that the unit presents itself will build great problem solving skills. This will help promote their interest in science and also math.

When I think of this age group I think of them as being curious. I would like to use this curiosity as a catalyst while doing the unit. I have provided interesting ways to discover the fractals and to look at chaos. This curriculum unit will make things other than themselves significant and help them integrate and assimilate other information as they continue their education. I have written the lessons to build on prior knowledge. I have sequentially presented them in such a way.
The reason I have chosen this way to teach it for my students is because of their age and cognitive development stage. They are in the stage of formal education but still operate on discovery and play. I have this unit on discovery because this age group can learn better by using manipulatives and on hand experiences. So as they do some of the lessons they can use their senses to understand it. They also know how to share and cooperate with each other. Cooperation will be important when they do discussion and share their drawings. They are also known to have excellent memories. I will build on their memories as I present each lesson and use the vocabulary. This is why the concepts and skills are repeated. They can master some things but are not clearly ready for abstract thinking. They need concrete examples of things, so I have provided concrete activities for them. The repetitions in the lessons are needed to get them to understand and remember.

The word Kindergarten originated from a German school teacher Friedrich Froebel. He believed that kindergarteners should have guided exploration of their natural environment through carefully planned activities. I have attempted to naturally guide them through these two avenues. This age group will bring an unlimited source of energy and enthusiasm. I will have to cultivate it through reinforcing their comprehension with stories and discussions. Some of the stories that have been chosen were selected to promote just that. Having the students use their perception through the use of their senses will help them better understand this whole concept of fractals and chaos.

Having already stated that this age group is egocentric when I first thought of doing this curriculum I wanted to come purely from a mathematical perspective. Using this content area I would have been using shapes (geometric) and algorithms. This proved to be disconnected for my students and limiting. What I mean by disconnected is they could not have been able to grasp the wonderful impact that using photos, plants and stories would do. This is purely because of their age group when abstract thinking has not developed. They need to connect the dots or have a sequence of connected events that are discovery based for input learning to take place.

The concept that fractals are of a higher level thinking phenomena, in which I had to as an adult do some researching to understand it myself made me aware that I had to be very careful about how I presented this to my students. So I looked at my current Science curriculum FOSS-Full Options Science Systems and I attempted to follow their belief about the early childhood student and my experience. I found through my researching as well that science for early childhood and how they often react to new knowledge led me to the gestalt theory because of the discovery section of the (life space). The early childhood student is very curious and learns well through play rather than rote learning. My expectations are for them to enjoy learning and this is such a great time because outside influences such as society and parental expectations are minimal. This eliminates the pressure and makes it easy for the student to learn. For an older student it could make them disinterested due to others' expectations. So for others who may be interested in teaching this unit these factors may unfortunately lose one or two students and I would not want to lose one. I found that young minds are agile and expansive and that they are eager science learners. They are superb at using all of their senses to build a repertoire of characteristics about their environment. This will give them the opportunity to learn similarities and differences among events and objects. This is unlike using the algorithms or shapes to teach fractals. I want my students to be able to communicate, describe and draw about what they observe. This will give them other avenues to experience this science. Early childhood students are said to guess instead of making predictions or inferences. This also led me to write this unit as I have. So the repetition in my lessons will help develop these skills that they just don't have at this moment. They can describe the cause and effect that may bring about change in a fractal. Describing some of the interrelationships between the

photo the repetitive piece and how the fractal becomes a fractal will be better understood through all of the lessons.

I have spoken about the developmental aspect of my student. Now I wish to talk about them in some other factors. Although these factors are not so apparent in this age group I think writing about it will make you more comfortable in using this unit. The first would be gender. It has been stated in the past that there are not a great deal of girls going in to the math and sciences. This is somewhat true but for this level it is an even discovery for both girls and boys. Both genders are introduced to both content areas at the same time. I think if you make it exciting for them they will succeed. This goes back to my comment about expectation. They can often be biased. As an educator I expect the student to participate and my job is to reach that student. Reaching that student is a complex endeavor but very rewarding, after you see that they understand. I do know from raising a son that they will enjoy any activity that is geared to their own interest as they get older. Although he is not heavy into either math or science but when something "cool/hip" comes along he takes notice and this is another example of life space. If it is not put into their perceived activities they will not see it. This is another example of learning in gestalt terms. Also another factor is cultural differences. What I mean is economic differences or race. Do students learn differently from others of different social/ racial backgrounds? Some studies suggest that they do, but in the kindergarten classrooms at my school over eighty percent of them are advanced or proficient. This may be based on the style of the teacher. I do believe it is based on all of those factors spoken about previously, the student not being affected by family, teacher and society. As a students move up in grade levels they are affected by this. In this age group this is not a major factor either because as I said if it is interesting and if brought to their attention they will get involved. Now I stated in the strategies that to reach the students who have not had any formal pre school or daycare exposure I have made the lesson so repetitive to catch the students who need that extra help. The lessons are designed to reach students with exceptionalities (learning disabilities). They can enjoy the on hand lessons with minimal one on one instruction. This is part of my response to student need. It is called differentiated instruction. Responding to my students' needs by using learning profiles (early childhood development) their interest, readiness and learning style. This is in content, process and the unit I have produced. In this type of instruction achievement is usually based on individuality. The student's interest, readiness and learning style are instrumental in driving the instruction. In this case it will be this unit. Differentiated instruction is one of the requirements of my school district. This through multiple assessments may be a checklist, oral or written the student gets an opportunity to learn what is best suited for them. This is called student centered instruction. I have also used tiered lessons in this unit. What I mean is basic level learning, mid level and higher level learning lessons so as to reach every learner.

The unit will also help meet the district's requirements in experiencing the sciences through continued positive reinforcement. This is all the reason for this unit to have

come into existence. They can visualize each year the plant growing. The process of recurring will be explored as well as chaos of the branches of the plant.

Objectives

There are various goals for this curriculum. The overall objective is to provide an environment that will give my students the opportunity to use problem solving techniques. They should be able to be aware of what is in their environment. They will become aware by carefully planned lessons. These lessons will bring about an understanding of how to look for a fractal. The questions in the strategies part of this unit will assist with building these skills. This will help with the visual manipulation of the pictures as well as promoting aesthetic appreciation. They should be able to question the attributes based on its fractal ability. We will do this through group discussion. To facilitate the discussion the students can do an art activity. This group work will also provide an avenue for team work.
They will be able to manipulate a camera. This will help with the understanding of fractal pictures. We will discuss the technology related to picture taking and focusing the camera. The demonstration will be done through a photo shop. They will look at different computer generated photos. These photos can be broken down into pixels. This is a computer term that is used. As the students move through the different phases of the curriculum they will be able to count in a pattern and draw patterns. These patterns will give them the base they need to understand a fractal. They will also describe the patterns, why, what and how it is one. Through this explanation they will be able to apply the questions as well from the strategies section. They will be able to use new vocabulary associated with the unit. They may apply this to their drawing journal as they label their drawings of fractals or use them in a team/group discussions.

The National Council of Teachers of Mathematics has objectives set out for student. I plan on applying these to my student's requirements to complete this unit and use them as a way of assessing them at the end of the unit. The standards that will be included are listed below:

*** To count and recognize how many in a set of objects.**
*** To use physical models and representations and fractions.**
*** To use other representational systems to understand what is going on.**
*** To use concrete models and computer generated material to understand geometry.**
*** To apply and adapt a variety of appropriate strategies to solve problems.**
*** To begin to use reasoning and proof as fundamental aspects of mathematics.**
*** To be able to understand measurable attributes of objects.**
*** To understand patterns relations and function.**
*** To be able to analyze change in various context.**
*** To understand operations and how they relate to each other.**
*** To analyze characteristics of properties of two and three dimensional shapes.**
*** To use visual and spatial reasoning and geometric modeling to solve problems.**

Science objectives are included as well: Students should be able

*** To use the inquiry and design model to bring about understanding.**
*** To develop process skills of observing exploring materials and phenomena, organizing, communicating and applying their experiences.**

The technology objectives will be basic: Students should be able

*** To operate a camera.**
*** To use basic mouse and computer.**
*** To learn computer vocabulary.**

Strategies

The strategies that I will be using are part of my school district's supplement to the current Foss Science curriculum. The Foss curriculum is based on theory that advancement is through predictable stages. The thinking behind Foss is observing, communicating, comparing, organizing, relating, inferring and applying. The supplemental part I will use has five instructional techniques to bring about an understanding of the terms fractals and chaos. The teacher will model the behaviors that the students will be expected to do; this will teach them the proper behavior that is expected throughout the unit.

The five are:

A. Engage- Engaging the student through stories and cooperative learning with classmates. The stories will be from the science or math books on my bibliography. Also I will use discussions to engage the student in the direction of the unit. I will introduce the concept of repetition, size and similarity in patterns. This premise will correlate with Gestalt psychology. This type of psychology was discussed in the rationale part of my unit. I would like to develop a word bank for the words as they are introduced throughout the unit. This also will be a way of getting the student to become engaged and learn new vocabulary.

B. Explore- Exploring patterns, looking at objects with patterns such as photographs or designs in nature. I would like to use a question and discussion technique to solicit visual perception and awareness. This will help my students develop visual literacy related to fractals. I will introduce other activities such as with snowflakes and how they are the simplest fractals. The students will investigate

each thoroughly and the investigation will be teacher directed so that the students can get more knowledge about the fractal or chaos of a system. The students will have a simple student data sheet so that they can keep a record of what is chaos within the systems we are studying. Content and inquiry will be correlated to elicit recognition of a fractal and why they are said to be chaotic.

C. Elaborate- Elaborating on patterns through the introduction of cameras, magnifying glasses, an Elmo (visual presenter). As each is introduced, image will be discussed and how it changes through magnification and I will try to show that the size (dimension) can be infinite. Using the designs and pictures on this equipment will help the fractal concept be understood by the students. I will let the student draw conclusions about their observations, citing evidence of a fractal and developing some logic about them.

D. Explain- Explaining a pattern by using different examples such as manual cellular grids for practice. Our grids will be done with out the animation. Have them make two or three color patterns. To use simple algorithms through the use of number patterns such as counting by 5s, 2s, and 10s. I would also like to have each of my students grow a plant that is a perennial so that the student can plant in their own gardens or into a flower pot at home so they can continually watch it come back. This will be to elaborate on the recursive process. Students can begin to explain to other classmates what they suspect is happening .They can infer from the examples They should be able to recognize variations in patterns and give a simple example through an algorithm or design. They should be able to continue to draw conclusions and connect them directly to a fractal or chaos. They will design and conduct their own experiments with material that will be provided in a learning center.

E. Evaluate- Evaluating my students through the use of a rubric and their participation in the activities throughout the unit. An ongoing checklist will be done to monitor student input and skill level. The word bank that is developed will be assessed through letting the students use the vocabulary as they conjecture about their activities. The students can create a fractal mural. The pictures taken from the digital cameras lesson will assist in evaluating my students. I will use other graphic representations to show fractals and check for understanding. Take walks to recognize geometric shapes in nature and just on there own in plane and solid shapes. Although all five of these models will be used I would hope to specifically develop my student's cognitive skills and scientific thinking processes. Those models will be coupled with observing by using the senses to get information using all of their senses to build repertoire of the characteristics from each lesson. Communicating with drawings or discussions in groups and using other skills such as comparing, organizing, relating, inferring or applying. I would like to see and develop learning with understanding. Building on my students agile and growing minds should be natural. I would also like to include a portfolio and have the students complete a visual art work for each fractal lesson and have them reflect on

them periodically. I would like to have a book made from their selections or a class newsletter to share with the student's families.

These are the strategies I plan to use along with the standards and objectives that are listed in the objective portion of this paper.
The *student outcomes* will be greatly enhanced by the strategies in this portion as well as proficiency with completing the objectives and the standards. These outcomes should include: evidence that the students will

- learn about and appreciate the use of fractal art.
-develop a vocabulary that fosters communication about fractals.
-make critical evaluations related to works of art related to fractal design.
-be able to design and construct fractals through patterns.
-be able strengthen problem solving skills through experimenting with fractals and chaos.

These outcomes should be expected and applied to a checklist based on observation from the teacher. The assessments will be based on a rubric and a self reflective conference.

CLASSROOM ACTIVITIES

Patterns (Repetitive Behavior of Things)

This lesson is for exposing students to patterns of all kind. I would like to start with the simplest pattern for this age group. This would be counting by 5s, 10s and 2s. This can be done daily prior to each lesson. To continue the pattern theory I would extend the lesson using the book A Drop of Water- A Book of Science and Wonder written by Walter Wick. This book is about what water can do when it drops a large container or puddle of water. I will be particularly interested in what it does when the ripple effect happens. This is also is an example of recursive. The students will do an experiment with the water. This will be by filling up the water table and using a large dropper to see the ripples. The five questions will be asked that are in the strategies to ensure that the students are engaged through the science story and experiment. The questions will lead to the core objective. A word bank should be established at this time. Those five concepts are explore, explain, elaborate, experiment and evaluate.

Grid and Patterns

For practice and visualizing I would do a pattern on a grid. In each grid let the student chose two colors or three color patterns. This lesson will reach the below basic, basic and proficient learner. Here is a pictorial view-

Green	**Red**	**Yellow**	**Green**	**Red**	**Yellow**
Green	**Red**	**Yellow**	**Green**	**Red**	**Yellow**
Green	**Red**	**Yellow**	**Green**	**Red**	**Yellow**

Or

Blue	**Purple**	**Blue**	**Purple**
Blue	**Purple**	**Blue**	**Purple**
Blue	**Purple**	**Blue**	**Purple**
Blue	**Purple**	**Blue**	**Purple**

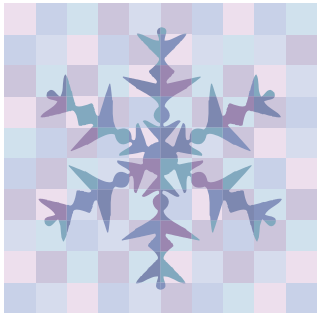
The grid would be in square shape and they can color in. Add the words grid, red, green, and purple, blue, yellow.

Symmetry

To give the students the opportunity to explore transforming images I would introduce symmetry. I would have the students take folded in half black paper and paint with white paint on one side. Fold it together and see how it appears. This will also be done by cutting out a heart, Christmas tree and a snowflake. These will be a fine example of what is on each side is the same? Symmetry is the property of the sameness when divided in the middle. I will also have some leaves available for the students to examine. I would bring their attention to the leaves and veins. Another good way of examining this would be to paint over the veins. The word bank should include symmetry, image and same.

Introduce the term Fractal

A fractal is a geometric image that is a repeat of a larger image such as a snowflake. Show examples of a snowflake and how the parts are the same.



I also have a copy of a three dimensional one. This I will hang up for the students to observe and draw about it.

For extension to this lesson, introduce geometric shapes, the rhombus, hexagon, trapezoid and triangle. With a template let the students place the shapes to make pictures. Using the trapezoid make and see how many shapes will fit in it with the triangle etc. Add the words trapezoid, rhombus, triangle, square and hexagon. This is also a classic example of *topology* (not perceiving something until it is put into your perception)

Fractal Images

The kindergarten students in my school district learn to use the computer in preschool. They will also be on the computers by the end of the first month of arriving to kindergarten. This is particularly important because we will need to go on the internet to see some fractal images. I particularly found that polymers were great images of fractals. They can be found on the web site The Center for Polymer Studies. The Mandelbrot Set is one that will be looked at. Seirpinskis Triangles can be introduced at this time. As the students have looked at each image ask questions about the image. The questions should be of this flavor. What do you see? Does the image have any patterns in it? If there are patterns- what type are they? What one item in the image is repetitive? After this show an image of a branch full of leaves and how it repeats itself. Now let the students use the geometric shape template again and explore the different shapes that can found. Let the students use a slate board and chalk to draw their favorite fractal image.

Problem Solving

This lesson is actually a contrast of what we are doing with fractal images. We will read the book Math-terpieces- The art of Problem Solving written by Greg Tang. This is a book that uses visual orientation to solving problems relating to art work. The artistic work of such famous artist as Henri Matisse, Van Gough, Claude Monet, George Seurat, Andy Warhol and Pablo Picasso will be examined through questions the author has made. This book will assist with infusing the arts into the unit. It also will help develop visual perception. The artistic appreciation that I was trying to achieve with the fractal images can be assist with this book. This will be a good time to review the information about fractals. Use your word bank as often as time will permit. This activity will allow for the developing of my students perception and since there is a great deal of repetition in the pictures I can discuss them in relation to previous fractal images. The word bank words are artwork and artist

Camera – Picture Taking

Introduce the camera. Discuss parts of a camera. Demonstrate how each part is used. Do these by using the book- Click a Book about Cameras and taking Pictures written by Gail Gibbons. Start by reading the book, go over all the distinctive parts of a camera such as, view finer, frame counter and lens I will only concern myself with three of the features the picture release button, focus lens and the advancer. This will keep it simple and more capable of achieving a picture of quality. A demonstration of the usage and proper handling of the camera should be done. Some of the qualities are basic as being still and steady. Make sure the student has framed their picture. The picture can be developed on the computer. I think this is consistent with their seeing the polymers on the computer. Another alternative to this could be a visit to a photo shop as a field trip and have the students get the photography side of making images. Go back on the internet and find pictures of fractals; let the students look at them again. Let them know at this time that they will be able to use their cameras to take pictures of trees or there leaves. This will be a practice shot. This will give them an opportunity to become familiar with their camera. This shot will help minimize bad picture taking later on. After this revisit the picture of the snowflake and discuss the patterns, geometric shapes, and some of the properties not noticed before.

Let the students discuss what type of picture they would like to take. Let them go out and take pictures of their choice. This will be another practice opportunity. I would give them as many practice opportunities, to take pictures of their choice. Since a disposable camera has sixteen exposures, give them four opportunities to take pictures. On the last shot they will be pictures that they want to use as their own fractals.
These are some of the important components in this unit. I have attempted to pull it together. This is at the cement level due to my students being young. You will find as I have that the concepts of fractals and chaos are not relative to you until it is put into your life space.

Chaos is a subject that I could write about separately. I wanted to focus on one of the concepts and briefly touch upon chaos. Chaotic Theory is the complex and unpredictable motion or dynamics of systems that are sensitive. These systems follow rules that are mathematically based. Most people will not perceive this chaos until it is part of their *life space- topology*. These systems have been analyzed to look at the changed to better understand systems such as the nervous system, measles outbreak or heart rhythms. These and other systems exhibit unpredictable behavior and this is what chaos is. With this topic I will be using a perennial plant (spider plant) to show the chaos in the leaves. This is just to touch upon the concept and give an example.

This unit was written to promote enjoyment of mathematics and science and how closely you can relate that enjoyment to the arts. Through this integration the students will learn these crucial concepts.

Summary

By the end of this journey my students will be engaged with what is happening in the many systems that govern our existence. One of the systems that my students could possibly look at after this unit is weather. Weather is very unpredictable and chaotic. The existence of seasons and what weather should be. These are some basic get started tools. These tools will make most elementary student ready to study fractals and chaos. Their perception will be keen and aesthetically oriented as well.

CLASSROOM MATERIAL

4 packs- Xerox paper
30- Disposable Cameras
30- Picture Frames
2 packs- Grid Paper
1 Computer (internet access)
3 Digital Cameras
1- Elmo
1- Projector
1- Screen
3 packs- Multi Colored Construction Paper
30 packs- Crayons
30- Pencils
1- Permission Slip- Frick Park Walking Trail
30- Perennials (Spider Plants)
30- packs- Paint Water Colors
30- Magnifying Glasses

BIBLIOGRAPHY

1. Mandelbrot B. Benoit. (1983). The Fractal Geometry of Nature. New York. W.H. Freeman and Company.
This book discusses different concepts such as dimension, symmetry and divergence. This book can be used to acquaint the teacher to the theory of fractals on a mathematical level.

2. Gibbons Gail. (1997). Click- A Book about Cameras and taking Pictures. Boston. Little Brown and Company.
This book explains all of the important components to a camera and how to use it. It has illustrations for you to look at and share with the students.

3. Gleich James. (1987). Chaos Making a New Science. New York. Viking Pequin.
Gleich thoroughly evaluates this new science by explaining it to a person that may not understand the concept of chaos.

4. McGuire Michael. (1991). An Eye for Fractals- A Graphic and Photographic Essay . New York. Addison Wesley Publishing Company.
This book has photo images of fractals. An explanation is given on what, how and when a fractal is present and what to look for. This is certainly a practical guide to the fractal image.

5. Stewart Ian. (1989). Does God Play Dice?. Massachusetts. Basil Blackwell Ltd.
This is one of the seminar readings I found it to clarify information concerning fractals.

6. Tang Greg. (2003). Math-terpieces- The art of Problem Solving . New York. Scholastic Press.

Greg has taken some of the most famous art paintings and combined them with problem solving strategies. This is a cleverly done art history and mathematics combination.

7. Wick Walter. (1997). A Drop of Water- A Book of Science and Wonder. New York. Scholastic Press.
Mr. Wick takes water to a different level. Water is used throughout the book to solve science related problems. The book is very entertaining and has illustrations to go with the activities.

8. Wildsmith Rebecca and Brain. (2002). A Look Closer. Chicago. Harcourt Publishing.
As you read through this adventurous student book you encounter insects that you normally would see if you would look closer. Very well illustrated book and great.

APPENDICES

I

A rubric was established so my students could have a guideline for judging their work. This will also assist with peer and /or teacher conferencing. I am also developing skills that will produce quality. This will give an example of a successful product and regular feedback. This will be used for all of the activities in the unit.

4- The student completes all important components of the task and communicates ideas clearly. **The student demonstrates an understanding of the process or concept. Where appropriate the student interprets, extends or generalizes about the skill or concept.**
3- The student completes most important components of the task and communicates clearly. **The student demonstrates an understanding of major concepts even though the student overlooks or misunderstands some less important ideas or details.**
2- The student completes some important components of the task and communicates those clearly. **The student demonstrates that there are gaps in their conceptual understanding.**
1- The student shows minimal understanding. **The student is unable to generate strategy: answers may display only effect, lack clear communication or be totally incorrect.**

A self check will be done through conferencing. A checklist can be used as well. List all of the important skills or observable behaviors you would like to see. For example,

Is my work neat? Yes No

Did I use the correct colors in my grid? Yes No

Am I holding my camera correctly? Yes No

These questions will help you and the student have clear expectations. This will give a sequence of measured activities as well.

II

Field Trip Permission Slip

Date

Dear Parents and Guardian:

On ---------- the kindergarten class will be visiting the Frick Park (Walking Trail). Students will enjoy a fun day of leisure as they see the various exhibits of outdoor nature. The students will be able to take pictures of trees. The students will be able upon their return to school to do a drawing about their favorite picture. This trip will be of no cost to you.

I think this will be a great trip for your child to attend.

We will board the buses to the Frick Park at 10:00 and return by 1:00. The lunches will be provided by the school so there will be no need for any money. Students should dress comfortably for there is a great deal of walking. Tennis shoes instead of open sandals should make them very comfortable. I look forward to enjoying this day with your child.

Sincerely,

Ms. Johnson

---------- has permission to attend Frick Park (Walking Trail) field trip. On ----------.
(Student's Name)

(Parent's/Guardian's Signature)

III
Pennsylvania Standards

Mathematics

2.2 Computation and Estimation
Skip count by multiples

2.3 Measurement and Estimation
To compare measurable characteristics of different objects to get an answer. Using appropriate problem solving strategies and explain how to solve the problem.

2.4 Reason and Connections
Verifying predictions about quantity, size and shape of objects by drawing, pictures and or concrete objects.

2.7 Prediction and Probability
State and justify an opinion on whether a given statement is reasonable based on comparison.

2.8 Geometry
Recognize and replicate patterns.

2.10 Trigonometry
Construct shapes on geo-board or object.

Science and Technology -General Standards

***To recognize change in natural and physical systems and that change is a fundamental part of most systems.**

***Recognize sub systems within larger systems.**

***Describe interrelationships –input/ output processes.**

*** Unifying a theme.**