

**Fractals for Fourth Graders**  
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Overview

Rationale

Objectives

Strategies

Classroom Activities

Annotated Bibliography/Resources

Appendices-Standards

**Overview**

What is a fractal? I am not sure that I fully understand the concept as of yet although I am constantly learning as I am researching. There is currently a great deal of research still being conducted about fractals. Compared to many mathematical ideas, fractals are a fairly new concept. I know that my fourth grade students would be interested to learn the meaning behind fractals, although only in the most basic form. I am interested in teaching my students how to understand fractals at their level so that they are able to experience these wonders themselves. There are many definitions for a fractal. All of them refer to the fact that a fractal creates a complex geometric shape that contains its own similarities. So, what does this mean? It means that a fractal has identical patterns contained somewhere inside of it. These properties are different from those of rectangles and other basic shapes. How am I going to create a curriculum that encompasses fractals at the elementary level?

My original plan was to integrate fractals into my Math teaching at the fourth grade level. However, as I began to research fractals, I found that although

they are mathematically based they can be found in and related to other subjects. I have decided to focus on three main areas of instruction pertaining to fractals. The main instruction of the basic background information of fractals will be taught during Math. However, I will integrate the teaching of fractals into Art, Science, and Writing. An interesting quote I found was "I find the ideas in the fractals, both as a body of knowledge and as a metaphor, an incredibly important way of looking at the world." Vice President Al Gore, *New York Times*, Wednesday, June 21, 2000. He was discussing some of the "big think" questions that intrigue him. I plan to use the idea of fractals to help motivate my students to look at the world from a different perspective. I hope that this will enable them to use problem solving skills to help them figure out solutions to difficult situations on their own. My plan is to allow students to explore the concepts with me so that they can get a new vision of how to deal with everything they are struggling with. The goal of my curriculum project is to integrate the teaching of fractals into my teaching of science, art, and writing.

Many Science theories are based on mathematical concepts. I would like to introduce students to fractals in nature. This would give students a tactile mathematical experience in nature. My students would be taught the basic concepts of fractals. We would first focus on symmetry. Students need to know that symmetry is everywhere in nature. I would discuss the three main types of symmetry that they need to be concerned with. These would include mirror symmetry (line or mirror), rotational symmetry (n-fold), and translational symmetry. I would teach students these types of symmetry by immersing them in nature so that they can see it for themselves. I feel this will enable them to better understand the concept of fractals. I also feel that students are better able to understand a concept by experiencing it more than just having a teacher lecture about it. Therefore, I will plan my lessons so that students have many opportunities to get out and see as much as they can. We will also use nature to explore many different geometric shapes and how they reflect various fractals.

I think that combining art into my instruction of fractals will help students visually understand the main concepts of fractals. Many students see art class as fun and interesting. "Art and science will eventually be seen as closely connected as arms to the body. Both are vital elemental of order and its discovery. The word 'art' derives from the Indo-European base 'ar', meaning to join or fit together. In this sense, science, in the attempt to learn how and why things fit, becomes art. And when art is seen as the ability to do, make, apply or portray in a way that withstands the test of time, its connection with science becomes more clear." (Sven Carlson, *Science News*, 1987)

I plan to teach fractals through art to catch those students who learn best by a hands-on, and visual approach to learning. While teaching this art section of

the fractal curriculum unit, musical fractals will also be introduced. I think that students will be amazed by how fractal algorithms can create music. This will allow students to see another side of fractals. Fractal art is mainly digital and tries to visually show the order and chaos of nature's demonstrations in a visual form. We will look at many types of fractal art and develop ideas for our own art projects that contain fractal images. I also plan to closely work with the Art teacher next year to see how this program can be combined with the teachings going on in the students' art class.

My main interest will be to combine the teaching of fractals with the teaching of writing. I think that poetry will be the easiest type of writing to fit in with the instruction of fractals. As we are working on all of the various concepts of fractals students will be required to keep a journal. I am requiring this so that students will be able to reflect back on what they are learning. I feel this is important so that they have their own personal reference to use while we are working. I also think that keeping a journal will inspire a student's personal writing. We will study general poetry and then I will show the class examples of fractal poetry. I think that this will spark an interest in most students because it is a way to think outside of the box. Once students have used fractal theories to design poetry we will move on to fiction. This will be our main project in writing. We will use the idea of a fractal snowflake to help us design the main structure of our piece of fiction. I believe this will help even struggling students with how to write fiction.

I presently teach fourth grade and have focused on those students to develop my curriculum project around. I plan to develop the project so that it can be adapted towards other grades as well. How do I plan on implementing this curriculum project into my teaching? I plan to explain to students that this project will help them to improve their problem solving skills while they are learning basic concepts in various subject areas. I hope to be able to regularly teach these lessons throughout the year while I am teaching all of the other subjects and concepts I am responsible to teach. I plan on developing this project so that it can be taught continuously or can be broken up into smaller parts so that it can fit into whatever else I am teaching. Although this will be a challenging project I feel that it will be one that is extremely beneficial to the students as well as their teacher and other teachers in the school. I hope to share this project with other teachers so that it can be adapted for other classes.

### **Rationale**

I have found that many of my fourth graders have great difficulties grasping basic mathematical strategies and then form a great dislike for Math. Since many students have trouble with math they don't want to try to learn it

because they just don't understand it. I have found that a lot of students take an "I don't care" type of an attitude when they don't understand something. For many students it is not that they don't care, it is that they don't know how to do something and they don't want to admit that so they act like it doesn't matter to them. I plan to engage students so that they are challenged to conquer what they don't know. I chose to form my curriculum unit around fractals to help broaden the horizons of my students because many students think that math is just about numbers. I have many students who groan and complain when I say that it is time for math because so many children have difficulties with Mathematics. I feel that if Math is made more interesting and integrated into other subjects that students might want to get a little more involved in it. My thinking is that if students can get interested in this part of the math it might spark their interest a bit which would make them want to learn more about math. "Kids think that all mathematics was learned 500 years ago, that math is a dead study like Latin is a 'dead' language. I want them to understand that there are people living, breathing, and making a living as math researchers." (Cynthia Lanus, 1996) My main goal for writing this curriculum unit is to bring the teaching of fractals down to the level of a fourth grader and still teach the curriculum mandated by my school district. I also want students to gain a tighter grasp on the fundamentals of math. Once they understand the basic concepts of math they can begin to understand more. By learning the basics of fractals I think they can gain a deeper understanding of the groundwork of math concepts. "Mathematics is the science of patterns." (Lynn Arthur Steen) I think that when students realize they can trace a lot of mathematical concepts back to a basic pattern they will be better equipped to solve more difficult problems. I hope to produce a renewed interest in Math for students so that they can better relate to the subject. I hate to hear students complain when it is time for math. I think that if they become more interested in it they won't build barriers where they think it is too hard for them. So, when it comes to learning new mathematical concepts they will try to understand instead of closing themselves off to learning something that might be difficult for them.

What do students need to know in order to learn about fractals? When students hear the word fractal most do not have a clue what it means. In fact, many adults do not know what fractals are. I chose to learn more about fractals because I did not know much about them either. I thought if I could learn more it would better equip me to teach Math to my fourth graders. I feel that teachers should be constant students so that they can learn as much as they can. If teachers continue to learn then they can constantly be bringing new concepts and techniques to their teaching. The basic definition of a fractal for fourth graders is the repetition of geometrical shapes. I find that I learn best when I am immersed in something. Teaching a group of students who are easily distracted, I feel that they also learn best when they are immersed in their subject. "Fractals make the shapes seen in nature." "You don't see a lot of triangles, squares or rectangles in

the woods, but fractals show up in everything from cumulus clouds to fern fronds.” (Cynthia Lanus, 1996) I usually have one to two students each year who are diagnosed with ADD and many others who have great trouble staying focused for very long. Researchers at the University of Illinois at Urbana-Champaign have found that children with ADD showed less symptoms when being out in nature and/or being in rooms with windows. It was concluded that green environments around schools and window views benefit all children by fostering creativity. When students are able to work outside, most are able to maintain their focus longer. I have chosen to conduct some of my instruction of the basics of fractals outside so that students can see examples of what fractals look like in actual models in nature. Some of these examples would be trees, clouds, leaves, ferns, and mountains. When I take my class outside I plan to give each student a clipboard and paper so that they can take notes about their observations. We will discuss the patterns of nature and how they relate to the basics of fractals. I think that this will give students concrete examples and how they can be found in objects that they are already familiar with. Some research has shown that people who are immersed in the fractals of nature become more relaxed and are able to reduce stress. Increased office worker productivity and speedier recoveries have been attributed to experiencing fractals in nature. (James Wise, 2002) I feel that showing students fractals in their natural habitat will help them to be able to focus on what they are learning. Charles Darwin once wrote the following home from a voyage about his impressions of the Brazilian tropical rain forest. “If the eye attempts to follow the flight of a gaudy butterfly, it is arrested by some strange tree or fruit; if watching an insect, one forgets it in the strange flower it is crawling over; if turning to admire the splendor of the scenery, the individual character of the foreground fixes the attention. The mind is a chaos of delight...”(Charles Darwin) I take this to mean that the mind gets lost when looking at different things. So if I immerse the students in fractals in nature they are better apt to be paying attention to what they are learning. I think this approach will also help to make the learning more concrete in the future.

I have found from experience that students learn best from a hands-on approach and plan to use that style as much as possible throughout the unit. By getting students moving and working on something that they can touch many learn more than if they were sitting at a desk being lectured to. I hope students will become excited about fractals which will be a concept that is new for them. If I as the teacher come in to the classroom excited about the subject I think that the students will be anxious to share in some of that excitement. Even if the subject is new to them and might seem a bit difficult if they can become excited about it they will be more apt to try to learn about the concept.

Fractals are everywhere. Instruction would begin by showing students that a fractal is a miniature part of the whole. Some examples I

would show would be cauliflower, a branch from a tree, and a frond from a fern. Instructing students by immersing them in math in nature will help to challenge their imaginations so that they will be better able to handle other situations they face. "The scientist does not study nature because it is useful; he studies it because he delights in it, and he delights in it because it is beautiful. If nature were not beautiful, it would not be worth knowing, and if nature were not worth knowing, life would not be worth living. Of course I do not here speak of that beauty that strikes the senses, the beauty of qualities and appearances; not that I undervalue such beauty, far from it, but it has nothing to do with science; I mean that profounder beauty which comes from the harmonious order of the parts, and which a pure intelligence can grasp." (Henri Poincare') Fractal geometry can make math instruction more interesting which will allow children to better understand it. Although the Pittsburgh Public School District has a rigid curriculum pacing schedule it would be easy to integrate the teaching of fractals into the regular curriculum. I plan to teaching fractals by immersing the subject into math, art, science, and writing. I chose to immerse the teaching of fractals into other subjects in an attempt to allow students to better relate to what they are learning. If the students are immersed in one subject and I infuse the instruction of fractals into it then they might not even realize what they are learning which will allow them to learn more without feeling confused. When studying Geometry as required by the curriculum we will also study fractals. Teaching about fractals will fit in with teaching geometry because there are so many different shapes that come out of making fractals. Students will be able to relate the basic meaning of a fractal to the basic shapes of geometry. As we are fulfilling our necessary writing requirements for our portfolios we will do a couple of pieces based on the nature of fractals and how the perspective of the students has changed as they are studying the nature if fractals. Most people don't think about writing when they think about teaching math. However, I think that students learn more about something when they write about it. If I teach students about fractals and then ask them to reflect upon what they learned they will be able to contemplate what they learned and possibly take it to a more concrete level of learning. In science, we are required to complete an entire unit surrounding water so it will be easy to integrate fractals into water by studying how some ice crystals and snowflakes contain fractals. Most students love science because they are able to do a lot of hands-on activities. Next year I will be teaching all of the fourth grade science classes in my school so I am very excited to have learned so much about fractals. I will display fractals in my room as decorations so that students are exposed to them at the beginning of the year. I think this is a good idea because I am figuring that it will provoke students to ask questions about them. When they are asking about the fractals it will start them thinking about how they work

and I will be able to explain the background of fractals. I plan on working with the art teacher to integrate the instruction of fractals into some of the students' Art classes. I will take the students on a virtual tour of some fractals while teaching them the basics about them. I will require them to research information and find some examples of fractals. Next, the students will be required to bring in as many examples of fractals that they can find. Then, they will be required to make some of their own. I am hoping to obtain some drafting programs so that students can use the computer to create some of their own fractals. I think that the students will get very excited about this because most of them love using the computers. I hope to line the walls with creations of the students so that people start asking what they are which will prompt my students to explain what they have been learning and creating. During Art class the students will also make some of their own fractals using different materials like, paint, markers, and any other medium that they think could be used to replicate the fractals that they have researched. While keeping with the curriculum pacing guide I will still infuse the instruction of fractals into what has to be taught. "I wonder whether fractal images are not touching the very structure of our brains. Is there a clue in the infinitely regressing character of such images that illuminates our perception of art? Could it be that a fractal image is of such extraordinary richness, that it is bound to resonate with our neuronal circuits and stimulate the pleasure I infer we all feel?" (P. W. Atkins) This quote shows that fractals can spark the imagination in those that see them. I am hoping that teaching fractals to fourth graders will help them get over their disinterest in math. As a teacher, one of my main goals is to get students interested in what we are learning so they can understand it better. It gives me great pleasure to see students become involved and show that they are eager to learn something new. It is also refreshing to see students want to be challenged by something after they start to understand it. This shows that they want to know more and are willing to find out as much as they can about something so that they can complete a task. Once some students start to get excited many others soon will follow. Then, the majority of the class will be so interested that it will prompt many to start learning outside of the school. It is important to hold students' attention so that they can learn as much as possible. By taking a hands-on approach to teaching fractals and immersing it into other subjects students will be learning as much as they can about this concept and how it relates to so many other areas.

### Objectives

I have six main objectives for this curriculum unit. The students will complete these objectives by reading, completing writing assignments,

conducting research, and through class discussions. I will describe the objectives in this section as well as how they relate to the standards. “It is always amazing to see how receptive and excited the children are when they see fractals for the first time, and they realize that what they are seeing is the beauty of math. Suddenly math transforms from something hard, boring, and useless into a fun, exciting, and magical realm to explore.” (Johnathan Wofe, 2005) My main method of instruction will be to immerse the children in fractals in as many ways as possible. I feel that the more interested the children are in the subject they are learning, the more apt they will be to learn as much as they possibly can. I want to ignite an interest in students so they won’t be overwhelmed by work but will be inspired to be challenged by what they are seeing around them. The six main objectives are as follows:

- The students will identify the properties of fractals in nature.
- The students will research information about fractals.
- The students will explore the world of fractals.
- The students will demonstrate how fractals relate to water.
- The students will write about how their perspective of nature has changed after researching fractals.
- The students will create a piece of art that contains the elements of a fractal.

Communication Standards two and six will be addressed.

All students read and use a variety of methods to make sense of various kinds of complex texts.

All students exchange information orally, including understanding and giving spoken instructions, asking and answering questions appropriately, and promoting effective group communications.

Mathematics Standards three and five will be addressed.

All students apply the concepts of patterns, functions and relations to solve theoretical and practical problems.

All students understand and apply basic concepts of algebra, geometry, probability and statistics to solve theoretical and practical problems.

Arts and Humanities standard two will be addressed.

All students evaluate and respond critically to works from the visual and performing arts and literature of various individuals and cultures, showing that they understand important features of the works.

Science and Technology standards one and six will be addressed.

All students explain how scientific principles of chemical, physical and biological phenomena have developed and relate them to real-world situations.

All students develop and apply skills of observation, data collection, analysis, pattern recognition, prediction and scientific reasoning in designing and conducting experiments and solving technological problems.

### **Strategies**

I plan to begin the curriculum with a basic study of fractals from the mathematical sense. I will teach the children the basics of fractals and how they relate to the children. I will first do this by showing the students some examples of fractals so that they can see what they look like. Then I will teach them the background information they need to know to create their own fractals. Once the students have a basic background of fractals we will focus on branching out into other subjects. I will infuse fractals into Science by having students create a fractal snowflake. We will write about fractals in Language Arts when we are focusing on how we look at the world. In Art the students will try to replicate a fractal they see in nature. I will make sure the students see as many fractals as possible. I also believe that students can learn a great deal from each other so I will have the students share their work in each subject area with each other. Once students have a grasp of fractal basics they we will be able to open their minds to various types of instruction that will allow them to grow as learners.

### **Classroom Activities**

#### **Fractal Introductions (One class period)**

Objective: The students will demonstrate how fractals relate to water.

I imagine that most students will have no previous knowledge of fractals and many will probably never have heard of the word fractal. Teacher will introduce the subject of fractals. The class will discuss what they already know about fractals (if anything). Class will complete a K-W-L chart about

fractals. As the class is discussing what they know and what they want to know about fractals the teacher will show students some pictures of basic fractals. The teacher will introduce how fractals relate to water. The teacher will explain how a drop of water repeating itself can be considered a fractal. This discussion will lay the groundwork for future activities. Students will return to the chart after they have learned about fractals.

Name \_\_\_\_\_

Date \_\_\_\_\_

## Fractals

What do we know?	What do we want to know?	What have we learned?

**Fractal Patterns (One class period)**

Objective: The students will explore the world of fractals.

Students learn best when they are given examples to follow and when they are immersed in the subject they are learning. Teacher will ask students what they know about patterns and the class will discuss the basic facts of patterns. Teacher will read the book Maggie and the Abacaba Genies. This book is a fun way for students to learn about fractals. The main character (Maggie) meets a genie with whom she interacts. As Maggie gets to know the genie she learns that the genie's name doubles in an interesting pattern. Maggie then learns that the pattern is a fractal. I feel this will help children to realize that a fractal is a repetitive pattern. Students will choose a partner to work with. Each pair of students will have fifteen minutes to come up with a plan for Maggie that she would act out if a second chapter of the book was written. The class would reconvene and each pair would share a short synopsis of their plan for Maggie. His activity would allow students to think outside of the box when it comes to what a fractal is. It would also allow the students to apply what they know about fractals in an interesting way.

### **Fractal Explorations (Two class periods)**

Objective: The students will research information about fractals.

I believe it is important for students to have a hands-on experience in order to learn as much as they possibly can. I think that they best way to do this is for the students to experience fractals. The class will use the computer lab for this lesson. The teacher will use web sites that are free and open to the public to show the students examples of fractals on the computer. The teacher will use a Smart Board to project the fractal examples on a large screen for all of the students to see. Students will discuss the factors that relate to each of the examples of fractals that are displayed. Students will create a class list on chart paper of what characteristics the fractal examples have in common. In the next class period the students will use the examples they studied and discussed to explore how to use computer web sites to create their own fractals. Each student will use a type of fractal creator to create their own fractals.

### **Fractal Sightings (Two class periods)**

Objective: The students will identify the properties of fractals in nature.

This lesson will allow students have a hands-on experience with fractals. It is important to choose an area where students will be able to see

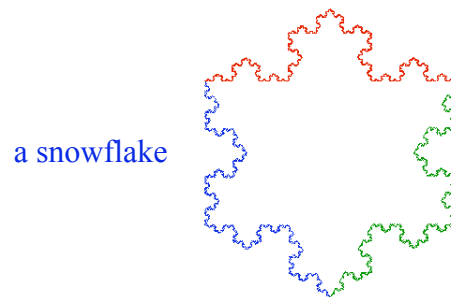
as much of nature as possible. If there is not a great deal of uninhabited land near the school it might be a good idea to arrange a field trip to a park if possible. The more land, trees, and water around the more ideal the situation would be. Before embarking on the outside adventure it is important to make sure that students know what they are looking for. They should have been exposed to numerous pictures of fractals in the classroom. I have attached some examples of pictures that could be used. Each student should be given a notebook for observations. Students should be given time to look at the world around them to see if they can find any fractals or fractal-like patterns. Some of these may be seen in the clouds, leaves, and ferns. Once students think they have found an example they should try to sketch it as best as they can. Then they should write an in depth description of what their example looks like. If it is possible it would be useful to have a digital camera so that each of the students could use it at some point to take a picture of their fractal example. Once students each have their example sketched the class can go back into the classroom. Now would be an appropriate time for students to revisit their KWL chart from one of the previous lessons to add some things that they have learned about fractals. The teacher should collect the sketches, pictures, and descriptions to be used in a future lesson.



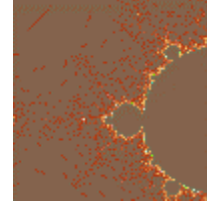
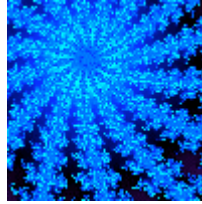
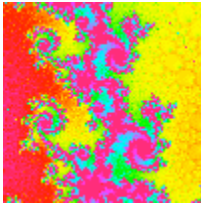
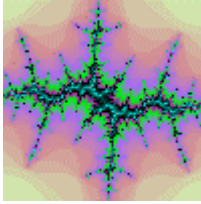
ferns



a  
leaf



a snowflake



All of the pictures on this page were retrieved from:  
<http://www.mste.uiuc.edu/courses/ci330ms/eilken/unitnatu.HTML>

### **Fractal Poetry** (One Class Period)

**Objective:** The students will write a poem about something that repeats itself. The teacher will reiterate the fact that the basis of a fractal is repetition. Students will be asked to choose a subject for their poem and use some form of repetition throughout their piece of writing. The teacher will explain how Randy Ingersom has used the snowflake pattern as a background for his writing. The teacher will lead the students in creating a class poem. Once the class has created a poem together they will be asked to create one on their own. Students will then be asked to share their poems. After the poems are collected the students will publish their final copies and they will be placed in their writing portfolios.

### **Fractal Perspectives** (Two class periods)

**Objective:** The students will write about how their perspective of nature has changed after researching fractals.

One culminating activity to this unit will be for the students to use what they have learned about fractals to teach others. The first part of this lesson will be for the teacher to ask the class how their perspective of nature has changed since learning about fractals. The class will spend five to ten minutes discussing this topic. Then, students will spend fifteen minutes in a group to make a list of what they now know about nature from learning about fractals. Next, students will be instructed to write a letter to a new classmate who is

new to planet and has never heard of a fractal. This will be an informational piece of writing that will be added to the student's writing portfolio.

**Fractal Artwork** (Two class periods)

Objective: The students will create a piece of art that contains the elements of a fractal.

Students will use the research and observations they conducted from the lesson where they went outdoors previously. Students will use the sketch they drew outside as a starting point for their piece of art. First, students will create a final copy of a sketch of their fractal on drawing paper. Next, students will use markers, chalk, or paint to cover over their sketch. The choice should be left to them so that it best matches the subject of their observation. The main goal of the students should be to make the art as realistic looking as possible. This will be the final activity of the unit.

**Annotated Bibliography/Resources**

Bourke, Paul. (1995, December) Fractals and Computer Graphics. *Interface Magazine*. This article explains how the computer can be used to create fractals.

Chandler, Gayla. (2004)Fractals: A Symmetry Approach Message posted to [http://www.public.asu.edu/~starlite/Fractals\\_a\\_Symmetry\\_Approach/MathEd\\_PDF\\_PresentIt.pdf](http://www.public.asu.edu/~starlite/Fractals_a_Symmetry_Approach/MathEd_PDF_PresentIt.pdf). This site explains the symmetrical properties of fractals.

Frame, Michael, Mandelbrot, Benoit, and Nial Neger. Fractal Geometry. *Yale University*. Retrieved February 28, 2006, from <http://www.classes.yale.edu/fractals/>. This site contains an in depth explanation of basic fractals and how chaos relates to them. This is very good background information for the teacher. It also contains a couple examples of fractal images.

Ingermanson, Randy. (2005, August). *Disturbing Your Universe*. [Electronic version] This author is known for his “snowflake version” of writing a novel. This is interesting for students to know that an author has used a fractal snowflake method for writing a novel.

Louvet, Jean-Pierre. (2000) Fractal Art FAQ. Retrieved February 17, 2006, from <http://www.fractalus.com/fractal-art-faq/>.

This is an excellent site to use with the fractal art lesson. It gives an enormous amount of information about the basics of fractals and fractal art.

Peitgen, Heinz-Otto and Richard F. Voss. Of a Fractal Nature. Retrieved February 17, 2006, from <http://www.public.asu.edu/~starlite/>

This is a very user friendly web site. First it shows numerous examples of fractals that have been placed in nature. There are coloring and building pages that allow users to build and color fractals in a step by step protocol. This site would be helpful for the lesson where the students go to the computer lab and for background information for their art project.

Pickover, Clifford A. The Pattern Book: Fractals, Art and Nature. Singapore, World Scientific Publishing, 1995.

This book explains background information about science, computers, art, and patterns. It shows the relationships between science and art.

Snyder, Dave. (2006, February 15). Astronomy Bibliography: Fractals and Astronomy. Retrieved February 28, 2006, from <http://www.umich.edu>.

This site explains how the study of fractals relates to science.

Stewart, Ian. Does God Play Dice? London, Penguin Books, 1989.

This book explains the history and theory of chaos.

Vassallo, Charles. (2005, January 25). Art and Fractals. Retrieved February 20, 2006, from <http://www.perso.wanadoo.fr/charles.vassallo/welcome.html>

This is an introduction of fractal art.

Wise, James. 2002. Fractals in Design. EDTG News, vol.6 (March), pp.1-2

This shows examples of fractals that have been created.

Young, Edwin. (2003, April 26). Fractal Software. Message posted to <http://freshmeat.net/projects/fraqtive/>.

This is a program that can be used to create Julia and Mandelbrot sets.

### **Appendix: Content Standards**

The following content standards will be incorporated into the fractal unit.

#### **Communication Standards**

**C.2** All students read and use a variety of methods to make sense of various kinds of complex texts.

**C.6** All students exchange information orally, including understanding and giving spoken instructions, asking and answering questions appropriately, and promoting effective group communications.

#### **Mathematics Standards**

**M.3** All students apply the concepts of patterns, functions and relations to solve theoretical and practical problems.

**M.5** All students understand and apply basic concepts of algebra, geometry, probability and statistics to solve theoretical and practical problems.

Arts and Humanities

**AH 2.** All students evaluate and respond critically to works from the visual and performing arts and literature of various individuals and cultures, showing that they understand important features of the works.

**Science and Technology Standards**

**ST .1** All students explain how scientific principles of chemical, physical and biological phenomena have developed and relate them to real-world situations.

**ST.6** All students develop and apply skills of observation, data collection, analysis, pattern recognition, prediction and scientific reasoning in designing and conducting experiments and solving technological problems.

**Abstract:**

As a teacher I hear complaints and groans when it is time for Math. I feel that many students dislike Math because they do not understand it. I chose to create a unit about fractals that is brought down to the fourth grade level. My main priority for this unit is to spark an interest for Math in students by integrating the teaching of fractals into other subjects. I also want students to get enthused about learning about Math so that they are willing to learn more.

This unit includes an introduction about fractals. The following lessons integrate the teaching of fractals into Math, Science, Writing, Computers, and Art. This unit takes a “hands-on” approach to teaching about fractals.

My theory is that when students are able to see and touch objects related to what they are learning they are better able to grasp the concept. By getting students involved in the process of learning I am hoping they will be encouraged to want to learn more about the mathematical concepts of fractals. Once they learn the basics about this will lay the groundwork for other math ideas.