



Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2006 Volume VI: Anatomy and Art: How We See and Understand

Art and Anatomy: The Vitruvian Teen

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Justification

Ultimately, learning becomes interdisciplinary as we mature and have opportunities for varied experiences. As adults and teachers it is our responsibility to facilitate growth and provide opportunity for different experiences. Meaningful interpretation and integration of experience must be modeled for our students as well.

In grade school children build reading, writing, computational and analytical skills in a step by step fashion usually with one teacher each year. The next teacher uses the previous years' accomplishments as building blocks. Gradually vocabulary expands and students read more complex books. Perspective expands as we start to learn about countries and cultures other than our own, and examine the physical world around us. A sense of community and of the value of education is a necessary ingredient, both in school and at home. Throughout the grades, our students' required readings are set in the historical setting that is being explored from a social standpoint. Our students are acquiring the computational skills needed in their current scientific studies. They move from learning about their town, to their state, to their country and finally to their world and beyond.

In middle school and high school courses and the school day becomes compartmentalized. English, now dubbed Language Arts, Social Studies, Science, Math, Art, and Foreign Language are separate departments with differentiated courses taught by many teachers in many ways. Should the History teacher include lessons about relevant scientific discovery? Should the Science teacher teach the historical and cultural setting in which certain discoveries and advancements took place? Should the Language Arts teacher have students read the scientific and literary writings of the same particular era? Should the Art teacher explore the art movements of that era? Ideally, yes.

In order to successfully contribute to society now and in the future, our students need an integrated, expanded, and global knowledge base, skill set, and point of view. This is critical in today's world of technological change which seems to proceed at the speed of light. Changes to our traditional compartmentalized studies must occur so that students of today are ready for the workplace, higher education, and life's challenges. Relevance is an essential ingredient to education, making it accessible and valuable. It is demanded by students who constantly ask "What does this have to do with me?", especially in

Science classes which may concentrate on abstract laws and atomic and cellular processes that are unseen and untouchable.

Anatomy and Physiology may actually be the most relevant course a student can take. Middle and High School students are at the developmental stage of constant preoccupation with thoughts about their own changing anatomy and physiology. They are interested in sports injuries and all manner of "grisly" injuries and diseases they hear and read about. As a physician I often use these inquiries as "hooks". This primary and urgent focus on their bodies virtually guarantees teachers of Anatomy and Physiology a captive audience. An interdisciplinary approach, including artistic media, makes the unit particularly relevant. Students often enjoy and should have the opportunity to demonstrate their understanding and application of knowledge by means other than essays and objective texts. Art projects and presentations allow students to use skills other than writing in order to shine and feel successful. An atmosphere of trust and teamwork is fostered as students first work with partners, then small groups and then as a whole class. The teacher models positive reinforcement and constructive critique and amplification.

The combination of science and art is natural. Artists and scientists must be keen observers of their environments. The artist who draws his inspiration from the natural world sees light, shadows, colors, textures, forms, and lines. She absorbs her observations, and combined with her experience, emotions, imagination, and purpose, art is synthesized. Scientists must also be keen observers of their world. After careful observation, those who are curious about the hows and whys of the world ask their questions and form their hypotheses. Scientists must use their creativity and imagination to stretch beyond the accepted theories of their time. Democritus, in 500 AD, postulated that all matter was made of tiny parts, which could not be divided which he called atomos. He derived this theory by observing the world around him. It is mind boggling to think that this philosopher and thinker came up an "atomic theory" of the world just by observing the macroscopic world. It was not until 2500 years later that we had the technology to test his hypothesis. Many scientists over a one hundred year span refined, tested, refined and retested, but Democritus had no instrumentation, did not conduct experiments, and was not believed by his peers. But he was right; we use his word, atom, still.

Leonardo Da Vinci was another individual "connected" to the universe, which he observed and translated for us all. His genius and achievements are too numerous for this discussion. He was a philosopher, scientist, artist, inventor, anatomist and his work included architectural and technological design. As an architectural apprentice Leonardo studied the work of Vitruvius, which was being rediscovered and revived during the Renaissance along with other ancient culture. Marcus Vitruvius Pollio was an ancient Roman architect whose ten volumes, *De Architectura*, was one of a scant few classical treatises to survive over time.

Vitruvius considered the human body to be the essence of perfection. In his third volume of *De Architectura*, he gives details on how to proportion a temple based on the proportions of the human body. He justified this theory by stating, along with citing specific measurements, that the human body with arms and legs extended fits into the perfect geometric forms, the circle and square. It is a translation of this original work that the students will use to form the basis of their "Vitruvian" measurements and drawings of the human form. And it was a translation of this work that Leonardo was illustrating when he drew his now famous "Vitruvian Man".

Beginning a course in Anatomy from an artistic perspective is a personal choice. However there is an enormous body of studies, which provides evidence of the positive relationship of art to school performance

In 1989, Eric Oddleifson created the Center for Arts in the Basic Curriculum (CABC). His theories were formulated with the original board members including Cognitive Psychologist and Harvard University Professor

Howard Gardner and Harriet Fulbright, Former Director of the President's Committee on the Arts & Humanities.

The mission of the CABC was to promote the inclusion of the arts in the curricula of public schools. Study after study of schools revealed to Oddleifson that inclusion of the arts increased student's learning in all areas of basic curriculum.

Oddleifson and the CABC followed and supported art curriculum in fifty schools across the country. In each one, be it public or private, measures of student's performance increased, some dramatically. For example, Roosevelt Middle School (K-6) in Wisconsin switched to an arts focus in 1984. Fifty-nine percent of students were from minority groups. Students achieving competency in reading rose from 30% to 80%. The proportion of students achieving math competency rose from 10% to 60%. Attendance rose to an average of 92% and the suspension rate dropped from 50% to lower than 10%. ¹

In a study of Seattle elementary schools, in a low-income area, all students in grades K through 6 were required to participate in performances of *The Phantom Tollbooth* and *The Wizard of Oz*. Their reading scores went up by 30% from the fall to the spring. ²

T.E. Mathews Community School is a school for twelve-to-eighteen year-olds who have been court ordered to attend because of crimes committed, some of them serious. The school is part of the detention center in Yuba County, California, which had the third highest crime rate in the country at the time. The experiment began in September 1993, when the head of the school participated in a two-week summer institute for public school teachers called The Waldorf Approach Applied in the Public School Classroom at Rudolf Steiner College.

The Waldorf approach is an integrated approach to learning, which incorporates art. The teacher was able to use story telling and writing, poetry, music, and movement with her 38 students. The principal of the school states:

"Students who couldn't focus on their work for more than two minutes at a time worked for 30 minutes practicing on the recorder. They continually asked to practice music during detention and lunch hour. Music lessons also taught cooperation and helped dissolve the polarization of gang culture so rampant among these young people. After all, how can you hate someone with whom you've just played a Mozart duet?" ³

Introduction

This unit is conceived for a large public High School in the city of New Haven. The school has an almost exclusively African-American population. The percentage of people living below the poverty level in New Haven is approximately 25% according to the 2000 census. The attrition rate is high. According to an informal survey I conducted, students in the Honors level classes have often taken two or more years of art instruction, but students in other levels generally have not. There is little if any art history taught. This unit, however, can be adapted to any grade or age or subject by slightly changing the emphasis to observation and measurement, understanding proportion, graphing, art appreciation and expression, or writing skills with a common theme of "it's about me and my body".

The Anatomy and Physiology course is generally taken in twelfth grade after completing Biology and Chemistry in the ninth and tenth grades. However it can be modified for Middle School or incorporated within a Biology course or an Art or Art History course. It is designed as the first unit of the course to grab students' interest and draw them into the subject matter. The unit functions as a guide for teachers to modify as they see fit by their own perspective and creativity.

This unit is an inquiry-based exploration incorporating concepts from science, studio arts, art history, language arts, social sciences, and mathematics. It teaches and reinforces skills needed in any area of study at every level of education. Students will be encouraged to be self-motivated independent problem solvers. They will need to apply previous knowledge to solving the problem at hand. Students will continue to develop research and writing skills across the disciplines. In small groups, students will have the opportunity to experience others' points of view and practice critically important interpersonal skills.

Students will have the opportunity to experience and challenge their own creativity.

They will be responsible for their own learning and practice self-assessment. This unit is an exercise in learning how to learn.

The combination of Science and Art is especially attractive in an urban school where Art is not required for graduation and taken by a small percentage of students. One year of art is presented in middle school. In exploring art history and various artistic media students may discover a vital interest, ability, or emotional outlet not previously accessed.

Ideally this unit, indeed the entire course, could be taught in a "Co-Lab", a collaborative classroom involving the Anatomy and Physiology teacher, the Art teacher, and the students in a back to back period, giving them one year of Art credit and one year of Science credit. There would be three one and one-half hour classes per week and one three-hour lab/studio art periods per week. However, it is directed at the conventional Anatomy and Physiology course. Additionally, guest artists, art historians or curators, and anatomists can be invited into the classroom. A museum trip or visit to the Yale Medical School anatomy lab may be considered.

Objectives

As a result of this unit students will be able to

1. Describe the history of the depiction of human anatomy.
2. Give examples of the historical and cultural influences that affected anatomical drawing over time.
3. Develop, in small groups, a working translation of Vitruvius' measurements of human proportions.
4. As a class, measure their heights and arm spans and create a graph of their data.
5. Evaluate why their findings may or may not support Vitruvius' work.
6. Study works that predate Da Vinci's famous drawing.
7. Evaluate Da Vinci's Vitruvian Man in terms of mathematics and geometry.

8. Create a personal interpretation of the "Vitruvian Teen" in their choice of artistic medium.
9. Write an essay relating their own work to concepts studied in the unit.
10. Present their choices and artwork to critique by their peers.

Strategies

Throughout the teaching of this unit I will draw from medical and anatomic examples to create relevancy and links to students' lives.

Lesson 1: The What and Why of Anatomy and Art

The unit begins with a brain storming session. I will pose the question "What is anatomy?" A response will be generated and the class will develop a working definition as a base for further study. I will ask the question "Why do we study Anatomy?" "How do we study Anatomy now?" "How did we study Anatomy in the past?" I will relate the study of Anatomy to specific medical cases. For example, "How does a surgeon know where to make an incision to remove your gall bladder?" "How does the Orthopedist know where to put the cast when you break a bone?" "Why does the doctor hit just below the knee with the hammer and what does it mean when your foot kicks her?" High School students are virtually obsessed with learning about their bodies and should have no trouble developing and answering questions of their own. Expansion of the topic beyond medicine to a historical and multicultural perspective through discussion and examples will follow in other lessons. We will relate Art and Science and the study of Anatomy to the Art of Anatomy.

All scientists start with careful observation of the human body and of their environment. Measurements of doorways, beds, desks, tables, cars and tools that humans use (i.e. circumference of a screwdriver, steering wheel, bowls, plates, etc.) will be taken for homework prior to Lesson 1. Students will be encouraged to make sketches of at least five different objects and measure and label dimensions. Discussion will center on why objects have these dimensions as related to Anatomy. Discussion also will include individuals with special needs using the same or different tools.

"Intruder" Observation Exercise in class: Another teacher comes into the room unexpectedly, dressed outlandishly with hat, umbrella, raincoat, wig, etc. and says something loudly and storms out of the classroom. Students must immediately write down all details of the encounter, including the "intruders' " wardrobe, what

was said, etc. Responses will be read aloud and then the "intruder" comes back. How accurate were the observations?

Lesson 2: Marcus Vitruvius Pollio: Search for Perfection

This lesson will be based on a translation of a passage in Book Three of Marcus Vitruvius Pollios' *De Architectura*. Vitruvius, as he is known, was an ancient Roman architect who wrote a series of ten books about the fundamentals of architecture. Few very early architectural writings survive. Vitruvius' collection of works not only survived but was revisited during the Renaissance by many artists. The passage, "The Planning of Temples", which we will use as the basis of our lesson, relates the building of a temple to the proportions of the human body. Vitruvius believed that human proportions were an archetype of perfection. Students will be have the opportunity to explore, interpret in their own words, and draw models of Vitruvius' proportions of man.

What follows is a translation passage 2 from Book 3, c 1, of Vitruvius' "*De Architectura*" :

For Nature has so planned the human body that the face from the chin to the top of the forehead and the roots of the hair is a tenth part; also the palm of the hand from the wrist to the top of the middle finger is as much; the head from the chin to the crown, an eighth part; from the top of the breast with the bottom of the neck to the roots of the hair, a sixth part; from the middle of the breast to the crown a fourth part; a third part of the height of the face is from the bottom of the chin to the bottom of the nostrils; the nose from the bottom of the nostrils to the line between the brows, as much; from that line to the roots of the hair, the forehead is given as the third part; The foot is a sixth of the height of the body; the cubit a quarter, the breast also a quarter. The other limbs also have their own proportionate measurements. And by using these ancient painters and famous sculptors have attained unbounded distinction. ⁴

Students will be given copies of this passage, sketch pads and pencil and free reign to draw well-proportioned humans. Two 45 minute or one 90 minute class period should be utilized. Students may

choose to work in pairs or alone and all work will be shared and discussed.

Lesson 3: How Has Man Depicted Man Over the Centuries?

As a group we will take a guided "tour" through the *Dream Anatomy* exhibit of the National Library of Medicine in Bethesda Maryland. This exhibition of works of art spanning 1500 years of anatomical drawing was on display at the National Library of Medicine from October 2002 to July 2003. Fortunately the exhibit is presented over the Internet along with the curators' comments and historical background information. It is a fascinating "trip" for students and teachers and will generate discussion, creative ideas, and a basis for evaluation.

Lesson 4: Are We Ideal?

This lesson will provide for continued discussion of Vitruvius' work and students' interpretations, conclusions and justifications of their particular drawings. In small groups, students will discuss and critique their products.

Their next small group task will be to devise a method of testing whether or not Vitruvius' postulates hold "true". They will evaluate whether they continue to be applicable today since human growth, health, and longevity have changed over time. Has the "ideal" human changed and if so, how and why? Are we still proportioned in the same way? Is everyone proportioned in the same way? Their materials will consist of string, yardsticks, pencil and paper.

Each group will present their findings in a formal laboratory report, including observations and statements of problem, hypothesis, procedure, data, conclusion, and discussion of validity.

The class as a whole will evaluate these "experiments".

Lesson 5: What About Leonardo?

In this lesson we will address Leonardo's famous drawing of the "Vitruvian Man" from historical, artistic, anatomical and mathematical perspectives.

Students will again have the opportunity to use their critical thinking skills, mathematic ability, and creativity to interpret the next passage of Vitruvius' work (see below), as did Leonardo when hired to illustrate the new translation of *De Architectura*. Students will

Follow in Leonardo's path by being asked to address the same task. Throughout the unit Leonardo's drawing will not be displayed. It will only be shown to the students after this lesson. Although some may look up the drawing before hand, I believe the exercise is still valid. Students will still be testing Vitruvius' theory of proportion and geometry. Is the navel truly the center of the circle?

The following is the translation of passage 3 of Book 3, c 1, of *De Architectura* by Vitruvius:

In a fashion the members of temples ought to have dimensions of their several parts answering suitable to the general sum of their whole magnitude. Now the navel is naturally the exact centre of the body. For if a man lies on his back with his hands and feet outspread, and the centre of a circle is placed on his navel, his figure and toes

will be touched by the circumference. Also a square will be found described within the figure in the same way as a round figure is produced. For if we measure from the sole of the foot to the top of the head, and apply the measure to the outstretched hand, the breadth will be found equal to the height, just like sites which are squared by rule." ⁵

Small sketches will be drawn and shared as a group. These sketches can be used as studies for the final project. After the sketches are completed and shared we will continue our art history "tour". Interpretations of Vitruvius' work by artists predating Leonardo's will be reviewed to contrast their earlier anatomic attempts with Leonardo's genius. Students will compare and contrast their own work to Leonardo's drawing to determine similarities and differences. They can then rework and rethink their sketches, which will be used for the final project, "The Vitruvian Teen."

Lesson 6: The Vitruvian Teen

Students will complete their final projects, "The Vitruvian Teen". Students will be given the task of creating a life-sized Vitruvian Teen, based on their own proportions. We will use rolls of canvas or butcher paper and students can trace each other or draw themselves free hand in the proper Vitruvian position and proportion. Any sketches or measurements from previous lessons can be used as notes for this assignment. Students can decorate and personalize their Vitruvian Teens as they wish, limited only by the extent of their imaginations. The use of varied media will be encouraged. I intend to partner with the school art teachers who can share skills, facilities, equipment, encouragement and constructive critique. I hope to display the students' work for the entire school population.

Additionally, throughout the course of the year, students will add their creative depictions and constructions of organ systems to their Vitruvian Teens. I believe this will be an engaging activity and serve to help relate internal systems to external anatomy.

Classroom Activities

Lesson 1

Goal: To introduce students to the concept of the relatedness of art and science, including the skill of careful observation

Objectives:

As a result of this lesson the students will be able to:

Brainstorm instances of the "combination" of art and science

Discuss the necessity of careful observation in art and science

Compile scientific data through measurement

Utilize careful observation in the classroom setting

Materials:

Board, Marker, Paper, Pens, Pencils, Sketch Paper

Rulers or measuring tapes for anticipatory set homework

Anticipatory Set:

Students will present data obtained from homework to their peers. They may also bring in particular objects, or measure objects in the classroom.

Procedure:

Discussion and comparison of students' measurements of objects. Students will be directed towards discussion of why objects are particular sizes and shapes in order to lead into the discussion of art (design) and science. Discussion of precision and accuracy in measurements can be incorporated.

"Intruder" observation exercise.

Closure:

Students will share their observations of the intruder. The teacher will bring back the intruder and students will compare their observations to the "actual" intruder.

Assessment:

Students will be assessed based on classroom contribution, homework assignments, and descriptions of intruder.

Homework:

Students will look through magazines and bring in pictures of people such as athletes, models, musicians, cartoon characters, etc, and be prepared to discuss their appearances with regard to proportion or variations from the "norm".

Lesson 2

Goal:

Students will develop an appreciation of ancient study of anatomy in anticipation of learning more about current methods of anatomical study.

Objectives;

As a result of this lesson students will practice interpretation of new information, i.e. nonfiction writing as translated from ancient Greek.

Students will apply their interpretations to construct human figure.

Students will use alternative methods such as drawing and oral description.

Materials:

Individual copies of Vitruvius' passage, sketch paper, pencil, erasers, meter sticks, tape measures, whiteboard and markers, colored pencils

Anticipatory Set:

Students will present their magazine pictures and observations.

Procedure:

The teacher will read the passage from *De Architectura* to the class. No questions will be answered by the teacher As described above in Lesson 2, students will interpret the passage and draw proportioned individuals as described in Vitruvius' passage. They will be encouraged to think independently. They may work cooperatively as well.

Closure:

Each student or pair of students will present their drawings and their justification for their drawing by way of their interpretation.

Assessment: Class discussion of the exercise, sharing and critique of drawings, and homework completed.

Lesson 3

Goal:

The goal of this lesson is to enable students to understand the methods of study of anatomy at various times in history. They will be able to relate and compare the artistic depictions of the human figure to the cultural values of different periods of time from pre-history to the present.

Objectives:

As a result of this lesson students will be able to:

Explore art history as related to culture

Draw conclusions from their observations of works of art

Critically evaluate new information to support conclusions

Materials:

Computer with Internet access and projector. Notebooks, paper, pens and pencils.

Procedure:

The teacher will show the *Dream Anatomy* "slides" and lead the class discussion regarding the curator remarks. It is advised that any teachers not familiar with the general periods of art history or discussion of works of art collaborate with the Art teachers in their schools for this portion of the unit. Please see Bibliography for the website.

Discussion should center on careful observation of the artworks, relationship of historical period to the style of art (i.e. symbolic, realistic, etc.) This lesson will require two class periods.

Closure:

The teacher will solicit from the student's two lists and write them on the board. One list will be a list of observations and the other list will be possible conclusion drawn from the observations.

Assessment and Homework:

Students will write a 5-paragraph essay, including an introductory paragraph and a conclusion. Student will give 3 examples of specific works of art that they feel do or do not reflect the culture of the time period in which they were produced. Students will site reasons from observing the artwork to support their conclusions. Works from the *Dream Anatomy* or other works with which the students are familiar may be sited. Students must bring to class any image used that was not presented in class.

Lesson 4

Goal:

The goal of this lesson is to relate the scientific method, often limited to the biology and chemistry laboratory to a non-traditional problem.

Objectives:

As a result of this lesson the students will be able to:

Review the scientific method and the formal laboratory report

Formulate hypotheses

Design experiments to test their hypotheses

Collect and analyze data using mathematic and graphing skills

Synthesize and support conclusions

Procedure:

Students will again refer to Vitruvius' passage used in Lesson 2. They will be given the problem: Using the scientific method, design an experiment to test Vitruvius' theory of the ideally proportioned human. Be sure to include observations, hypotheses, experimental design (including controls), materials, data, and conclusions. No other instructions will be given. This is an inquiry-based lesson. Students must determine what kind of data they want to collect and how to collect it.

Materials: Students may choose their materials from the lab.

Closure:

Each table will present a synopsis of their experiment. They will put their data on the board. The class will evaluate experimental design, data, and synthesize a conclusion for the combined data.

Assessment:

Class participation and laboratory reports.

Lesson 5

Goal:

The goal of this lesson is to have students put themselves in the frame of mind of artists interpreting an anatomical and geometric description of the human form. Students will be encouraged to follow their own path without worrying about being right or wrong.

Objectives:

After participating in this lesson students will:

Use artistic media to demonstrate their scientific understanding

Describe similarities and differences between their own works and the works of other artists

Support their artistic strategies with excerpts of the text

Interpret unfamiliar language and new information

Procedure:

The teacher will read the passage from *De Architectura* quoted above in Lesson 5.

In addition each student will receive a written copy of the quote. Students will "be" Leonardo, and will illustrate Vitruvius' passage. Each student will produce his or her own sketch. Two class periods should be allotted for this lesson.

Materials:

Drawing paper (various sizes), pencils, colored pencils, rulers, compasses, computer with Internet access, projector.

Closure:

Students will share their sketches with the class, describing and justifying their artistic decisions according to their interpretation of the passage. At the end of the presentations the teacher will show "slides" of various artists' interpretations of the Vitruvian man including Leonardo's. With the renewed interest in the classics, during the Renaissance, many individuals were translating and sketching from *De Architectura*. Google Images is an excellent source of images for this lesson (see Bibliography and Illustrations below).

In 1511 Fra Giovanni Giocondo, an Italian architect, tried his hand at translating and interpreting *De Architectura*. He used two images, rather than one, for his interpretation. Another Italian artist, Cesare Cesariano, in 1521 drew his Vitruvian Man inside a circle tangent to a square. Students can compare this drawing to their own and to Leonardo's.

Again, if the teacher is not adept at interpreting artwork, she can collaborate with the school's Art teacher.

Assessment:

Students will be assessed on class participation and sketches.

Homework:

Students will think about and plan their life sized "Vetruvian Teen". We will be primary using Found Object art and collage. Students will be asked to look around them and bring in objects that can be used in creating and decorating their figures. Examples are buttons, string, yarn, fabric, stickers, small toys and figures, foil, bottle caps, shells and other items that catch their eye and imagination.

Lesson 6

Goal:

The goal of this lesson is to have students utilize newly acquired knowledge to create their own artwork, which represents the principles learned in the lessons.

Objectives:

After participating in this lesson students will be able to:

Explore various artistic media and their own personal artistic style

Relate art and science experientially

Materials:

Ideally rolls of artists canvas (at least 6' by 150') but butcher paper (brown or white)

can be substituted. Paper should be handled with extreme care so that the projects can be used throughout the course of the year. Acrylic paints, markers, watercolors, fabrics, found objects, pastels, and any other available media. Glue, meter sticks. Canvas stretchers or wooden dowels for stabilizing the final works.

Procedure:

Students will be directed to use the various media available to create life-sized Vitruvian Teens. Body proportions should be realistic and the circle and square as described in Vitruvius' work should be included. Students will be encouraged to be creative and find their personal style or artistic voice. Final works will be glued to dowels or stretched to preserve them and to allow for display. Works will be shared with the class. Students will work individually. Two to three class periods should be allotted for this lesson.

Closure and assessment:

Students will share and describe their projects. Students will answer ONE of the following open-ended questions as a final paper of 5 to 7 paragraphs. These will be handed in 5 days after completion of lesson 6.

1. Compare and contrast the roles of artists and scientists in today's society. Use specific examples of artists and scientists with whom you are familiar.
2. Do you agree or disagree with Vitruvius' theory that there is an ideal human proportion. Support your answer with information from your experiments.
3. Suppose you are an architect hired to design a well functioning classroom. Determine the dimensions of the room and it's furnishings, windows, doorways, etc. Give reasons for your design based on knowledge acquired in this unit. You may include sketched but a verbal description and justification is required.

Although the activities and discussions presented are meant for high school students the lessons can easily be simplified for younger children. Middle and elementary school students will enjoy measuring themselves and their everyday objects, creating experiments, and especially tracing each other on large paper to create "Vitruvian Kids." Emphasis can be placed on learning about proportion, external anatomy, and exploration of art history

Bibliography

Clayton, Martin. *Leonardo da Vinci: A Singular Vision*. New York, NY: Abbeville Press, 1996

A shorter reference regarding Leonardo's figure drawing.

Lazaroff, Michael. *The Complete Idiots' Guide to Anatomy and Physiology*. Indianapolis, IN: Alpha Books. 2004

Mr. Lazaroff is one of the finest Science teachers I have ever met and observed. He teaches at Staples High School in Westport, CT. His book is very readable, organized, and relevant and can be used as a textbook.

McCracken, Thomas O., Ed. *New Atlas of Human Anatomy*. Barnes and Noble Books, Inc.,

1999.

An excellent resource for teachers and high school students.

Perard, Victor. *Anatomy and Drawing*. Barnes and Noble Books, Inc., 1999.

A beautifully and simply rendered book of line drawing of the human body.

Suh, H.A., ed. *Leonardo's Notebook*. Black Dog and Leventhal Publishers, 2005.

An excellent source of information about the life of Leonardo Da Vinci with magnificent artwork and examples of Leonardo's own thoughts in "mirror writing", translated for us.

Examples of his figure drawing are presented.

<http://aiwaz.net/modules.php?name=News&file=article&sid=24>

An on-line "art institute" with extensive information and links for various artists.

http://www.nlm.nih.gov/exhibition/dreamanatomy/da_intor.html

This is the website for the *Dream Anatomy* "tour" of the National Library of Medicine in Bethesda, Maryland.

A Fifty School Arts Education Demonstration Project, previously published in

New Horizons for Learning's, On The Beam, Vol.XI, No.1, Fall 1990, p. 4-5 :251, as quoted in
<http://www.newhorizons.org/strategies/arts/cabc/oddeifson.html>

<http://www.newhorizons.org/strategies/arts/monks.html>

A website which accesses many studies regarding the necessity of incorporation performing and visual arts into school curriculums at all grade levels.

<http://www.cln.org/themes/skeletal.html>

Links to Internet sites, which contain information, related to the specific theme of the body's Skeletal System. Useful for teachers and students

<http://www.massculturalcouncil.org/services/integrating.html>

The Massachusetts Cultural council provides excellent support for teachers, schools, and school districts, which are interested in including arts in their curricula. There is an extensive listing of programs and sources of funding, including the MCC itself.

<http://www.metmuseum.org/toah/splash.htm>

An excellent website to explore art history and changes over time. A timeline from 20,000 BC to 2,000 AD is presented with images from each period. Useful for students and teachers as a general review/preview of art history. Can be used as a prelude to Dream Anatomy tour.

<http://www.ms Jensen.gen.umn.edu/webanatomy>

This site is an interactive study guide in the form of games, covering all aspects of anatomy and physiology. Especially useful for high school students and teachers.

<http://www.google.com/imghp?hl=en&tab=wi&q>, last accessed April 7, 2006

Google's image search is excellent for providing a wealth of images on any subject.

Many images of "Vitruvian Man" by artists over the centuries can be found including

" *Vitruvian Spongebob* ".

<http://www.princetonol.com/groups/iad/lessons/high/highlessons.htm>

An excellent site for art lesson plans which can be adapted to various subjects.

Illustrations

<http://leonardodavinci.stanford.edu/submissions/clabaugh/history/othermen>

Explanations and illustrations of Cesariano's and Giocondo's Vitruvian Man.

<http://rubens.anu.edu.au/htdocs/laserdisk/0205/20576.JPG>

An illustration of Cesariano's Vitruvian Man.

<http://www.visi.com/-reuteler/vinci/vitruvian.jpg>

A clear image of Leonardo's Vitruvian Man.

<http://www.arch.ttu.edu>

Image of Cartesian Man.

<http://images.google.com/imres?imgurl=http://discauthors.com/blog/spongebob>

Vitruvian Spongebob!

Notes

1. A Fifty-School Arts Education Demonstration Project, previously published in

New Horizons for Learning's, On The Beam, Vol.XI, No.1, Fall 1990, p. 4-5 :251

<http://www.newhorizons.org/strategies/arts/cabc/oddlifson.html>

2. *Ibid.*

3. <http://www.newhorizons.org/strategies/arts/monks.html>

4. As quoted from F. Granger's translation of *De Architectura*, Loeb Classical Library, 1970 in <http://aiwaz.net/modules.php?name=News&file=print&side=24>.

5. *Ibid.*

Appendix A

UCP 1: Systems, order, and organization

UCP 2: Evidence, models, and explanation

UCP 5: Form and function

SAI 1: Abilities necessary to do scientific inquiry

SAI 2: Understandings about scientific inquiry

ST 1: Abilities of technological design

ST 2: Understandings about science and technology

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