Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2013 Volume III: Sustainability: Means or Ends?

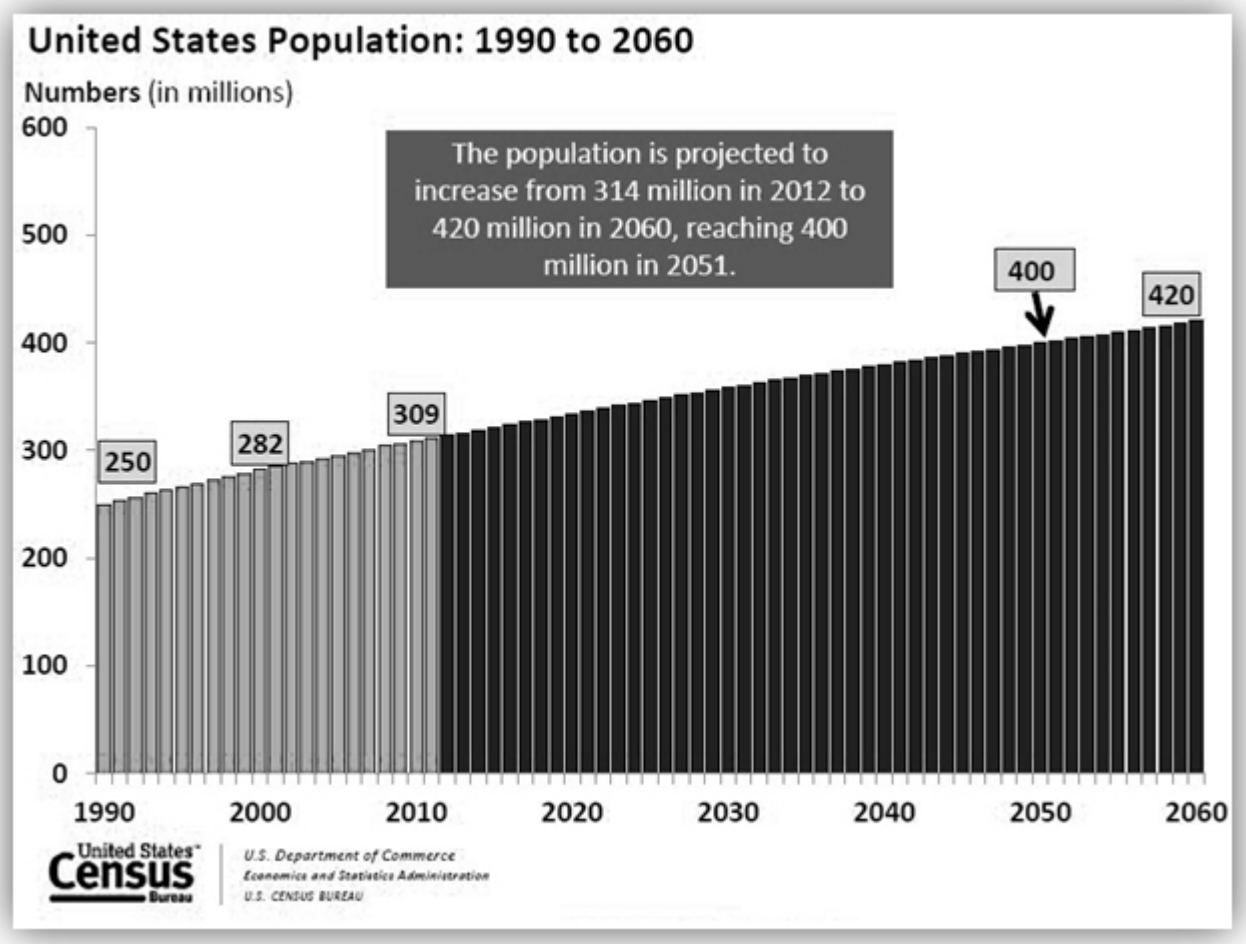
Designing a Micro-Apartment

Curriculum Unit 13.03.05
by William O'Shea

Introduction

Wealth, health, opportunity, prosperity, education and social proximity are the implicit promises of urban life. The world is now home to over seven billion people and the United States to more than three hundred million people [1]. According to the United States Census Bureau, the United States is currently gaining one inhabitant every thirteen seconds.

Urban density is the number of people living in a city per square mile and is on the rise in cities across the United States. There were 27,543 people living in each square mile of New York City in 2012. There were 6,948 people per square mile in New Haven in the same year. New Haven's population increased, per the United States Census bureau, by an estimated 962 people from 2010-2012. That's 51 more people per square mile in just two years. The area described as downtown (census tract 1401) saw a 26.4% increase in population in the ten years since between the 2000 census and the 2010 census. The United States Census Bureau predicts significant population growth over the next 37 years. [1]



http://www.census.gov/newsroom/cspan/pop_proj/20121214_cspan_popproj.pdf

Harvard University economist Edward Glaeser believes that education is the most reliable predictor of urban growth (after January temperatures) among older cities. [2] He reasons that an educated city has higher productivity and a higher quality of life and that, in turn, attracts college graduates and sustains population growth. As a satellite of New York City, home to Yale University, and presently in the midst of a robust public education reform movement, New Haven is poised for further population growth.

In July 2012 the Mayor of New York City, Mayor Michael Bloomberg, proposed a very interesting design competition to help meet a perceived housing need. In 2012, New York City determined it required almost one million more one and two-person households to meet demand. The city proposed a design competition for a rental building composed entirely of micro-apartments (apartments approximately 275-300 square feet).

"Developing housing that matches how New Yorkers live today is critical to the City's continued growth, future competitiveness and long-term economic success," [3] said Mayor Bloomberg. "People from all over the world want to live in New York City, and we must develop a new, scalable housing model that is safe, affordable and innovative to meet their needs." [4]

Yale Professor of Architecture Michelle Addington suggested in a Yale-New Haven Teacher's Institute Seminar on April 2, 2013 that energy demand for a high density high rise buildings could offer more than a 50% energy savings per user as the energy required to meet the needs of the individual is shared. City residents use less

energy than that of rural residents for a number of reasons (transportation costs and other such potential services that can be amalgamated), one of which being building densities and increased numbers of occupants per square foot allow for energy savings from such expenditures as lighting and heating, ventilation and air conditioning. These opportunities exist in spite of the increased concentration of high energy needs equipment being concentrated concomitantly in the same structure. The important distinction that Professor Addington makes is the consideration of energy consumption per user rather than per building. The assumption for this unit, Designing a MicroApartment, is that the MicroApartments will be clustered in sufficient density to capitalize on shared resources like HVAC systems and could reap energy savings benefits from energy supply models used by organizations like Yale University. For example, Yale's Central Power Plant utilizes a power cogeneration technique that recaptures released heat during electricity generation and further utilizes that high quality thermal energy with the result being significantly higher efficiencies from initial fossil fuel investment (from a Yale Power Plant tour, July 2, 2013). It's design capitalizes on the energy needs of a large community tightly clustered in an urban setting.

This unit, Designing a Micro-Apartment, was developed in light of the trend toward urban densification and in the spirit of Mayor Bloomberg's design competition, adAPT NYC. This unit is a scaled down iteration of Mayor Bloomberg's competition and is offered to the students of New Haven Academy in a new course offering: Introduction to Design.

Context

New Haven Academy (NHA) is a small, progressive magnet high school serving approximately 250 students from the greater New Haven area. I teach Chemistry at NHA to high school juniors, but this coming academic year, I have been invited to create, direct and administer a new course for the school entitled "The Design Process." I have been invited to do so during a time of great programmatic shifts for the both our school and the State of Connecticut. This unit on designing a Micro-Apartment was developed for this new course.

The New Haven Academy Science Department is undergoing a number of significant programmatic changes as well. Some changes are a result of the shift in educational philosophy nationally, some due to the adaptation of The Common Core by the State of Connecticut and other changes are encouraged by the reform movement within the City of New Haven. The State of Connecticut is poised to shift away from its old set of science standards to a new national set of science standards entitled the Next Generation of Science Standards (NGSS). The NGSS seeks to integrate a great many concepts in science that, until now, have been taught in modular isolation and to include engineering principles in traditional science instruction. It focuses on a smaller set of Disciplinary Core Ideas encouraging depth (not breadth) of topics and application of content. The NGSS is designed to encourage students to consider science concepts in the context of real world application instead of in topical isolation. The NGSS seeks to accomplish this with an appreciation of how science and engineering is practiced in the real world.

In as much as our school is aware of these shifts at the federal and state levels, New Haven Academy has always endeavored to be an engine of innovation and a catalyst for change. Our school chooses to be on the leading edge of school reform through its focus on curriculum development rather than follow.

This unit was born from a union of interests, needs and inspirations. New Haven Academy is concurrently making the shift to Mastery Based Learning which seeks to achieve thoughtful learning through questioning, researching and presenting. The identified need for an elective course that focused on the design process was the result of discussions held with my colleagues. In its shift from a traditional form of instruction and assessment to Mastery Based Learning, or Competency Based Learning, students take greater responsibility for their learning. In a Mastery Based Learning model the student applies content knowledge skills in and/or across content areas. Students clear formative benchmarks that contribute to approximately 10% of their grade leading to a key summative assignment which constitutes 90% of their grade. Students are not permitted to move forward in their coursework (or on to other courses) until they demonstrate mastery on a key summative assignment designed to assess competency of a content skill.

Whatever the merits or flaws of this system, there are two important practical considerations: 1. Mastery Based Learning is the direction that the New Haven Public School System (and the State of Connecticut) is headed toward. 2. A leap from a traditional model to a mastery based model is no small challenge. New Haven's High School in the Community serves as an apt illustration of this. It is the first school in New Haven to institute a form of this model. At the conclusion of the last academic year the headline from our local online newspaper gives some indication of the results: Zero Out of 44 Students Complete Freshman Year by Melissa Bailey (June 28, 2013), The New Haven Independent (www.newhavenindependent.org). It is in the context of these reform movements, shifting educational landscape, and within the progressive crucible of New Haven Academy that this unit was developed.

Rationale

This unit was designed utilizing a backward design which is "an approach to designing a curriculum or unit that begins with the end in mind and designs toward that end" [5] and will therefore be presented in a manner consistent with this method. The culminating project, Designing a Micro-Apartment, was conceived and focused on educational standards. These worthy intellectual priorities are central to coherent connections in the engineering and architectural design process and further linked to specific standards in the Next Generation of Science Standards and Connecticut State Standards of scientific inquiry, literacy and numeracy. In designing a micro-apartment, students will meet the following state standards:

D INQ.1 Identify questions that can be answered through scientific investigation.
D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.
D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.
D INQ.6 Use appropriate tools and techniques to make observations and gather data.
D INQ.10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

In designing a micro-apartment, students will meet the following Next Generation of Science Standards:

HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

The culminating project itself is a focused effort on a singular task of designing a micro-apartment, however, meets the above standards by being broad and abstract in its concept. The core of this assignment examines a set of skills that traverses vertically, through the years of prior and subsequent science coursework and horizontally, across other core academic subjects. Students will develop previously introduced skills of the Design Process to design and build a scale model of a micro-apartment. This unit will successfully bridge current Connecticut State Science Standards with the Next Generation of Science Standards currently under consideration for adoption by the state.

Culminating Project

There are as many similarities between the fields of architecture and engineering as there are differences. This unit will draw upon the similarities between these two fields. Designing a Micro-Apartment will focus on skill sets that both architects and engineers must possess. Engineers and Architects must be analysts, be able to work in teams, be creative problem solvers, be project managers, be able to work with several design/model aids and must understand materials.

The following design constraints were adapted from the adAPT NYC design competition [6] and made less complex for its intended audience. Students will plan, design, create scale models and present a proposal for their design of a micro-apartment that adheres to a set of given design constraints. Within these design constraints, creativity is encouraged. The apartment will be approximately 300 square feet. The apartment (within the walls) will be 10 feet wide by 30 feet deep and feature a 14 foot floor to ceiling space. Proposals should consider all three dimensions of units and amplify the sense of openness by:

1. Maximizing the floor?to?ceiling height;
2. Increasing the number and size of windows to provide substantial access to light and air;
3. Providing windows that are operable and

4. Designing the interior surfaces to accommodate multi?functional use of the space, for living, sleeping, dining, etc. For example, counter?tops could be used as dining/work space and "Murphy?beds" could increase the flexibility of living space.
5. Floor space requirements: Building Code requires at least 150 square feet per unit with a minimum clear dimension of eight feet for a room.
6. These dimensions cannot include a kitchen.
7. The materials for interior finishes, architectural details, and equipment should be durable.
8. Efficient and attractive storage systems are encouraged.
9. Door way thresholds should be no less than 32 inches wide.
10. Each space in this apartment should be large enough to permit a wheelchair bound client room to enter and turnabout without difficulty.

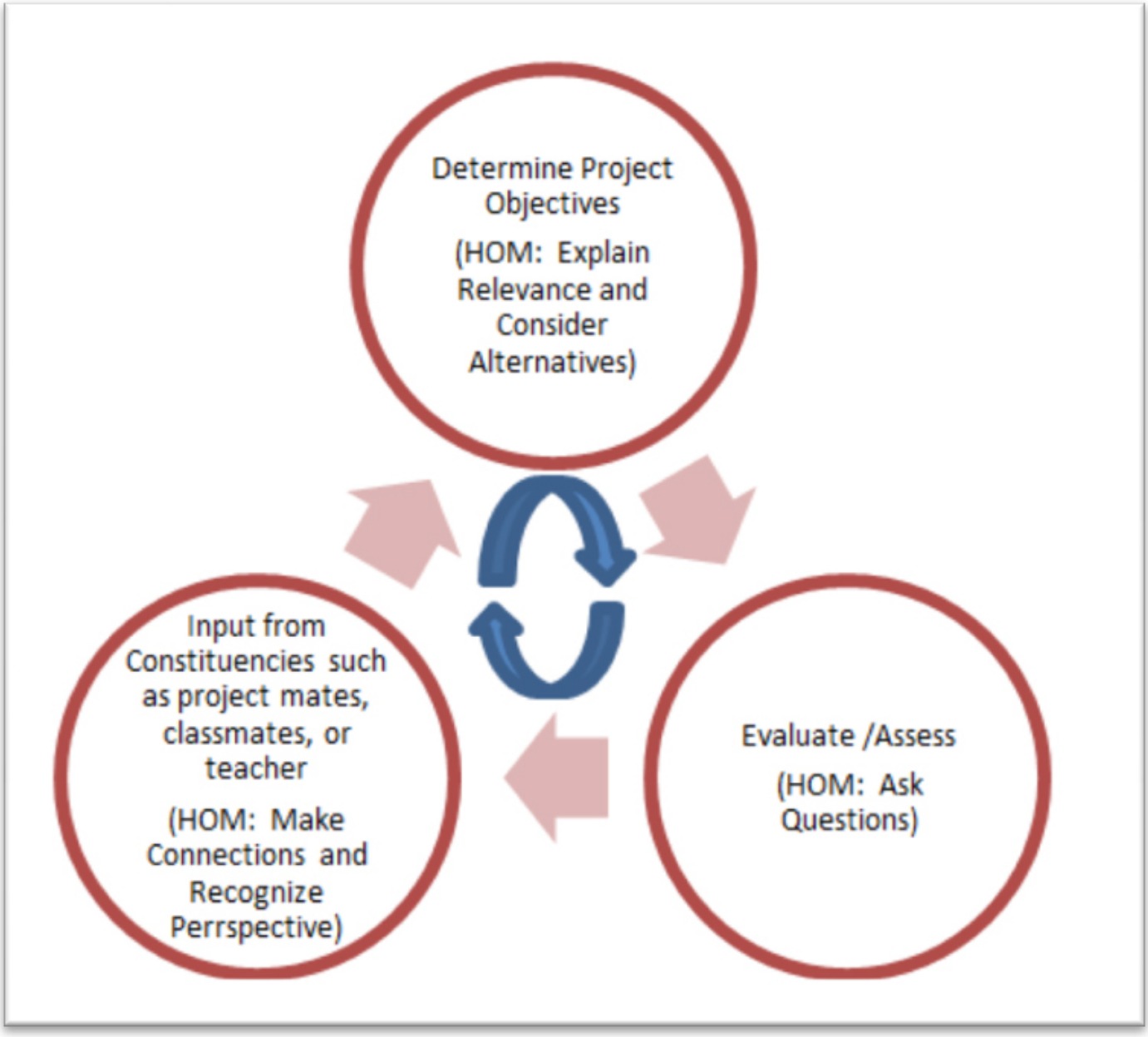
There are three phases to this summative assignment that will be assessed. The planning phase, the model phase and the presentation phase.

The Planning Phase

Students are divided into groups of four and presented with the design challenge. The design process is represented by two or more iterative process loops.

Problem Definition

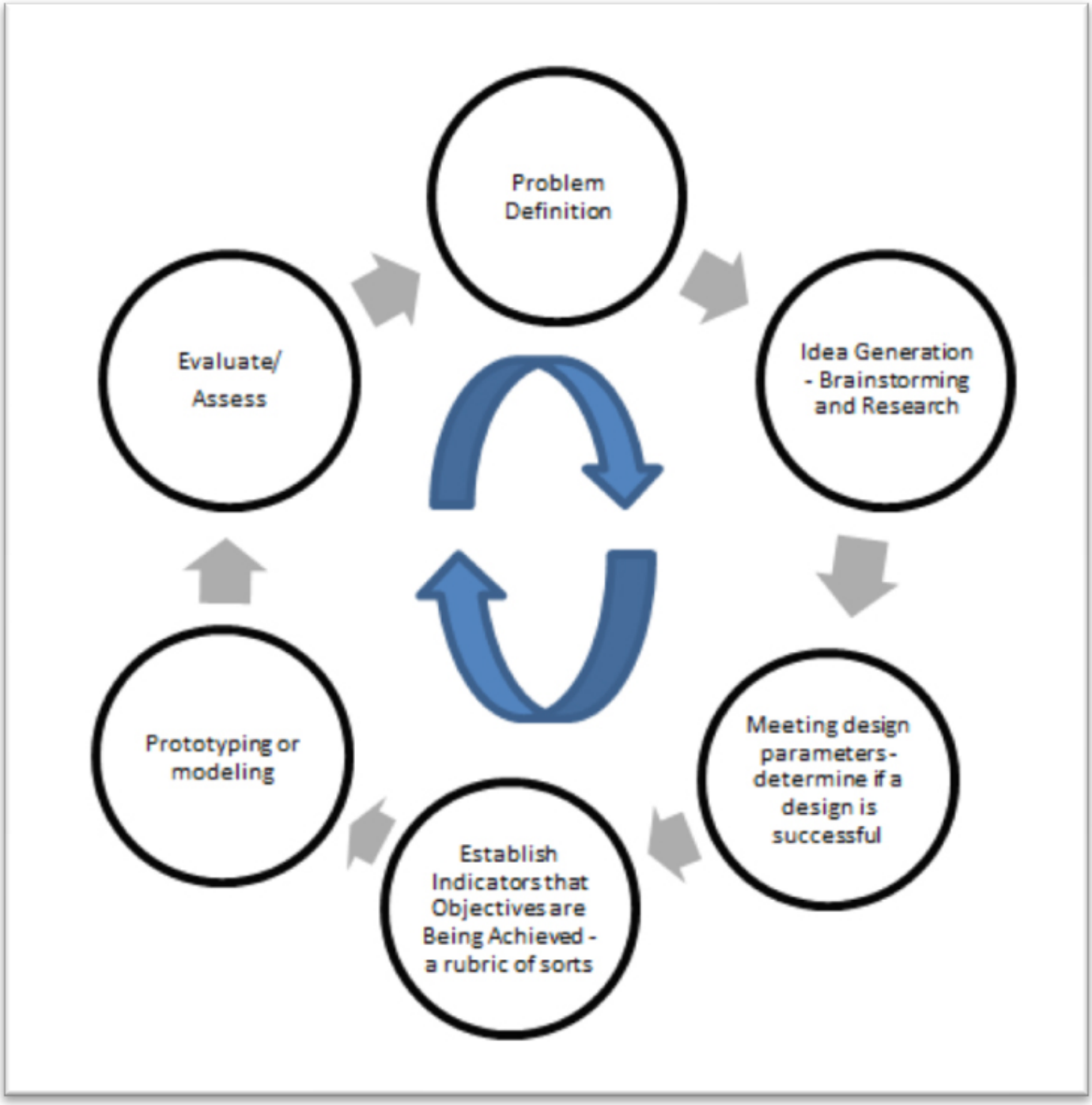
Students at New Haven Academy are encouraged to use processes like this in all their coursework. These steps are known to our school as "The Habits of Mind" or HOM.



The process of defining a problem is iterative. It is important to ascertain the needs and wants of the constituencies (ordinarily a client) and develop a solution that meets the need and satisfies the client. Recognizing that this is an open process that must be revisited mandates frequent reevaluation.

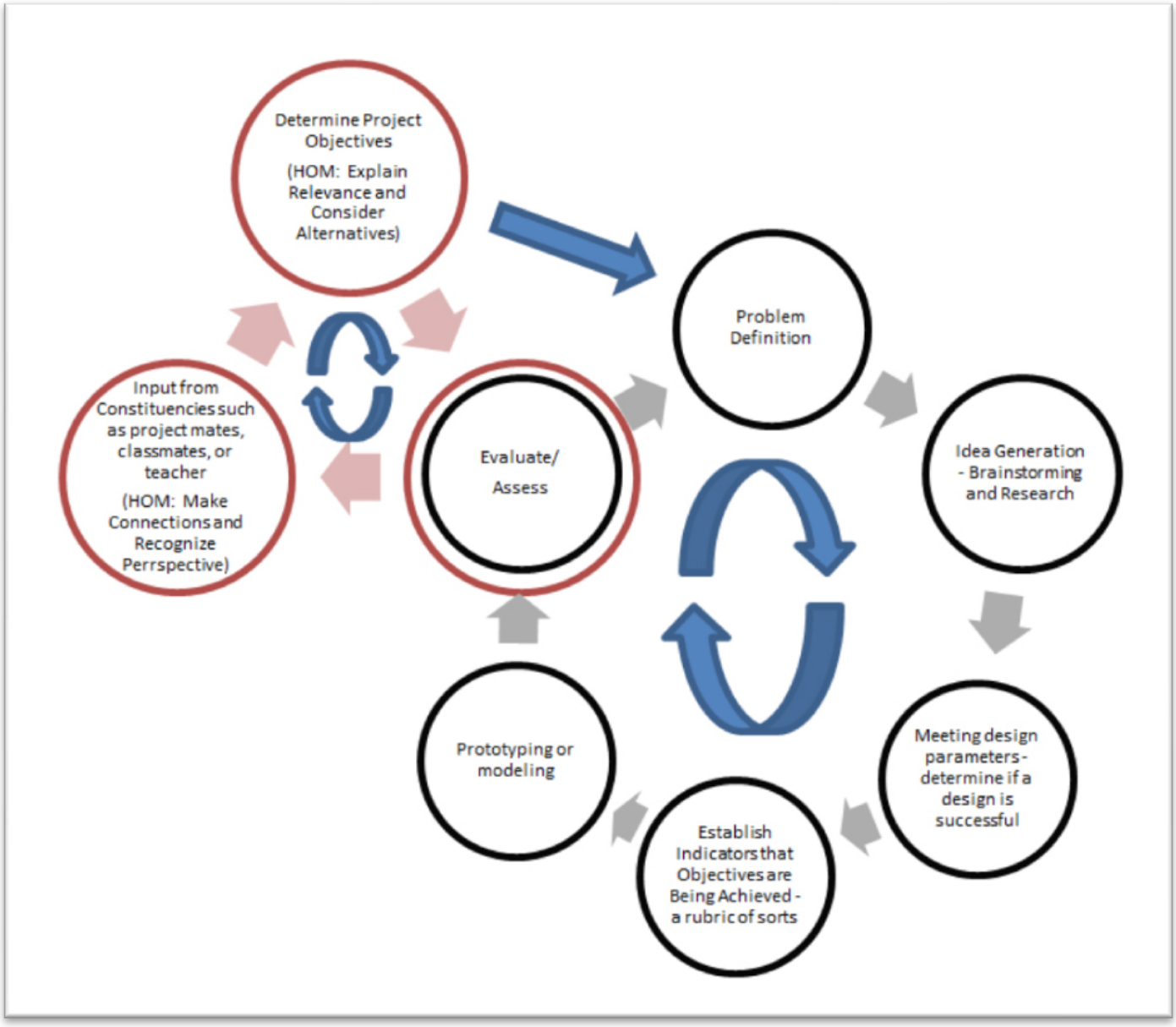
The Design Process

Once the problem has been to some extent satisfactorily identified, students will enter a second iterative cycle of the design phase; The Design Cycle.



Francis D.K. Ching writes "Design is a generative process of analysis and synthesis, of trial and error, of trying out possibilities and seizing opportunities." [7] The design cycle developed above represents a fusion of Francis Ching's notions on the design process, the scientific method and New Haven Academy's Habits of Mind.

Should a design be produced that does not satisfy the client, then it is the responsibility of the design team to return to the first process of defining the problem, to go back to the proverbial drawing board as it were.



The above cycle demonstrates the interplay between the problem identification cycle and the design process cycle and the important relationship between these generative processes.

Design and Teamwork

High school students often find themselves placed in groups or with lab partners with whom they must work. Each group of four students have responsibilities one to another as well as to the teacher (from this point forward identified as the client). Students will "blog" all steps of the design process in Google Docs and share these documents with one another as well as the client.

Students will work in a computer lab. Each group of students will work at a personal computer with the following resources:

1. Microsoft Office (word processing software being the most relevant)
2. Internet access

3. Access to the Google Application Coggle (http://www.coggle.it) for project planning (provided at no cost to the New Haven Public School System student).
4. SKETCHUP (http://www.sketchup.com) CAD software (licenses for 10 computers - $250). The State of Connecticut is in negotiations with the Trimble Navigation Ltd. to provide Sketchup Pro to the Connecticut K-12 students free of charge for the 2013-2014 academic year.
5. Mavenlink (http://www.mavenlink.com). A free application that integrates with Google Apps.
6. 10 recycled/functional computers for the lab (no cost).
7. Access to the New Haven Academy Library and the New Haven Public Library

Brainstorming in the Design Process

Students will brainstorm ideas and research and plan their micro-apartment together. Students will project plan with their partners using a Google based mind mapping software called Coggle (www.coggle.it). Students will develop their design using SKETCHUP Computer Aided Design Software.

To paraphrase Alex Osborn's rules for brainstorming from his 1963 book *Applied Imagination* , participants should encourage a lot of ideas (quantity is quality), should encourage a wide and wild variety of ideas and should never be criticized. Finally, ideas should be nurtured, expanded and explored within the group. Osborn also suggests that optimal brainstorming sessions last approximately 30-40 minutes at which point returns on time invested diminish precipitously. [8]

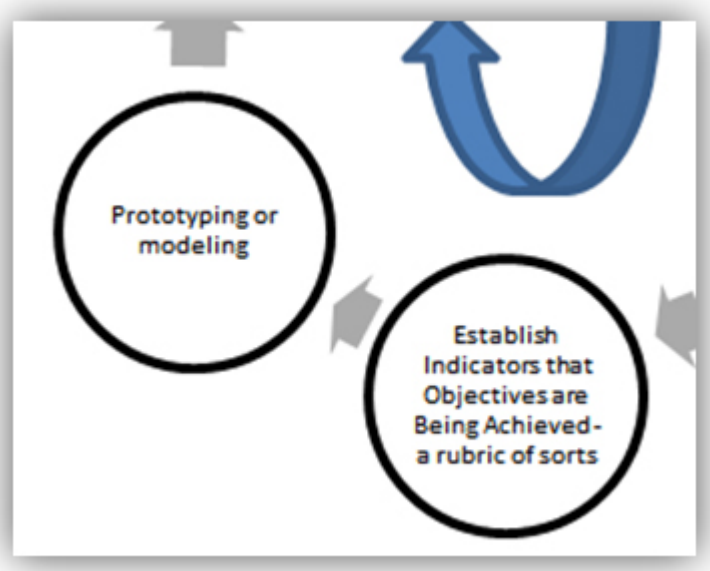
Project Timeline

Students should create a project timeline using Mavenlink (http://www.mavenlink.com). Within Mavenlink, students will create a project timeline. The final due date as the project culmination date. Students should list the tasks to be completed, list decisions that need to be made and list supplies and equipment that must be obtained. Then working backwards from the due date, assign each task, each decision and each supply acquisition to be made. Students must also create a responsibility chart similar to the one below: List tasks and subtasks

Tasks	Team Member 1	Team Member 2	Team Member 3	Team Member 4
Task and date	✓			
Task and date		✓		
Task and date				✓
Task and date			✓	
Task and date			✓	
Task and date	✓			

The Model Phase

Once the design team has settled on a design, the team must commit that design to a model. Students must commit to an iteration of their design options and place that design in Sketchup. Whilst brainstorming, students are directed not to be critical of ideas, however, during the modeling phase, criticism is necessary and must be constructive. A set of criteria for examining solutions to the design assignment must be well established prior to this phase so that arguments for or against a design can be focused and transparent.



Use of a Computer Aided Design program like Sketchup allows students to realize their vision with the only expenditure being time. Once a final iteration achieves approval from the group (evaluate/assess), a physical model will be built. Student groups will be provided the following materials to make their physical model:

1. Stainless steel flex rule 24 inch - 93191 $6.15 at Hull's Art Supply, New Haven, CT
2. 12 inch architect plastic 110P - 92914 $3.75 at Hull's Art Supply, New Haven, CT
3. 2B drawing pencil - 17642 $0.75 at Hull's Art Supply, New Haven, CT
4. T-square transparent edge 36in 11547 $24.10 at Hull's Art Supply, New Haven, CT
5. 10 inch adjustable triangle - 18097 $29.95 at Hull's Art Supply, New Haven, CT
6. Cutting mat grn/blk 24x36 - 60163 $34.99 at Hull's Art Supply, New Haven, CT

7. Ultility knife olfa-hvy duty cuttr w/rbbr hnd - 93565 $9.50 at Hull's Art Supply, New Haven, CT
8. Extra utility knife blades blades-heavy duty blister pack/6 - 93183 $5.25 at Hull's Art Supply, New Haven, CT
9. #1 xacto knife - 94674 $4.10 at Hull's Art Supply, New Haven, CT
10. Hot glue, wet glue and dry glue
11. Tape (masking and transparent)
12. Pliers

Students will be given a limited budget at Hulls Hobby to purchase additional materials like foam core, poster board, chipboard (1-4 ply) or wood.

Presentation

Students will present their designs to the greater New Haven Academy student body for evaluation by their peers. Students will prepare their presentation using Microsoft Office PowerPoint or any other suitable presentation software (subject to pre-approval).

Students will be expected to prepare a paper report and a presentation that reads like a thesis. An introduction should "hook" their audience. The body of their presentation should be divided into two-three main points about the assignment and their design and should provide examples that support their main points. The conclusion should summarize major points, show appreciation for their audience and invite the audience to ask questions about their design.

A good presentation is a presentation that is cognizant of the audience, should be free of jargon and acronyms, purposeful and brief. Presentations are best made in the active voice as opposed to the passive voice. (Example: active voice: "The apartment flows from the front door to the back of the apartment." Passive voice: "The front door to the back of the apartment will flow nicely.") Finally, a good presentation inspires and respects the audience and understands their wants and desires.

Each slide should be simple. One idea per slide with no more than 5-7 lines of text. `No more than one minute per slide. Picture, videos and diagrams should be large enough to be seen by all members of the audience. Pictures (and graphs if any) should not be complex. Avoid complete sentences, instead bullet major points. Text should be large enough to read (18-24 point font) and low contrast color schemes and fancy fonts avoided. Light background with dark print is best (dark background with light print is least favorable).

Animations should be kept to a minimum so that the audience's attention is on the material that matters.

During the presentation, the presenter should not simply read the slide. The presenter should appear relaxed, speak slowly (being aware that adrenaline flow typically causes nervous presenters to speak rapidly), use hands minimally and make eye contact throughout the audience. In order to achieve this, presenters need to practice their presentation out loud several times. The presenter should not announce that he/she is nervous, should avoid continued/sustained use of humor, and should avoid the excessive use of words like "I," "like," "um," "ur," or "uh." Finally, the presenter should suppress nervous habits like pacing the floor, leaning against walls, slouching, swaying, looking down, mumbling and other such tendencies.

Teaching Strategies

The formative assignments in this Mastery Based learning model will focus on the development of necessary skills and knowledge to be successful on this culminating project. A number of smaller projects dedicated to design (and lacking the presentation aspects) will be assigned.

Lesson Plans

Lesson Plan 1 - The Design Process

Day 1. Without any formal instruction on design process, students will be broken into groups of 3, given 20 spaghetti sticks, 1 meter of masking tape, 1 meter of string and a marshmallow. The groups will be directed to compete with one another to build the tallest spaghetti structure that supports the marshmallow at its apex.

The models will be photographed and heights will be recorded on the blackboard. The winning team will be given a small token.

Day 2. The challenge will be repeated with a more substantial reward offered. The models will be photographed and heights will be recorded on the blackboard.

At the conclusion of day 2, students will be asked to analyze the structures and results of the two days (collectively and individually). The expectation is that overall heights will be collectively higher owing to the structure being a second iteration and the learning curve associated with the design challenge. The analysis of the outcomes of the marshmallow challenge provides a suitable starting point for students to consider and refine their understanding of the design process.

Lesson Plan 2 – Design Thinking

Students will watch "Tim Brown urges designers to think big" by Tim Brown on Ted.com, *Recorded at TEDGlobal, July 2009, Oxford, UK.Duration: 16:50* . In this lesson students will watch this Ted Talk and relate their experiences designing and building their marshmallow towers in the previous lesson. Student will discuss their process and relate it to Mr. Brown's concept of "design thinking." It is said that necessity is the mother of

invention. Students will be asked to explore this idea and relate it to their experiences in the first few days of this unit.

Lesson Plan 3 – Floor Plans

Students will learn how to draw a simple layout of a building using a bubble diagram. This kind of diagram does not show the size and shape of a room, only how rooms are connected throughout a structure.

Next, students will draw a floor plan of the first floor of New Haven Academy. Everything should be the right size and shape, and in precisely the same location as the actual building. Students will then review their work, compare it to a professionally drawn floor plan and critique their work.

Students will then draw a floor plan of the second floor of New Haven Academy. Everything should be the right size and shape, and in precisely the same location as the actual building. Students will then review their work, compare it to a professionally drawn floor plan and critique their work.

Students will then draw a floor plan of the third floor of New Haven Academy. Everything should be the right size and shape, and in precisely the same location as the actual building. Students will then review their work, compare it to a professionally drawn floor plan and critique their work. Students who achieve mastery of the floor plan will move forward to the next assignment: Section and Elevation.

Lesson Plan 4 – Plan, Section and Elevation

Students will practice drawing plans, which are views from above by drawing a bell pepper from above. Students will then cut the pepper horizontally and remove the top sections so that the inside of the pepper is revealed. Students will sketch what they see.

Students will practice drawing an elevation of another bell pepper. This looks at one side of the pepper from the outside. Students will sketch what they see. Students will then slice this pepper vertically and remove the side to reveal a "cut away" view and sketch this as well.

Students will then make a section drawing of an object found in the classroom.

Students will take a walk around the school building (inside and out) and discuss drawing a section of it and what they would see if they could perform a cutaway.

Students will draw a section of the school building based on the discussions and label their drawings appropriately.

Students will draw a section of their home for homework.

Lesson Plan 5 – Communciation Skills

Students will begin to develop their communication skills by critiquing and practicing a number of essential communication activities. Students will critique student presentations (redacted) and discuss improvement strategies

Students will begin to practice getting up in front of a group. The topics will be "light" as the purpose of these lessons is to gain confidence speaking to an audience. Presentation topics will be assigned to students

randomly and will be limited to sixty seconds. Points will be deducted for students falling short of this time frame by ten or more seconds or by exceeding this time limit by ten or more seconds.

Presentations should be educational, tell a story and be unique.

Presentation topics will be created by the teacher and assigned randomly. Topics might include:

- Favorite sport
- Favorite form of entertainment
- Best day of the week
- Interesting dream
- Favorite local eatery
- Favorite course
- Best school project assignment
- Students Goals
- Student Dreams
- Student Ambitions
- Important role model
- Best year

Lesson Plan 6 – Writing

Students will be given a number of previously completed student writing assignments, read and discuss improvements in small group settings. Some writing assignments will be a short thesis while others will be actual student emails.

Lesson Plan 8 – Technical Writing Skills

Writing in technical language is a somewhat unique skill. Students will practice technical writing skills by examining student lab report abstracts for points such as:

1. clarity

2. formatting (mechanical specifications) such as font size and line spacing

3. term definition

4. use of past tense verbs

5. distinction between facts and inferences

6. flow

Students will work together in groups and edit and rewrite these works in order to improve them.

Lesson Plan 7 – Email Ettiquette

Students will learn how to properly compose a professional email. Students will compose emails to one another, correctly address the recipient, have an appropriate professional subject line and include a proper closing and signature line.

Lesson Plan 8 – Presentation Software

Students will learn how to design and conduct a simple presentation using PowerPoint (or other suitable presentation software). Students will create a presentation on a program like PowerPoint from the topic they were assigned in Lesson Plan 5 – Communciation Skills and present it again to the class using a projector and computer.

Presentations will be limited to ninety seconds. Points will be deducted for students falling short of this time frame by fifteen or more seconds or by exceeding this time limit by fifteen or more seconds.

Presentations should be educational, tell a story and be unique.

Resources

Ching, Frank. *Architecture--form, Space, & Order* . Hoboken, NJ: John Wiley & Sons, 2007.

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www.nyc.gov/hpd

http://www.sketchup.com

http://www.teachengineering.org

http://tryengineering.org

http://www.ted.com

Appendix

In designing a micro-apartment, students will meet the following state standards:

D INQ.1 Identify questions that can be answered through scientific investigation.

D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.

D INQ.6 Use appropriate tools and techniques to make observations and gather data.

D INQ.10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

In designing a micro-apartment, students will meet the following Next Generation of Science Standards:

HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

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HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Notes

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[1] http://www.census.gov/

[2] Glaeser, Edward L. *Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier* . New York: Penguin, 2011.

[3] www.nyc.gov "HPD - Developers - AdAPT NYC Request for Proposals." *HPD - Developers - AdAPT NYC Request for Proposals* .

[4] www.nyc.gov/hpd "HPD - Developers - AdAPT NYC Request for Proposals." *HPD - Developers - AdAPT NYC Request for Proposals* .

[5] Wiggins, Grant P., and Jay McTighe. "Glossary." *Understanding by Design* . Alexandria, VA: Association for Supervision and Curriculum Development, 1998. Page 337.

[6] www.nyc.gov/hpd "HPD - Developers - AdAPT NYC Request for Proposals." *HPD - Developers - AdAPT NYC Request for Proposals* .

[7] Ching, Frank. *Architecture--form, Space, & Order* . Hoboken, NJ: John Wiley & Sons, 2007. Page 370.

[8] Osborn, Alexander Faickney. *Applied Imagination.* 1963