

# **NTeQ Lesson Plan**

Prepared by: Bill Van Loo  
EDMT 602

## **Project Title: Sustainable House Design**

### **Big Idea**

The decisions we make have an impact on our environment, the economy, and the welfare of ourselves and others in the world.

### **Overview**

Our middle school students are working on a project integrating pieces of the science, social studies, and engineering/design education curriculum.

For this portion of the project, students will be taking the information they have learned about climate, the effect of humans on ecosystems, and using it to help them plan a house designed for a particular climate zone. Their house design must meet the needs of the occupants they decide on (will it be for one person or a family of five?), as well as considering the sustainability aspects of their house design, building materials, and construction methods.

### **Grade Level: Middle School (grades 6-8)**

### **Objectives: Students will be able to:**

- Create a graph comparing the environmental and economics of different construction methods
- Use their graph and other supporting data to create a decision chart that uses data to explain their choices in location, occupants, construction technology, and house size/style.
- Use both computer-based and hand-drawn methods to create floor plans for their house
- Use the plans they create to generate estimates for associated cost
- Create a 3-dimensional model of the house design they create

### **Benchmarks/Standards**

Michigan Grade Level Content Expectations for Social Studies

G3.2.2 Identify ecosystems of a continent and explain why some provide greater opportunities (fertile soil, precipitation) for humans to use than do other ecosystems and how that changes with technology (e.g., China's humid east and arid west and the effects of irrigation technology).

G5.1.2 Describe how variations in technology affect human modifications of the landscape (e.g., clearing of agricultural land in Southeast Asia, fish factories in North Atlantic and Western Pacific Ocean, and damming rivers to meet needs for electricity).

L.EC.06.32 Identify the factors in an ecosystem that influence changes in population size.

Michigan Grade Level Content Expectations for Science

E.ES.07.71 Compare and contrast the difference and relationship between climate and weather.

ITEEA: Standards for Technological Literacy, Grades 6-8 Technology and Society Standard 4

Students will develop an understanding of the cultural, social, economic, and political effects of technology.

In order to recognize the changes in society caused by the use of technology, students in Grades 6-8 should learn that

G. Economic, political, and cultural issues are influenced by the development and use of technology. For example, information technology systems have been used to both inform and influence society. Technology also affects the way people of different cultures live, the kind of work they do, and the decisions they have to make.

### **Prior Knowledge**

Students have worked on the following skills in science:

- Analyzing climate data
- Comparing climate variations across the country

Students have successfully performed the following tasks with computers under the guidance of their teacher:

- Composing and sending email to individuals and groups
- Creating documents using Google Docs
- Sharing documents via Google Docs's "Share" feature
- Using the iPad's basic functions, including emailing documents using its built-in "File and Share" menu
- Taking digital photos using the iPad's Camera app

New technology skills students will acquire in this project will include:

- Creating a spreadsheet using Google Docs
- Graphing data using Google Docs
- Importing graphics into the Autodesk Sketchpad iOS app
- Creating hand-drawn sketches using the Autodesk Sketchpad iOS app
- Emailing photos taken with the iPad's Camera app

## Computer Functions

Learning Task	Computer Function	Computer Application	Data Manipulation
Construction Method Comparison Graph	Graph comparison data	Google Docs: Spreadsheet	Calculate mean average, graph mean and small data set
Create 3 thumbnail sketches of floor plan	Drawing utility (iPad)	Autodesk Sketchbook	Import graph paper background, draw floor plans in app
Share sketches with instructor	email	GMail	Export sketches from Autodesk Sketchbook, attach floor plan sketches & email to instructor
Make copy of final floor plan for student portfolio	Digital photo	iPad Camera app	take & email photo

### Opening Set Activity

Share the following problem statement with the students. Share an electronic presentation discussing 2 different construction methods, then split the class into 2 groups.

### Problem Statement

Sustainable design means considering the economic, environmental, and social equity aspects of all decisions of designing an object or system. We all live with the consequences of these decisions, so it's important to make good ones.

Your task is to create a house design that takes into consideration the economic, environmental, and societal impacts of your choices. Use the data provided about several different construction technologies to choose which one you will use for your house design, graphing the criteria to better understand which is most important to you. Then complete a provided Decision Grid to evaluate how your choice of location and occupants will factor into the house design you will create. Make several rough sketches that show your proposed floor plans for your house, then complete a final, detailed floor plan. Finally, construct a 3-D model of your final house design.

**Procedures:**

All sessions will be conducted in the students' regular classrooms, using a combination of 1:1 device carts (laptop & iPads), plus supplementary tools and materials.

The first two activities will both be conducted using the 1:1 Macbook laptop cart, due to its ease of use in accessing Google Docs.

In the first session, students will be broken into 2 groups, each of which will be assigned a particular construction technique (timber frame and straw bale). Each of these 2 groups will then be split into pairs. Each pair will be responsible for understanding either the economic or environmental aspects of the construction technique, and will then work with a pair examining the same criteria for the other construction method. They will work together to create a spreadsheet and graph that compares the two methods, using Google Spreadsheet.

In their next class session, students will use this data to begin filling out a Decision Chart. The template for this chart will be shared with students via Google Docs. This chart will include data such as which construction method their house will be built using, what climate zone their house will be located in, how many square feet their house will be, and more.

The remaining sessions will use the 1:1 iPad cart. The iPad is a good tool for these lessons because it is extremely portable, features a built-in camera, and has apps for quick sketching of ideas.

After students complete their Decision Chart, they will begin creating the floor plan for their house. They will use Autodesk Sketchpad, an iPad app that allows students to import a "graph paper" background and quickly sketch ideas using their finger. They will share these rough draft ideas with the instructor by exporting and emailing them.

After instructor approval, students will then use pencil and graph paper with architectural templates to create their final floor plan. Since the paper floor plan will be incorporated into their final 3-D model, students will document their floor plan digitally by using the iPad to take a high-quality photo of their final, approved floor plan before building onto it.

Finally, students will build a 3-D model of their house design using foamcore board. This will take a number of class sessions, and students will keep an electronic portfolio of their work by taking progress photos using the iPads to take at least 2 pictures during each work session. When they are finished, they will have both a physical model and photo documentation of their work.

**Multidimensional Learning Activities**

Activities prior to using computer (round 1):

- View presentation about choosing appropriate graphs by information type
- Read Construction Methods datasheets

Activities while using the computer (round 1):

- Enter criteria data into Google Spreadsheet
- Decide on appropriate graph type (bar chart, pie chart, etc) and insert graph into spreadsheet
- Share completed graph with instructor via Google Docs sharing

Activities prior to using computer (round 2):

- Review Construction Methods graphs
- Group discussion: which method did you choose as most appropriate?

Activities while using the computer (round 2):

- Access Google Docs
- Copy Decision Grid template into individual Google Apps account
- Fill out and complete Decision Grid, and share with instructor via Google Docs sharing

Activities prior to using computer (round 3):

- Review Decision Grid
- Compare Decision Grid with table partner
- View instructor demonstration of using Autodesk Sketchpad on iPads

Activities while using the computer (round 3):

- Open the Autodesk Sketchpad app
- Import the “graph paper” background as a layer
- Create the 1st rough draft of floor plan and save as a new Sketchpad file
- Create the 2nd rough draft of floor plan and save as a new Sketchpad file
- Create the 3rd rough draft of floor plan and save as a new Sketchpad file
- Email 3 rough draft images to instructor via iPad

Activities prior to using computer (round 4):

- Conference with instructor regarding rough draft of floor plan
- Instructor demonstration of using graph paper and architectural templates to create finished floor plan
- Instructor demonstration on using the iPad to take documentary photograph of finished floor plan

Activities while using the computer (round 4):

- take digital photo of completed floor plan using iPad
- email digital photo to instructor

Activities prior to using computer (round 5):

- Review finished floor plan
- Instructor demonstration of creating 3-D model of house design (cutting foamcore board, tool usage, gluing techniques and safety considerations)
- Instructor demonstration of using iPad to take documentary photos of house building process

Activities while using the computer (round 5):

- take digital photo during each work session to document 3-D model progress
- email final digital photo portfolio to instructor

### **Assessment strategies**

Students will submit 6 pieces of work for this project:

- Completed Construction Methods graph (shared via Google Docs)
- Completed Decision Grid (shared via Google Docs)
- Rough Floor Plans (emailed via iPads)
- Final Floor Plan (check off with pencil/paper and emailed via iPad)
- Final 3-D Model of house
- Digital photographs of 3-D model building process

### **Implementing the Plan**

Handouts & Materials:

- Print out Timber Frame & Straw Bale Construction data sheets
- Print out Floor Plan requirements & checklist sheet
- Prepare foamcore board for 3-D house models

Prepare Google Docs:

- Decision Grid template
- Floor Plan requirements and checklist sheet

Technical preparation:

- Prepare example Google Spreadsheet with example graph
- Load Autodesk Sketchpad on iPads (20)
- Upload “graph paper” background for Autodesk Sketchpad