MSTP Science/Technology Lesson Template

Teacher(s): Chris Malanga		**Date: 12/16/07**
Subject: Technology	**Grade(s): 8**	**Time to complete (in periods): 20**
Unit: Measurement, Ratio & Proportion, area, perimeter, percentages	**Lesson Topic/Title: 3D Bedroom Design**	
Student population: ☑ Special Education ☑ LEP ☑ LD ☐ G&T ☑ Academically Average ☑ Low achieving ☐ other		

OBJECTIVES of the lesson:

[State the SPECIFIC Science/Tech and Math goals of this lesson. What will students know or be able to do by the completion of the lesson? Start each statement with "Students will understand…" or "Students will be able to…".]

Pre-Test

Day 1: Students will be given a project introduction and learn the concept of unit cost in construction

Day 2: Students will understand how to design within constraints.

Day 3: Students will review percentage. Students will be able to draw different geometric shapes and will then begin using Google Sketch-up software Students will be able to draw different geometric shapes.

Day 4: Students will: Understand how to derive formulas such as area and perimeter;

Day 5: Students will understand ratio and proportion and use this knowledge to draw their room and furniture to scale; Students will use derived formulas to solve for the areas of their room and furniture area. Students will understand the concept of scale and create an appropriate scale for their project

Day 6-8: Students will understand that design and budget affect the aesthetics of their room. Students will make design decisions and begin to choose bedroom furnishings.

Day 9-11: Students will finish learning how to render objects using "Sketch up" 3D software. Students will create a 3D drawing of the bedroom they designed.

Day 12-16: Students will use previous design plans to construct the bedroom using materials and tools given by the teacher. They are encouraged to also bring in their own materials to supplement what they are given in class.

Day 17: Students evaluate their work

Day 18: Post Test

Day 19: Wrap-up

BACKGROUND KNOWLEDGE necessary for students before engaging in this lesson:

Measuring an object with the standard system of measurement. Geometric shapes, Ratio & Proportion, Percentage as math knowledge.

PRECONCEPTIONS that may need to be addressed: Only a standard ruler or measuring tape can be used to calculate measurements, Computer-Aided drafting is out of reach for the students level of computer knowledge, math is only used for theoretical purposes, cost of building above or below realistic values

List 1 or 2 of the overarching NEW YORK STATE TECH STANDARDS to be addressed in this lesson:	**Write out CODES and PERFORMANCE INDICATORS for RELATED TECH CONTENT & PROCESSES addressed in this lesson:**
Students will apply technological knowledge and skills to design, construct, use and evaluate products and systems to satisfy human and environmental needs.	• use a variety of equipment ,tools and materials to enter, process, display and communicate information in different forms using text and pictures.

MSTP Science/Technology Lesson Template

List 1 or 2 of the overarching NEW YORK STATE MATHEMATICS STANDARDS to be addressed in this lesson:	**Write out CODES and PERFORMANCE INDICATORS for RELATED MATHEMATICAL CONTENT & PROCESSES addressed in this lesson:**
Students will apply and adapt a variety of appropriate strategies to solve problems ***Students will communicate their mathematical thinking coherently and clearly to peers, teachers, and others.***	**7.PS.10, 8.PS.10, 7.CM.4, 8.CM.4, 7.R.1,8.R.1**
MAJOR CONCEPTS addressed:	**MAJOR SKILLS addressed:**
Technology **Scale in object design** **Math** **Scale, Proportion, Ratio**	**Technology** Designing using ratio, scale, & proportion **Math** Abstract Concept

How does understanding the listed math concepts INFORM Science/Technology knowledge? (Not just math that is simply *related* to the science/technology, but math that helps students better *understand the science/technology ideas*)

The students have an application of a concept that is usually only illustrated on paper with theoretical objects, where as this applies to the design process of an eventual tangible project

How does this lesson represent BEST PRACTICE?

- ☑ Focuses on important (standards-based) ideas & skills and promotes conceptual understanding
- ☑ Uses a *variety* of instructional approaches to maintain student engagement (e.g., ☑ lecture, ☑ group work and team work ☑ demonstration ☐ field trips ☐ role play ☐ skits ☐ dramatization). (others) ☐ _____ ☐ _____ *Please check.*
- ☑ Encourages guided discovery, inquiry, and design
- ☑ Engages students in peer and self assessment
- ☑ Includes key questions to elicit responses that reflect understanding of important content
- ☐ Promotes procedural fluency
- ☑ Addresses naïve conceptions
- ☐ Prompts discourse among students and with teacher
- ☑ Builds on prior student knowledge
- ☑ Aligns curriculum, instruction, and assessment Establishes cross-disciplinary connections
- ☑ Establishes real-world connections for students so that they generalize lesson concepts to MST applications
- ☑ Prompts higher order thinking (students analyze, compare and contrast, classify…)
- ☑ Prompts students to generate alternative ideas and strategies
- ☑ Adjusts instructional methods according to student population and understanding
- ☐ Procedure includes summary focused on key ideas
- ☑ Motivates learning during and beyond the lesson

MATERIALS AND RESOURCES Needed (List IT resources and other materials)

All materials listed in construction procedure as well as all supporting craft tools to accomplish this, calculator, for 3D Modeling: Google Sketch-up software with Bonus packs and all self-paced tutorials, 3D Bedroom Design Packet taken from Technology Education: Learning by Design Workbook, and supplemental handouts created by instructors.

ASSESSMENT Methodologies [Embedded Diagnostic, Formative and Summative] planned to demonstrate the degree to which students have mastered the listed NYS Performance Indicators indicated on the prior page. *Attach COMPLETE EXAMPLES of all methods checked below*

- [x] Selected Response: (Circle type(s): Paper/pencil tests; multiple choice; true/false; matching; short answer fill-ins)
- [ ] Essay: (Circle type(s): Extended written answers; Graphic organizers - KWL or TWK) (*indicate guiding questions, scoring criteria, and sample student responses*)
- [ ] Constructed Response: (Circle type(s): Multi-steps; Document-based questions) (*indicate guiding questions, scoring criteria, and sample student responses*)
- [x] Performance Assessment: (Circle type(s): Individual; group; product-based; performance-based; artistic; authentic. (I*ndicate guiding questions, scoring criteria, and sample student responses.*)
- [x] Classroom observation (Circle type: Formal; Informal) (*if formal, indicate guiding questions, scoring criteria, and sample student responses*)
- [x] Whole class discussion (*indicate guiding questions, scoring criteria, and sample student responses*)
- [ ] Small group discussions (*indicate guiding question, scoring criteria, and sample student responses*)
- [ ] Individual student interviews (*indicate interview questions, scoring criteria and student responses*)
- [ ] Process or Reflective measures: (Circle type: Journals; Logs) (*indicate scoring method; explain development and use of rubrics; provide an example of a finished journal*)
- [ ] Portfolios (*indicate scoring method; explain development and use of rubrics; provide an example of a finished portfolio*)
- [x] In-class worksheet/written assignment (*explain assignment and/or provide example of student work*)
- [x] Quiz/Test/Exam (*indicate scoring method; provide an example*)
- [ ] Others (*describe*)

INSTRUCTIONAL PLANNING: PROVIDE A COMPLETE SEQUENCE OF ALL TEACHING PROCESSESS AND STUDENT ACTIVITIES FOR IMPLEMENTING THE LESSON.
This should include ALL teacher explanations, examples, questions, and student activities associated with the delivery of the lesson. Nothing should be left to the imagination. *Other teachers should be able to reproduce this exact lesson using this lesson plan.* Indicate (with an asterisk) where embedded formative assessments will occur during the implementation of the lesson. Indicate instructional alternatives that may be employed for differentiating instruction for students with special needs. **BE SPECIFIC ABOUT HOW MATHEMATICAL CONCEPTS ARE INFUSED INTO THIS LESSON* Use additional pages if needed.*

Technology

Pretests:

The teacher will introduce the Bedroom Project by either providing photos or actual examples of prior student work. Students will be told that they will need to work within a budget, choose a theme for their room, and use internet resources to shop for items & furnishings. Certain skills are necessary to successfully complete this project therefore the teacher will inform students that their knowledge base needs to be assessed. The teacher will then administer the pre-test, being sure to inform students that this test will not be part of their grade for this project. Students will be told that their grade on this test will be determined by their effort.

Day 1: Students will be given a project introduction and learn the concept of unit cost in construction

The teacher will begin a discussion about real life construction costs and requirements. The teacher will use the blackboard or smart board to draw a floor plan of a house. The dimensions of the house are about 30' X 40'. Using the drawing, the concept of area and perimeter are reviewed. The students are then taught the basic symbol set used for creating a floor plan. The teacher prompts students to list rooms typically found in a home. When several rooms have been listed, the teacher completes the floor plan by adding additional rooms. At this point, students are introduced to the symbol set necessary for such a drawing. The symbols include: interior walls, exterior walls, windows, doors, toilet, stove, brick fireplace, sink and tub. (typical architectural)

Now the discussion will turn to construction costs. The teacher, through guided discussion, leads students to realize that the purchase of land is necessary. Costs for this are discussed and the teacher provides a final cost based on location. Having already calculated the square footage of the home, the teacher will explain that cost is typically expressed in dollars per square foot, and that the dollar value will vary with the level of quality and options. Three examples of costs will be provided by the teacher during this discussion. Students learn that a "bare bones" home costs around $150 per square foot to construct. A slightly more elaborate home will cost between $200 and $300 to build. A "high end" home will cost over $300 per square foot. The cost for the houses at these various trim levels will be calculated by the teacher during this discussion. Students are then told that they will be charged $75 per square foot for their rooms. The students receive a "**Bedroom Design Packet**" which will be completed as a class, facilitated by teacher led discussion. Using the "**Design Activity Teacher's Resource Packet**" as a guide the teacher will present the problem.

Day 2: Students will understand how to design within constraints.

Using the "**Design Activity Teacher's Resource Packet**" as a guide the teacher will present the design challenge, and clarification of the design specifications and constraints. The teacher will initiate a discussion about constraints. The teacher will ask, "Why are windows necessary?" The utility of windows will be discussed as a class. Students will be informed that building codes exist to ensure these criteria are met. The teacher discusses how Town codes (real codes can be shown) affect the window size of a design and how that ties in with the 3D design project using actual codes.
Students will note that one of our constraints is that window size be equal to at least 20% of the floor area. The teacher takes this opportunity to review the process of taking a percentage by calculating the window area for a room of 120 square feet. The concept of area will also be reinforced. The teacher will demonstrate several more examples on the board. Students will use the **packet page containing a floor plan** of a house with several

rooms, including dimensions and a space to record room & window square footage. Once the window square footages have been calculated, the teacher will explain that windows are not manufactured and purchased by square footage, but rather by dimensions. Using a rectangular example, the teacher will demonstrate the conversion from square footage to height and width. Students will be shown how to use factorization to come up with various widths and heights that will generate the proper square footage.
Once the KSB 1 page of the packet has been completed to teacher satisfaction, the students are asked to create a basic floor plan of their own bedroom from memory. The teacher may notice that students have an inherent ability to scale objects. The teacher will then discuss this "skill" with students and discuss. For example, the teacher may ask, "Why didn't you make the bed take up the entire floor plan?"
Homework will then be assigned: Students will be asked to measure three objects found in their room as well as their room size using a shoe or sneaker as a measuring tool and record the dimensions on their worksheet.

Day 3: Students will review percentage. Students will be able to draw different geometric shapes and will then begin using Google Sketch-up software

Students will then choose one room from the floor plan, and determine possible window sizes if a rectangular window is chosen. The teacher will then instruct students to use the KSB 1 "Geometric Shapes" worksheet to draw several rectangles that have an area of 24 square units. Remind students that they need to find the factors of 24 to complete this exercise.

Students will be instructed on how to start up Google Sketch-up and use the toolbars. Then the students and the instructor will walk through the self-paced tutorial Introduction and Drawing Part 1.

Day 4: Students will: Understand how to derive formulas such as area and perimeter

This class begins with the teacher showing the Anderson windows website and how there are many different shaped windows available online as well as the ability to plan them out and print. (printed out version could be used) The teacher will ask students to open their packets to page 3, Part B of KSB 1 "Geometric Shapes", and have them read instructions along with teacher. The teacher will ask students to provide formulas for calculating the areas and perimeter so the shapes on the sheet. The formulas will be discussed to provide a connection to the physical world and how they were derived. The students will write the formula in the appropriate shape. The teacher will distribute rulers and calculator and ask students to complete the sheet working in teams of two. After about ten to fifteen minutes the teacher will discuss student work and demonstrate the solutions.

The concepts of factorization and solving for variables will be reinforces using KSB 1, part C. The teacher will show, step by step, how to use an area formula and a given area to find the dimensions of the triangular room. The teacher will demonstrate solving for variables using the derived equations when the objects area is given. Students then complete a worksheet to practice this skill. Students are encouraged to use remaining time in Google Sketch-up to grow accustomed to the program.

Day 5: Students will understand ratio and proportion and use this knowledge to draw their room and furniture to scale; Students will use derived formulas to solve for the areas of their room and furniture area. Students will understand the concept of scale and create an appropriate scale for their project

The teacher, using the written instructions provided in KSB 2 "Ratio and proportion", will discuss ratio and proportion and how it relates to scale. Students will then be given time to complete KSB 2, through question 3, while the teacher circulates around the room offering guidance and assistance when necessary. Student work is then reviewed and the proper solutions shown and discussed. The teacher will then, through class discussion, solve KSB 2, question 4 and discuss. With the worksheet that students created for homework, using a sneaker or shoe as a measuring tool, students will convert the measurements to feet. The teacher will explain that the sneaker length is a dimension, though not a standard one. The teacher will derive an equation, which will just be a proportion and demonstrate the conversion from sneaker length to feet. Each student will be given a ruler, and

asked to measure their own shoe in inches. The teacher will then discuss the "Compare Standard Measurement to Your Personal Measurement" worksheet. The teacher will model a second example, then the students will complete the worksheet independently. The teacher will visit students and provide guidance as necessary.

**(Extra Credit) Using the "Create a Floor Plan of Your Room" worksheet (derived from KSB 3 "Sketching, Measuring, & Calculating"), students will make a scale floor plan of their own room, including furniture and standard dimensions.

Day 6-8: Students will understand that design and budget affect the aesthetics of their room. Students will make design decisions and begin to choose bedroom furnishings.

The teacher will introduce KSB 4, "Aesthetics" A guided conversation will encourage students to consider that atmosphere of their room. The shapes and designs of furniture will be explored. When the teacher is confident that students understand how their choices affect the overall feel of the room, students will be asked to work in groups on KSB 4. The teacher will walk around the classroom and encourage students to express their ideas in writing.

The teacher now moves on to KSB 5, "Pricing Information." Students will now see how much of their $15,000 budget is spent on construction. There are some decisions than need to be made by students, window size for example, but students will be told that they may change these later. Students are asked to complete this sheet on their own. The teacher will circulate the room offering assistance as necessary. Once students know how much of their budget is spend on construction, they can figure out what is left for furnishings and other fixed cost items. The teacher will explain the difference between a fixed cost item and a variable cost item. For example, the teacher may ask, "What if the room was 20 X 15, what would be the cost. Note the difference. However a twin bed, based on the sheet we provide is a fixed cost.

Students are now ready to compile a list of items for their rooms. Costs and sizes for many items are given to students in their packets. Additionally, students will be allowed to do some **internet shopping** and provided they can find dimensions, may record items that are not on our list. They are also instructed to copy and paste into MS Word any pictures they would like to print out and use in their constructed room.

Day 9-12 Students will finish learning how to render objects using "Sketch up" 3D software. Students will create a 3D drawing of the bedroom they designed.

The teacher will lead the students through the Drawing Part 2, 3, Colors and Materials, and Breaking edges Sketch up tutorials. Once the tutorials have been completed, remaining time can be used to experiment in the program by the students. Each student will be working on their own three dimensional rendering, however the start of the project will be done as a class. Walls will be created as a class. The teacher will use the projector to demonstrate as the students follow along. The teacher should encourage students to save their work periodically. Once all students have the basic structure of their rooms, they will work on their own adding objects from the Sketch up library. The students will be limited to the amount of time they spend individually on drawings to prioritize the group drawing. Since one drawing will be used per group the students are asked to choose the person who is most efficient to create it. Once the model is complete, students will print out a front perspective to aid in the physical construction.

Day 12-16 Students will use previous design plans to construct the bedroom using materials and tools given by the teacher. They are encouraged to also bring in their own materials to supplement what they are given in class.

Procedure for Construction of 3D Bedroom

1. Students cut out the walls and floor, a kit is given as follows
   a. (2) 8" x 10" walls (mat board)
   b. (1) 8" x 12" wall (cut from 11" x 14" mat board)
   c. (1) 10" x 12" floor (cut from 11" x 14" mat board)
   d. (2) 3/16" x 3/16" x 18" balsa
   e. (2) 3/16" x 1/8" x 18" balsa
   f. (2) 1/16" x 3" x 18" balsa
   g. (1) 4" x 6" thick mirrored paper for windows
   h. Assorted special papers for interior design
   i. Choice of felt, wood textured foam, or marble textured foam for flooring
2. Students layout their windows on the walls
   a. Using previous knowledge they sketch the outline of the window(s)**
   b. The students submit the walls to the teacher**
   c. The teacher uses a cutting tool to do the inside cuts (**optionally give a 4"x6" mirrored paper)
3. Students assemble the walls using hot glue guns
4. Students apply coverings to the inside walls and then the floor
5. Students create furnishings to put in room and glue them down
   a. All furnishings must be to scale
   b. Inform students that using cut-out patterns may aid in construction
6. Students create a name card and do a final check on the room
   a. The name card shouldn't obstruct a front perspective picture of room
7. The room is photographed by teacher

Day 17 Students evaluate their work

Students complete the "Bedroom Design" packet. Students then use a teacher supplied rubric to evaluate their own work.

Day 18 Post Test

The teacher will administer the post test.

Day 19 Wrap-up

Student's projects are displayed and students are encouraged to circulate around the projects as if in an art gallery. A slide show is played of sketch-up drawings, work photos, and room photos. A discussion ensues about obstacles and how they were overcome as well as why certain design decisions were made. After the reflection period all packets and design rubrics are collected.

<u>DESCRIPTION OF SUMMATIVE ASSESSMENT</u>: Indicate how students' learning of lesson objectives (stated earlier) was comprehensively assessed. ("Post" assessment.) Include description of assignment and sample items. Attach scoring criteria (checklist or rubrics) used to evaluate the work, and three samples of student work (high, medium, and low).

The packets will be assessed as follows:
1 After the end of KSB 2 Ratio and Proportion to check for completion of work only
2 After the end of KSB 5 Pricing (up to variable cost) to check for completion of work only
3 At the completion of packet

Low Completed 1
Med Completed 1,2
High Completed 1,2,3

Students use self-assessment "Rate your Room" rubric for grading. The teacher uses the collective quality level of all projects as a basis for increasing or decreasing the student's self-assessment grade to determine a final grade. The Google Sketch-up drawing is compared to the digital photograph (taken from identical perspective) and also used to determine grade.

Low 70-80
Med 80-90
High 90-100

AFTER LESSON IMPLEMENTATION, **PROVIDE YOUR REFLECTIONS: Tell the story of what happened in the classroom. Indicate what worked, what you would change for the next implementation, and students' reactions to the lesson. Use additional pages if needed.**

Starting with the pre-test, the students were skeptical about having math in Technology as they aren't in the mindset to use it in the amount given. The amount of lecture time used to fill the Knowledge Base for the students was much greater than the students are accustomed to in this mostly hands-on and minimal instruction, inquiry driven curriculum. Several parts of the original lesson plan were modified. The days that were supposed to take a full period but didn't were combined with the following day's work to utilize all time. Rather than having continuous lecture days prior to hands-on work, Google sketch-up tutorials were used to break this part up.

It is very important to break-up the lecture days to prevent the students from losing interest in the project. The students are normally not given homework in this class. For this reason, even with several reinforcements about the importance of completing the Personal Measurement exercise at home and ample time, most students did not complete this assignment. It was for this reason that the Personal room drawing that accommodates the measurement worksheet was used as extra credit. All handouts mentioned in the unit plan were integrated into the existing 3D Bedroom Design Packet as well as the removal of pages that weren't relevant to the project in the instructor's opinion. It was also easier for the students to get credit for their packet work by using three separate occasions to collect the packets and check for completion rather than one final collection. The amount of packets turned in for final collection was rather low in certain classes so this reinforced the instructors decision to periodically check for completion of pages throughout the project.

The use of Google Sketch-up as well as other minor aspects put this project as the number one assignment chosen by students determined by a Tech Project Survey given by the instructor on the last day of class. The instructor found the students using Google Sketch-up to create various objects as an alternative for their normal game-playing and e-mail checking during free-time. This was done by the students without the encouragement of the instructor which leads one to believe that rendering objects in virtual world gives the students a sense of control and independence that they find pleasurable. The students were told that not only is the free-version of the program available for download, but is was also discovered that the Professional version of the program is also available for free to Students and Educators. As a member of the District Technology Committee the instructor recommended the program to be available and used in all labs throughout the district.

As an instructor previously experienced in using the 3D Bedroom Project, it was found that using Google Sketch-up and increased infusions of math in this Pilot Test Lesson Plan created an environment of greater understanding and enthusiasm for this work. The instructor plans to continue with the newly created version for future classes.

Attach to this lesson template: any and all WORKSHEETS and HANDOUTS, examples of ALL indicated ASSESSMENTS (embedded formative and summative), and SAMPLE STUDENT WORK.