BEDROOM DESIGN – INSTRUCTOR'S GUIDE

A Hybrid Modeling Activity for Middle School Technology Education

Developed by the MSTP Project at the Hofstra University Center for Technological Literacy
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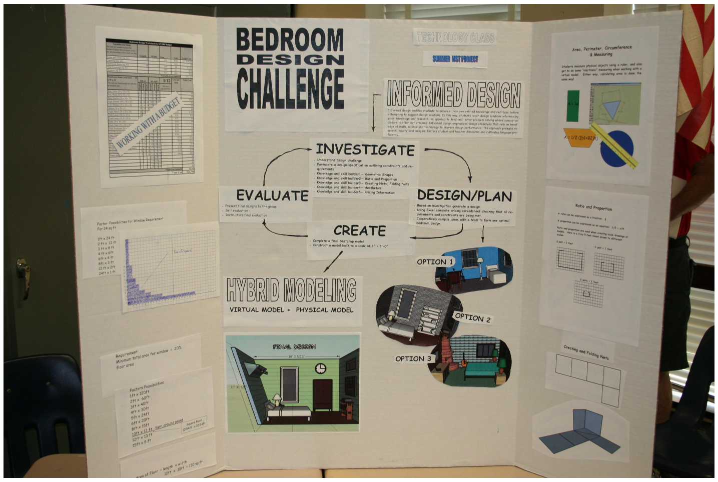

Overview of the Instructional Model

Bedroom Design is a unique activity for middle school technology education that is underpinned by a "hybrid" instructional model that has the potential to transform instruction in technology education. The model preserves the hands-on physical laboratory activity that has engaged generations of students, but incorporates an IT-based engineering design approach that will accelerate technology education's transition to a contemporary STEM-based discipline.

The model expands the responsibility of technology educators to reinforce core disciplinary concepts within technological contexts and includes four components that can redefine the way technology education instruction is conceptualized:

1. Infusion of core disciplinary concepts (i.e., grade-related mathematics) into technology education instruction.
2. Use of STEM teacher teams to collaboratively plan, assess, and revise instructional approaches.
3. Use of an "informed design" approach to instruction that leads students to develop understanding before they engage in design activity.
4. Establishment of a hybrid instructional model that integrates both screen-based 3D simulation and real-world physical modeling into middle school technology education programs.
   Note: In this case, the hybrid model uses Google SketchUp (GSU), a 3D modeling program available at no cost from Google, followed by hands-on physical modeling activities and reflection time.

The Bedroom Design activity was designed as part of the MSTP Project, a National Science Foundation–funded Mathematics and Science Partnership Project conducted by the Hofstra University Center for Technological Literacy (CTL). Following initial development, the activity was refined by a team of 15 expert middle school technology teachers during the summer of 2008 and field tested during the fall 2008 semester.

A day-by-day activity guide for instructors follows. Student knowledge and skill builders (KSBs) are embedded within the day-by-day schedule. The activity can be downloaded from the Hofstra CTL Web site at http://www.hofstra.edu/ctl. For further information, contact Chris Malanga at chris.malanga@riverhead.net or Mike Hacker at mhacker@nycap.rr.com.

DAY-BY-DAY ACTIVITY GUIDE FOR INSTRUCTORS

Begin by presenting the problem situation, the challenge, and the design specifications and constraints to the students, as follows:

PROBLEM SITUATION

You are moving to a house that is being built for you. The architect who is working on the project needs information regarding your lifestyle to determine the best design for your bedroom. It can be a dream bedroom. The budget is $27,500 for a rectangular bedroom with a minimum area of 120 square feet. However, the budget increases to $30,000 for a nonrectangular bedroom with the same minimum area.

THE CHALLENGE

You and your teammates will design a furnished bedroom. You will build virtual and actual scale models of your bedroom, with furnishings.

CLARIFY THE DESIGN SPECIFICATIONS AND CONSTRAINTS

To solve the problem, your design must meet the following specifications and constraints:
- The window area must be equal to at least 20% of the floor area.
- The minimum room size is 120 square feet. The minimum height of all ceilings is 8 feet and the maximum is 12 feet.
- The bedroom will have two outside walls and two interior walls. In both models one interior wall can be removed for easy visualization of the design.
- The budget is $27,500 for a rectangular bedroom and $30,000 for a nonrectangular bedroom.
- The cost of basic construction is estimated at $150 per square foot of floor area

A WORD ABOUT THE INFORMED DESIGN PEDAOGY AND THE KNOWLEDGE AND SKILL BUILDERS (KSBS)

Informed design is a validated design pedagogy developed through NSF projects conducted by the Hofstra CTL. It will be used to meld guided inquiry with open-ended design and lead students to develop conceptual understanding **before** they begin designing. This is different from the trial-and-error problem solving (gadgetering) where conceptual closure is often not attained. In an informed design activity, students develop their STEM understanding (they will *inform* their STEM knowledge and skill base) by completing a series of short, focused tasks called *Knowledge and Skill Builders* (KSBs) before they start designing. Seven Knowledge and Skill Builders are provided within the Student Packet. These include the following:

Math-related KSBs
- *KSB 1: Geometric Shapes*
- *KSB 2: Factoring*
- *KSB 3: Percentage*
- *KSB 4: Mathematics of Scale*
- *KSB 5: Mathematical Nets*

Design-related KSBs
- *KSB 6: Aesthetics*
- *KSB 7: Spreadsheets and Pricing Information*

Unit Overview Summary and Approximate Instructional Time
(In days, each day is one 40 minute period – Total time needed is 30 days)

Flex Unit: GSU Tutorials 1–6. Should be completed before GSU Drawing in Unit 3 (3 Days)

Unit 1: Introduction to Bedroom Design Activity (3 Days)
Pre-assessment
Introduction to Construction Costs
Homework: Measure your room floor, windows, and furniture

Unit 2: Specifications and Constraints (3 Days)
Floor Plan Introduction
Building Codes
Percentages
KSB 1: Geometric Shapes
Extrude shapes in GSU as illustration if the tutorials haven't been done; otherwise students extrude shapes in GSU

Unit 3: Factors for Given Numbers (3 Days)
KSB 2: Factoring; LWAP, Table Questions
KSB 3: Percentage; review HW Measuring
Start Google SketchUp Virtual Model—drawing of walls, floor, and windows that meet requirements

Unit 4: KSB 4: Mathematics of Scale (2 Days)
KSB 5: Mathematical Nets

Unit 5: KSB 6: Aesthetics (1 Days)
KSB 7: Spreadsheets and Pricing Information

Unit 6: Groups optimize existing individual drawings and budgets (4 Days)

Unit 7: Groups construct physical models (7 Days)

Unit 8: Group Presentations to Class (4 Days)
Post-assessment
Debriefing

Appendix 1: ITEA Standards for Technological Literacy (STL)

Appendix 2: Participating Teachers / Experts

Materials and Tools you will need:
Google Sketch Up, Microsoft Excel or equivalent, Internet access (optional)

Enough mat board to build walls and floor
(1) 3/16" x 3/16" x 36" balsa for furniture
(1) 3/16" x 1/8" x 36" balsa for furniture
(1) 1/16" x 3" x 36" balsa for furniture
(1) 8" x 10" mirrored paper for windows
Assorted special papers for interior design
Choice of felt, wood textured foam, or marble textured foam for flooring
Assorted Tools provided by instructor

FLEX UNIT: **Note: Although presented here, this unit is not to be done first.** It relates to Google SketchUp Tutorials 1–6, and should be completed before GSU Drawing in Unit 3.

Objectives
Students will:

- Complete the six self-paced individual tutorials of Google SketchUp.
- Develop a greater understanding of Google SketchUp.
- For extra credit, download and install Google SketchUp at home and explore.

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)
Assign the “Do Now” activity (a short exercise given to students to get them on task as class begins): List three examples of 2D items and three examples of 3D items.
What advantages are gained by showing an object in three dimensions as opposed to showing it in two dimensions?
If possible, show an elaborate drawing created in SketchUp.

Key ideas to be addressed (Note: numbers in parentheses refer to the NYS Standards for Mathematics, Science, and Technology (See http://www.emsc.nysed.gov/ciai/mst.html)
Math Standard 3:

- Understand the concepts of and become proficient with the requisite mathematics.
- Communicate and reason mathematically.
- Become problem solvers by using appropriate tools and strategies.
- Model situations mathematically, using representations to draw conclusions and formulate new situations. (8.CN.4)
- Use physical objects, drawings, charts, tables, graphs, symbols, equations, or objects created using technology as representations. (8.R.1)

Technology Standard 5.3: Engineering design is an iterative process involving *modeling* and *optimization* used to develop technological solutions to problems within given constraints.

- Use a computer system to connect to and access needed information from various Internet sites.
- Use computer hardware and software to draw and dimension prototypical designs.
- Use a computer as a modeling tool.
- Use a computer system to monitor and control external events and/or systems.

Instructional Hints
Use the help menu and the tutorials. Allow students to explore using Google SketchUp. Keep class on same tutorial page.

Key Questions (Note: Key Questions within this document are used to elicit student ideas)
Why would an engineer benefit from a Google SketchUp design versus one drawn on paper?
What careers could you pursue after mastering Google SketchUp?
Outside the classroom, where could you apply your newfound skills in Google SketchUp?

Summary Questions
Name a few of the Google SketchUp tools you used.
Describe the function of those particular tools.

How understanding will be assessed (formative and summative)
Understanding will be assessed through successful completion of the sequential tutorials.

Unit 1: Introduction to Bedroom Design Activity

Objectives
Students will understand:

- The scope of the Bedroom Design activity.
- The concept of unit cost in construction.
- The basics of "informed designed."

Administer the pre-assessment to students.

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)
Assign the "Do Now" activity: Ask students to name their top five priorities in designing their dream bedroom.

Key ideas to be addressed (based on math and technology standards)
Math Standard 3:

- Understand the concepts of and become proficient with the skills of mathematics.
- Communicate and reason mathematically.
- Become problem solvers by using appropriate tools and strategies.
- Recognize and apply mathematics to other disciplines, areas of interest, and societal issues. (8.CN.9)
- Use mathematics to show and understand social phenomena (e.g., determine profit from sale of yearbooks). (8.R.10)

Technology Standard 5.1: Engineering design is an iterative process involving *modeling* and *optimization* used to develop technological solutions to problems within given constraints.

- Consider constraints and generate several ideas for alternative solutions, using group and individual ideation techniques (group discussion, brainstorming, forced connections, role play); defer judgment until a number of ideas have been generated; evaluate (critique) ideas; and explain why the chosen solution is optimal.
- Develop plans, including drawings with measurements and details of construction, and construct a model of the solution, exhibiting a degree of craftsmanship.

Instructional Hints
Use video to spark interest and class discussion. Through guided discussion, lead students to the realization that the purchase of land is necessary. Talk about land, and provide students with a final cost based on location. Calculate the square footage of the house ahead of time, using a floor plan, and explain to students that the cost of construction, after factoring in land cost, is typically expressed in dollars per square foot. Then describe how the dollar value will vary with the level of quality and options. Provide three examples of cost during this discussion. Explain that construction of a bare-bones home will cost around $150 per square foot; a slightly more elaborate home will cost between $200 and $300 per square foot; and a high-end home will cost over $300 per square foot. Calculate the cost of a house at these various levels during the discussion, and then tell students that they will be charged $150 per square foot for their rooms.

Key Questions

If construction costs $150 per square foot, what would it cost to build:

- A room of 500 square feet?
- A very large room of 1,000 square feet?

How much would it cost to buy a 10' x 9' carpet that sells for $25/square yard?

Summary Questions

Explain the Bedroom Design project in your own words.
What are the steps you go through when doing informed design?
Why would unit costs in construction change with the size of the project?

Note: This activity will allow students to discover on their own the relationship between room size and cost. It will also deepen their understanding of why a budget is important.

How understanding will be assessed (formative and summative)

Classroom dialogue about the summary questions will be used to assess understanding.

Homework Assignment

Create an assignment that requires students to go home and measure the length and width of their bedroom. They must also measure the windows and furniture in their bedroom. This assignment will be reviewed during instruction of *KSB 3: Percentage* in Unit 3.

Unit 2: Specifications and constraints, floor plan introduction, building codes, percentages, geometric shapes, shape extrusion

Objectives
Students will:

- Identify the components that make up a floor plan.
- Define specifications and constraints.
- Calculate percentages.
- Identify the rationale behind local building codes.
- Complete *KSB 1: Geometric Shapes*.
- Draw and extrude shapes in Google SketchUp.
- Evaluate and choose an appropriate shape for their bedroom design.

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)
Assign the "Do Now" activity: Engage students in a discussion, based on the previous day's homework, of their experiences with measuring their rooms.
Show them real-world blueprints.
Use the floor plan handout to reinforce student understanding of window constraints, area calculations, and percentage calculations.
Ask students to draw by hand a floor plan of their dream room (this can be used as the "Do Now" activity for one or several days). Note: This assignment calls for the introduction of Google SketchUp if activity is done on the computer.

Key ideas to be addressed (based on math and technology standards)
Math Standard 3:

- Understand the concepts of and become proficient with the skills of mathematics.
- Communicate and reason mathematically.
- Become problem solvers by using appropriate tools and strategies.
- Model situations mathematically, using representations to draw conclusions and formulate new situations. (8.CN.4)
- Use physical objects, drawings, charts, tables, graphs, symbols, equations, or objects created using technology as representations. (8.R.1)

Technology Standard 5.3: Computers, as tools for design, modeling, information processing, communication, and system control, have greatly increased human productivity and knowledge.

- Use a computer system to connect to and access needed information from various Internet sites.
- Use computer hardware and software to draw and dimension prototypical designs.

Instructional Hints
Have students open the Bedroom Design packet. Then present the design challenge to them, clarify the design specifications and constraints, and initiate a discussion about constraints. Have the students fill in the first page and save it.

Use the blackboard or smart board to draw a floor plan of a house. (Note: The dimensions of the house are about 30' x 40'.) Using the drawing, review the concepts of area and perimeter. Describe to students the basic symbol set used for creating a floor plan. Then prompt them to list the rooms typically found in a home. After they have listed several rooms, complete the floor plan yourself by adding additional rooms. At this point, introduce students to an expanded symbol set including the symbols necessary for such a drawing. Typical architectural symbols should be used and should include those used for interior walls, exterior walls, windows, doors, toilets, stove, brick fireplace, sink, and tub. It may also be a good time to rope off an 8' x 10' area in the room to illustrate size.

Students will note that one of the design constraints is that the window size must be equal to at least 20% of the floor area. Take this opportunity to review the process of taking a percentage by calculating the window area for a room of 120 square feet.

Examples:
20% of 120
20% = 20/100 or 1/5
1/5 of 100 is 20 and 1/5 of 20 is 4. 20 + 4=24

20% of 120
10% of 120 is 12 so 20% is twice 12, or 24.

120 x 0.20 = 24

$20/100 = x/120$
$100x = 2400$
$x = 24$

$20/100 = x/120$
$20(120) = 100x$
$20(120)/100 = x$
$20 \times 1.2 = x$; $x = 24$

The window size must be ≥ 24 square feet.

Students will examine a floor plan handout of a house that will be provided by the instructor. The handout will show several rooms, including dimensions, and provide a space for students to record room and window square footage. Inform students that building codes exist to ensure that these criteria are met. Discuss how town codes (real town codes can be shown) affect the window size of a design and how that ties in with the 3D design project that uses actual codes. If possible, show the local code for window requirements.

Key Questions
How do you calculate percentages of numbers?
Why do building codes require a specific amount of window area?
Summary Questions
What components make up a floor plan?
What is the importance of universal symbols in drawings?
How do you calculate percentages?
What is the rationale behind local building codes?

How understanding will be assessed (formative and summative)
Classroom dialogue about the summary questions will be used to assess understanding.

Note: The following relates to KSB 1: (Area and Perimeter of Geometric Shapes)

Objectives
Students will:

- Complete *KSB 1: Geometric Shapes*, using previously taught strategies for creating rectangles given an area.
- Find the area and perimeter (circumference) of objects drawn in the KSB worksheets (if possible, touch base with grade-level math teachers for instruction on terminology and such).

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)
Discuss with the class the utility of windows. Ask students again why windows of a specified area are necessary, and remind them why this constraint exists. Explain to students that the math that was reviewed yesterday is necessary for designers to choose window sizes that satisfy building inspectors.

Key ideas to be addressed (based on math and technology standards)

- Observe patterns and formulate generalizations. (7.PS.4)
- Use mathematical strategies to reach a conclusion. (7.RP.2)
- Recognize connections between subsets of mathematical ideas. (7.CN.2)
- Explain how different representations express the same relationship. (7.R.4)
- Find the common factors and greatest common factor of two or more numbers. (7.N.8)
- Calculate the radius or diameter, given the circumference or area of a circle. (7.G.1)
- Identify the right angle, hypotenuse, and legs of a right triangle. (7.G.5)
- Determine the area of triangles and quadrilaterals (squares, rectangles, rhombi, and trapezoids) and develop formulas. (6.G.2)
- Use a variety of strategies to find the area of regular and irregular polygons. (6.G.3)

Instructional Hints

Ask students to look at *KSB 1: Geometric Shapes* (see the following page). Tell students that this page is very similar to what they have just reviewed and what they did yesterday. Each student should complete the page.

This page has six shapes, and students must calculate the areas and perimeters (circumferences) of each shape. Make sure that students are provided with rulers and have access to calculators. Quickly present the formulas for each shape and facilitate a classroom discussion as to why particular terms appear in the formula. For example, why is the area of a rectangle $A = lw$? The formulas must be discussed in order to provide a connection to the physical world and to illustrate how they were derived. After 10–15 minutes, discuss student work and demonstrate the solutions.

Students will complete *KSB 1: Geometric Shapes* in the Student Packet

Notes Related to KSB 1, Geometric Shapes (Instructional Hints for Teachers).

The first figure in the set of geometric shapes on the prior page is a square. If the measures don't appear to be the same, try measuring again. This is a good example of all measures being approximate.

The second figure is a circle.

- The circumference of any circle will always be slightly more than 3 times the length of the diameter. The formula $C = \pi d$ provides the circumference when C represents circumference, d represents diameter, and a value of approximately 3.14 or 22/7 is substituted for π.
- The area of any circle will always be slightly more than 3 squares with side lengths equal to the radius of the circle. The formula $A = \pi r^2$ provides the area when A represents the area, r represents the radius, and a value of approximately 3.14 or 22/7 is substituted for π.

The third figure is an isosceles triangle. Two sides should have the same measure.
If two of these triangles were placed together along congruent sides, a parallelogram would be formed. The area will therefore be one-half the area of the parallelogram, or $A = 1.2\ bh$.

The fourth figure is a right triangle. We know that the Pythagorean theorem tells us that the sum of the squares of the measures of the two legs (shorter sides) will equal the square of the hypotenuse (longest side). If you don't find this to be exactly true for this right triangle, the theorem simply helps us remember that measurement is approximate. The lengths of the three sides should make the equation $a^2 + b^2 = c^2$ true. If it is almost true, but not exactly, the measurements are simply not exact.

The fifth figure is a semicircle. You will apply your knowledge of the circle.

Key Questions
Why are windows of a specific area necessary?
Why are we using our ability to find the factors of a number to design windows of various sizes?
Do windows have to be rectangular?
If a window is made up of a few shapes, how can we find the area of that window?

Summary Questions
How can knowing how to find the factors of a number help us in designing windows?

If you are given a number and asked to find its factors, what is an easy way to find the turnaround point? (Answer: It is ≤ the square root of that number.)

What does it mean if a triangle or trapezoid is referred to as an isosceles figure? Be sure to use the word *congruent* when restating the answer. (Two sides of the isosceles triangle have the same length or are congruent.) Describe an "area" and tell how it is different than a perimeter or a circumference.

How understanding will be assessed (formative and summative)

An in-class worksheet or written assignment will be used to assess understanding (explain assignment and/or provide example of student work).

Informal classroom observation may also be used. (Note: If formal observation is used, indicate guiding questions, scoring criteria, and sample student responses.)

Unit 3: Factors for given numbers; math background for *KSB 2: Factoring* and *KSB 3: Percentage*

Objectives
Students will:

- Find the factors of a given number and develop an understanding of the characteristics of factors through charting and class discussion.
- Find the factor pairs for a number representing the dimensions of a room having that number of square feet. (For 120 square feet, the factor pairs are 1 x 120, 2 x 60, 3 x 40, 4 x 30, 5 x 24, 6 x 20, 8 x 15, and 10 x 12. These factor pairs are read as "1 by 120," "2 by 60," etc.)
- Create rectangles of various sizes, given a specific area.

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)
Suggest to the students that most bedrooms are rectangular in shape. Suggest that if a budget allows for 180 square feet for a rectangular room, they might explore possible dimensions for a rectangle having an area of 180 square feet. Note that working through a simpler problem often helps with a more challenging one. Tell the students that their task is to explore rectangles that can be designed with an area of 24 square units. Invite the students to arrange tiles to create a physical model and make a sketch on grid paper to create a visual model. Students will complete the table to record details on all possibilities having whole number dimensions. Since the perimeter of the rectangle impacts the cost of walls, the perimeter is included.

Key ideas to be addressed (based on math and technology standards)

- Observe patterns and formulate generalizations. (7.PS.4)
- Use mathematical strategies to reach a conclusion. (7.RP.2)
- Recognize connections between subsets of mathematical ideas. (7.CN.2)
- Explain how different representations express the same relationship. (7.R.4)
- Find the common factors and greatest common factor of two or more numbers. (7.N.8)
- Calculate the radius or diameter, given the circumference or area of a circle. (7.G.1)
- Identify the right angle, hypotenuse, and legs of a right triangle. (7.G.5)
- Determine the area of triangles and quadrilaterals (squares, rectangles, rhombi, and trapezoids) and develop formulas. (6.G.2)
- Use a variety of strategies to find the area of regular and irregular polygons. (6.G.3)
- Define and identify the commutative and associative properties of addition and multiplication. (6.N.2)

Instructional Hints

Make sure that students, working in groups of two or three, have 24 tiles each, and tell students to arrange the tiles in as many different rectangles as possible. Circulate around the room, monitoring student progress and guiding groups as necessary. The students will record their rectangles on the graph paper so that they have a record of their work.

While circulating around the room, ask groups the following questions to encourage critical thinking:

1. How did you get the perimeter? (One student may count all the way around the arrangement of tiles or the sketch. Another student may count two sides and double that number. Yet another might use the dimensions recorded in the table. These student actions help inform our instruction.)
2. I see the numbers 1, 2, 3, and 4 being used as one of your dimensions. Why not 5? (The number 5 is not a factor of 24. If I try to make five rows using 24 tiles, one more tile is needed to complete the rectangle.)
3. What is the difference in the 3 by 8 and the 8 by 3? (The physical orientation is different. We also know that the *commutative property* for multiplication applies: 3 x 8 = 8 x 3.) Note: Eighth-grade mathematics assessments often include questions about the commutative property.

After students feel they have exhausted all possibilities, discuss the results with them. The questions above will also be discussed as a group. Guide the class toward the completion of the LWAP chart. This chart should be filled out on the board, with the lengths ordered from 1 to 24.

Base in Units	Height in Units	Area in Sq Units	Perimeter in Units
1	24	24	50
2	12	24	28
3	8	24	22
4	6	24	20
6	4	24	20
8	3	24	22
12	2	24	28
24	1	24	50

Discuss the "turnaround point" with the students and explain that the factors that appear after that point are just repeats of factors that have already occurred. (The turnaround point in the chart above is 4 by 6.) Take this opportunity to reinforce learning of the commutative property by noting that the factors that appear after the turnaround point, though written differently, are equivalent to those that appeared earlier. This is also the time to reveal to students the fact that this turnaround point occurs near the square root of the number for which you are finding factors. In the case of 24, the square root of 24 is approximately 4.9. The number 5 is not a factor, so we know 4 is the turnaround point. If we try 1, 2, 3, and 4 as divisors of 24, we will get all possible factor pairs since 4 x 6 is the same as 6 x 4. To find all rectangles with whole number dimensions with an area of 100, we must try divisors 1–10 since the square root of 100 is 10.

Key Questions

What patterns do we see?

As the base increases, the height decreases.
The base and the height represent a factor pair for 24.
The product of the base and the height is 24 square units.
Perimeters decrease as the rectangle gets nearer to a square.
No new rectangles were found after the 4 by 6.
The area is always 24 square units.

After a class discussion, collect the manipulatives. Then give students a sheet with a new table and ask them to find the factors of the number 36. Remind students that the turnaround point will be close to, or exactly the square root of, 36. Later, the fact that the turnaround point is the exact square root of 36 will be discussed. Students will be guided through discussion to realize that when the square root is a whole number, it is possible to create a square using whole units.

After students complete the chart, or feel as if they have completed it, re-create the chart on the board, using student input.

The chart will be discussed, as will the relationships that exist between length, width, and area. Also discuss the relationships between length, width, and perimeter. Reinforce and/or discuss the relationships that exist between various configurations and associated perimeters, specifically the fact that there are many different perimeters for a given area. We see that the area of 64 gives us rectangles of 1 by 64, 2 by 32, 4 by 16, and 8 by 8. The 8 by 8 is a square and minimizes the perimeter. We find no new rectangle after 8 by 8 if lengths are ordered from smallest to largest.

To close the lesson, review with the class the major concepts that evolved: When listing the factor pairs for a number, we need to check numbers from 1 to the square root of the number as trial divisors. The minimum perimeter for a given area is achieved when the rectangle is as close as possible to a square when working with whole units. There are relationships that exist between length and width.

On the following day, display a LWAP chart for the factors of 24 and perhaps 36. Also display a sheet listing some of the relationships that students discovered during the lesson.

At this time, discuss the concepts of area and perimeter. Explain how to maximize the area using a given perimeter and how to minimize the perimeter using a given area.

Discuss how trial divisors range from 1 to the square root of the number.

Summary Questions
Consider making the table and sketches on a sheet of gridded chart paper to post on the wall for future reference. It is important for students to observe patterns and formulate generalizations. (7.PS.4)
(Note: Collecting and recording the students' results in an organized way models for them an effective way to work.)
Ask students how they would find possible rectangles, given a target area. The ability to explain this indicates that the student recognizes connections between subsets of mathematical ideas. (7.CN.2)
Ask students why the square root of the number they are trying to factor is important. This demonstrates "number sense" and also gives students a strategy for finding factors. (7.N.8)

The summary should also include making sense of the formulas for area and perimeter of a rectangle as follows:
1 row of 24 tiles
2 rows of 12 tiles
3 rows of 8 tiles
4 rows of 6 tiles
These help us visualize 1 set of 24, 2 sets of 12, 3 sets of 8, and 4 sets of 6. The relationship between *repeated addition* and *multiplication* is observed. The formula of $A = bh$ is derived.

Take the opportunity to note that perimeter provides a context within which to teach students about the important math concept *equivalent expressions*. For example, the two equations below

can be used to demonstrate the commutative property. The commutative property means that order doesn't matter when adding (or when multiplying) numbers, so:
$P = b + h + b + h$
$P = b + b + h + h$

As you work through the equation, the following three steps clearly demonstrate the application of the *distributive property*. The distributive property can be explained by the following example: 3 x 24 = 3(20 + 4) = 60 + 12 (note here how the 3 is "distributed" across the 20 and the 4). This should be highlighted to students, as eighth-grade mathematics assessments often include questions on the distributive property. For example:
$P = 2(b + h)$
$P = 2b + 2h$
$P = (b + h)2$

If discussion seems appropriate and timely, help students discover that the sum of the dimensions is half the perimeter. Have students look at the chart posted for rectangles with an area of 24. Relationships exist between dimensions and area and dimensions and perimeter.

What is the relationship between the dimensions and the area?
1, 24; 1 x 24 = 24
2, 12; 2 x 12 = 24
The dimensions are factor pairs for 24.

What is the relationship between the dimensions and the perimeter?
1, 24; 1 + 24 = 25 and 25 is half of 50
2, 12; 2 + 12 = 14 and 14 is half of 28
The dimensions are addends with a sum equal to half the perimeter.

We found no new rectangles after the 4 by 6, which was as close to a square as we could create with tiles. Since 24 is not a perfect square number, a square with an area of 24 cannot be created with whole number dimensions.

Note the impact of factor pairs on perimeter:
Long and skinny dimensions will illustrate a greater difference in factors. This maximizes the perimeter.
More square-like dimensions will illustrate less of a difference in factors. This minimizes the perimeter.

Students need experience with more numbers and factor pairs to discover/understand/appreciate that the square root of a number represents the *greatest trial divisor necessary* to determine all factor pairs for a given number. A "Do Now" activity may feature other numbers on other days to bring students to this understanding.

How understanding will be assessed (formative and summative)

An in-class worksheet or written assignment will be used to assess understanding (explain assignment and/or provide example of student work).

Informal classroom observation may also be used. (Note: If formal observation is used, indicate guiding questions, scoring criteria, and sample student responses.)

Sketch all of the different rectangles that have an area of 24 square units and whole number dimensions. From a math perspective, what are the factors of 24? Indicate next to each figure its perimeter. (Show the whole numbers used for the dimensions.)

How do you know you have found all rectangles meeting the requirements provided?
Responses may include:

- I tried using 24 tiles to fill 1 row, 2 rows, 3 rows, and 4 rows and they worked. Five rows did not work because I needed one more tile. Six rows worked but 6 rows of 4 are the same as 4 rows of 6. Seven rows did not work. I kept trying numbers and found no new rectangles.
- The dimensions are factor pairs for 24.
- I could not break tiles into pieces to make rectangles with dimensions that were not whole numbers.

What is the relationship between the dimensions of a rectangle and its area?
Responses may include:

- The product of the dimensions is the number of square units in the area.
- Each dimension is a factor of the number of square units in the area.
- If the area is an even number of square units, the two dimensions may both be even numbers or one dimension may be odd and one even. They cannot both be odd.
- If the area is an odd number of square units, each dimension is an odd number.
- If the dimensions are the same, the area is a perfect square number.
- Dimensions with a small difference yield a more square-like rectangle.
- Dimensions with a greater difference yield a less square-like rectangle.

What is the relationship between the dimensions of a rectangle and its perimeter?
Responses may include:

- The sum of the dimensions is half the perimeter.
- The greater the difference in the dimensions, the greater the perimeter.
- The smaller the difference in the dimensions, the smaller the perimeter.
- The perimeter is twice the sum of the dimensions.

Describe the rectangle with an area of 24 square units and the greatest perimeter.
Responses may include:

- The 1 by 24 rectangle has a perimeter of 50.
- If one dimension could be a number between 0 and 1, the perimeter could be even greater. A ½ by 48 rectangle would have a perimeter of 97 units.
- The long, skinny rectangle has the greatest perimeter.
- The dimensions with the greatest difference (24, 1) will have the greatest perimeter.

Describe the rectangle with an area of 24 square units and the least perimeter.
Responses may include:

- The 4 by 6 rectangle has an area of 24 square units and a perimeter of 20 units.
- If one dimension could be $\sqrt{24}$, the rectangle would be a square with a perimeter less than 20 units since $\sqrt{24}$ is a little less than 5.
- The dimensions with the smallest difference (6, 4) will determine the rectangle with the smallest perimeter.
- The more square-like the rectangle, the less the perimeter.

Note: See the following page for the grid upon which students will draw their rectangles with an area of 24 square units.

Students will complete *KSB 2: Factoring* in the Student Packet

KSB 3: Percentage

Objectives
Students will:

- Understand the different ways to calculate percent of a given number and express that relationship in ratio.
- Sketch different geometric shapes and derive dimensions for a given area.

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)

Discuss the homework given in Unit 1 about measuring the student's bedroom and components. Relate the components as percentages of the floor area to illustrate the forthcoming instruction.

Key ideas to be addressed (based on math and technology standards)
Math

- Verify the proportionality, using the rule stating that the product of the means equals the product of the extremes. (6.N.10)
- Read, write, and identify percents of a whole (0% to 100%). (6.N.11)
- Solve percent problems involving percent, rate, and base. (6.N.12)
- Solve simple proportions within context. (6.A.5)

Technology

- Develop plans, including drawings with measurements and details of construction, and construct a model of the solution, exhibiting a degree of craftsmanship. (5.1)
- Cite examples of how different aspects of natural and designed systems change at different rates with changes in scale. (6.3)
- Use graphs of information for a decision-making problem to determine the optimum solution. (6.6)

1. We know that the window area should represent 20% of the floor area. Since that is the case, ask students to figure out the ratio of window area to floor area.
2. What should the window area be for a floor area of 120 square feet? Look for strategies used by students. Examples:

20% is the same as 1/5 1/5 of 100 is 20 1/5 of 20 is 4 20 + 4 = 24	20% is the same as 0.20 120 x 0.20 = 24	10% is half of 20% and 10% of 120 is 12. Twice 12 is 24.	20/100 = x/120 Method A 100x = 2400 x = 24 - - - - - - - - - - - Method B $\frac{20}{100} = \frac{x}{120}$ $\frac{20 \times 1.2}{100 \times 1.2} = \frac{24}{120}$ $x = 24$

We know how to find the area of a triangle if we know its dimensions. How do we find the dimensions of a triangle if we know its area?

Area of a triangle: $A = \frac{1}{2} bh$. If the area is 24, then the dimensions must be factors of what number? ($24 = 1/2bh$ so $bh = 48$)
The base and the height will be represented by factor pairs for 48 (1, 48; 2, 24; 3, 16; 4, 12; 6, 8).

Area of a trapezoid: $A = \frac{1}{2}(b_1 + b_2)h$
$36 = \frac{1}{2}(b_1 + b_2)h$
Students need to realize that $\frac{1}{2}(b_1 + b_2)$ represents the mean of the two bases.
We then know that the mean of the base and the height are factors of the area 36.

Summary Questions

1. Which bedroom (geometric) shape would have the least wall perimeter for a given floor area?
2. Show at least two ways to find a percent of a number.

How understanding will be assessed (formative and summative)
Informal classroom observation, as well as the in-class worksheets from *KSB 3: Percentage*, will be used to assess understanding. (See the two pages that follow.)

Students will complete *KSB 3: Percentage* in the Student Packet

Unit 4: KSB 4: Mathematics of Scale; KSB 5: Mathematical Nets

KSB 4: Mathematics of Scale

Objectives
Students will:

- Determine the correct scale to use for drawing their design on the basis of paper size and actual room size.

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)
Question: What would be a logical scale for drawing the Empire State Building, which is 1,250 feet high? How big of a piece of paper is necessary to draw the room we are in?

Ask students why it is necessary to build a scale model. Help them come up with this answer: Scale models help us visualize what a finished room will look like. Instead of making a full-size drawing, we can use a scale in which, for example, 1 inch equals 1 foot. If the full-size dimension is 12 feet, the scaled dimension—the line we draw to represent 12 feet—is 12 inches long.

Key Ideas to be Addressed
Math

- Express equivalent ratios as a proportion. (6.N.7)
- Solve proportions, using equivalent fractions. (6.N.9)
- Use mathematics to show and understand physical phenomena (e.g., make and interpret scale drawings of figures or scale models of objects). (7.R.9)
- Calculate distance, using a map scale. (7.M.2)

Technology

- Develop plans, including drawings with measurements and details of construction, and construct a model of the solution, exhibiting a degree of craftsmanship. (5.1)
- Cite examples of how different aspects of natural and designed systems change at different rates with changes in scale. (6.3)

Instructional Hints
Display a map of your area, and apply the map scale to determine distance. Ask students: How would you be able to determine distance between two cities, using only this map? Engage students in a discussion of ratio and proportion and have them explain how these concepts relate to scale.

Key Questions
Which of the following scales would require the largest piece of paper?
Which would provide the most detail?
a. 1.2 inches = 1 foot b. 1 inch = 1 foot c. 2 inches = 1 foot
If a room measures 12 feet by 18 feet, determine the scaled dimensions for each of these scales.

Summary Questions
What factors should be considered when choosing an appropriate scale? (Note the different meaning of the term *factors*.)
If we create a drawing that is half the actual size, what is the scale as a ratio?

Students will complete *KSB 4: Mathematics of Scale* in the Student Packet

KSB 5: Mathematical Nets

Objectives
Students will:

- Identify the two-dimensional shapes that make up three-dimensional objects.
- Create nets, using two-dimensional shapes.
- Transform nets into three-dimensional objects.
- Make a pattern for creating a solid (empty) object for their physical model.

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)
Draw a cubical net and a cube on the board.

Ask students if they have ever noticed how the numbers 1–6 are arranged on a fair cubical die. Invite students to draw a net of the die. Hand out graph paper as an aid to do the drawing.

Hints to elicit response:

1. There is a pattern.
2. The sum of opposite faces is the same.
3. Start filling in the three visible faces of the cube on the board as further hints.

Solution: Opposite faces represent a sum of 7: 1, 6; 2, 5; 3, 4

Key ideas to be addressed (based on math and technology standards)

- Identify the two-dimensional shapes that make up the faces and bases of three-dimensional shapes (prisms, cylinders, cones, and pyramids). (7.G.3)

Instructional Hints
Before working on the KSB, demonstrate Google SketchUp. Use the "Folding Nets" file and the rotation tool to fold a net (sometimes called a *stretch-out*, or a development drawing) into a virtual 3D object. While this image is fresh in students' minds, have students take out their Bedroom Design packets and present the topic in an engaging way (see above).

Before breaking students into groups to work on the KSB, make the learning relevant by illustrating how a net can be used to create furniture for the bedroom. Show the students how a dresser would be built (it's a rectangular prism). A sample drawing of a net (representing a dresser) on graph paper and a constructed net could be possible teaching/visual aids. Mention to students that this will help them complete question c on the KSB. (Students should realize that more than one net can be designed to fold into the dresser.)

Alternative 1: Using grid paper, groups of two to three students will draw, cut, and fold their nets to create as many different cubical nets as they can. The nets should be composed of 6 square units and correctly labeled (1–6) to create a fair cubical die. There are a number of arrangements of the 6 square units that will result in a cube, but some arrangements will not work. We'll restrict our nets to those with one edge adjoining another edge. To facilitate the group activity, either demonstrate another net that would fold into a cube or ask a student to offer a possibility. As an aid, give students one-unit cubes and suggest wrapping the cube with graph paper.

Alternative 2: It is often helpful for students to arrange 3 or 4 cubes in a prism and then design and cut a net to wrap it with no holes or overlap. This task also will help students complete question c.

Closure
Review answers and discuss findings.
Discussion for alternative 1 could focus on the question, Which net or combination of nets would maximize results when arranged to be cut on paper, wood, cookie dough, etc.? Construct a piece of furniture that will be common to all rooms, using what you have learned.
Propose summary questions.

If time permits, conclude cube netting by visiting
http://illuminations.nctm.org/activitydetail.aspx?ID=84

Vocabulary (if possible, touch base with the math department again)
Square
Rectangle
Triangle
Pyramid
Prism
Rectangular Prism
Triangular Prism

Key Questions
Could you create a net to represent any object in the world? (Note that uniform shapes are easiest; natural, ornate shapes are more difficult.)
Why is a picture of a cube not a three-dimensional object?

Summary Questions
In what types of buildings do you see examples of these shapes? (houses of worship, homes, warehouses, skyscrapers, schools)
What parts of buildings have some of these shapes? (steeples, roofs, doors, chimneys)
How will understanding the creation and folding of nets help us improve project results?

How understanding will be assessed (formative and summative)
The in-class worksheet that is completed by making models from nets will be used to assess understanding, as will informal classroom observation.

Students will complete *KSB 5: Mathematical Nets* in the Student Packet

Unit 5: KSB 6: Aesthetics; KSB 7: Spreadsheets and Pricing Information

KSB 6: Aesthetics

Objectives
Students will:

- Compare aesthetic choices for their bedroom by changing the virtual model's colors and textures.
- Continue learning how to render objects, using Google SketchUp software.

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)
Show the same virtual models in different colors and textures to compare the effects.

Key ideas to be addressed (based on math and technology standards)
Math

- Use representations to explore problem situations. (8.R.6)
- Investigate relationships between different representations and their impact on a given problem. (8.R.7)

Technology

- Describe objects, imaginary or real, that might be modeled or made differently and suggest ways in which the objects can be changed, fixed, or improved. (1A)
- Use the computer as a tool for generating and drawing ideas. (3B)

Instructional Hints
Introduce *KSB 6: Aesthetics* (in the Bedroom Design packet, provided separately). Encourage students, through guided conversation, to consider the atmosphere of their rooms. Explore different shapes and designs of furniture. When you are confident that students understand how their choices affect the overall feel of the room, ask them to work in their groups on the KSB. Walk around the classroom and encourage them to express their ideas in writing in the packet. Students will continue to finish their previously started room designs, but they will choose one person's drawings to complete and use as the final group drawings, and they will appoint an official draftsperson for SketchUp. Then show students how to insert furniture from the component library and the 3D warehouse and how to move, resize, and rotate the furniture inside the room. Finally, tell students to add materials to all surfaces, if possible.

Key Questions (Note: Be sure to relate cost to choices made)
What aesthetic qualities do you want your bedroom to reflect?
What components are necessary for a complete bedroom?
How do colors affect your mood?
Is there anything you would like to change about your bedroom design?

Summary Questions
Does every major component in the room contribute to the atmosphere you wanted to create?
Will this design be a passing fad or will it be something that you can live with and that will be worth the cost?

How understanding will be assessed
Observation of group progress will be used to assess understanding.

Students will complete *KSB 6: Aesthetics* in the Student Packet

KSB 7: Spreadsheets and Pricing Information

Objectives
Students will:

- Demonstrate knowledge of Microsoft Excel (spreadsheets) by working within a fixed budget to create and furnish their bedroom design.
- Make trade-offs in choosing various furnishings for their bedroom design.

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)
How can you record and track your budget when designing your bedroom?

Key ideas to be addressed (based on math and technology standards)
Math

- Evaluate the efficiency of different representations of a problem. (8.PS.17)
- Work backwards from a solution. (8.PS.9)
- Formulate mathematical questions that elicit, extend, or challenge strategies, solutions, and/or conjectures of others. (8.CM.8)
- Provide a correct, complete, coherent, and clear rationale for thought processes used in problem solving. (8.CM.1)
- Recognize and apply mathematics to other disciplines, areas of interest, and societal issues. (8.CN.9)

Technology

- Use appropriate graphic and electronic tools and techniques to process information. (2E)

Instructional Hints
Introduce *KSB 7: Spreadsheets and Pricing Information*, and tell students they will use Microsoft Excel to open the "Pricing Information" file containing the budget. Students will now see how much of their $27,500 budget is spent on construction. Show students how to use Excel to calculate areas for shapes with various dimensions and to calculate costs. Tell them that they will have to make decisions about some things—window size, for example—but that they may change their minds later. Once the variable cost calculations have been completed, show the class how the fixed cost items have been listed in the second half of the spreadsheet. These items include major furniture and electronic equipment and their corresponding dimensions and costs. Finally, tell students that they may find items to complement their rooms through the Internet or other research; however, they are responsible for recording the description, dimensions, and costs for their group budget. Ask students to complete this spreadsheet on their own, but you may want to walk around the room and offer assistance as necessary. Once students know how much of their budget is spent on construction, they can figure out what is left for furnishings and other fixed cost items. Instruct them to copy and paste into Microsoft Word any pictures they would like to print out and use in their constructed room.

Key Questions
How does Excel benefit a person creating a budget?
How do your design choices change your budget decisions?

Summary Questions
Why are budgets necessary when designing products, systems, or environments?
How do dimensional changes affect cost?

Unit 6: Groups optimize existing drawings and budgets.

Objectives
Students will work as a team to:

- Demonstrate knowledge of Google SketchUp by producing a final group bedroom design both virtually and in hard copy.
- Make trade-offs in completing their budget for the bedroom design.
- Prepare and complete a budget spreadsheet, using Microsoft Excel.
- Demonstrate knowledge of drawing to scale by completing all physical components of their final design to a specific scale set by the instructor.

Present the task in an engaging way
Hand back the individual designs and spreadsheets and have each group choose one design.

Key ideas to be addressed (based on math and technology standards)
Math

- Work in collaboration with others to solve problems. (8.PS.11)
- Evaluate the efficiency of different representations of a problem. (8.PS.17)
- Connect and apply a variety of strategies to solve problems. (8.CN.3)

Technology

- Generate ideas for possible solutions, individually and through group activity; apply age-appropriate mathematics and science skills; evaluate the ideas and determine the best solution; and explain reasons for the choices. (1C)

Instructional Hints
Present to students the specific roles and responsibilities of the design team. Then describe the techniques for importing images into Google SketchUp, and discuss the steps necessary to produce a front-perspective drawing, using Google SketchUp.

Key Questions
Does the design that your group selected meet the specifications and have good aesthetics?
How can you optimize the design and stay within budget?

Summary Questions
Are all designs and spreadsheets completed?
Are all furnishings drawn to the correct scale?
(Note: Solicit student bed sizes and compare them to standard bed sizes [e.g., full, twin, queen] in scale.)
Did everyone stay within budget constraints and develop an optimal design? Why or why not?
What trade-offs did you make?
Is any group under budget? Why did your group choose to be under budget?

How understanding will be assessed (formative and summative)
Teams will hand in a list of the roles, the design selected, and the reasons why the particular design was chosen by the group.
Teams will hand in the final design (in front perspective), an Excel spreadsheet, and any imported graphics or textures that were used.

Groups finalize drawings and budgets, and submit final drawings and budgets in preparation for physical modeling.

Students will complete *KSB 6: Aesthetics* in the Student Packet

Unit 7. Constructing the Physical Model

Objectives
Students will:

- Complete a physical model of their Google SketchUp design.
- Transfer technical data from Google SketchUp to create a scaled physical model.
- Demonstrate their ability to apply angles and other mathematical calculations.
- Design within constraints.
- Understand ratio and proportion and use this knowledge to draw a room and furniture to scale.
- Use derived formulas to solve for the room area and the furniture area.
- Understand the concept of scale and create an appropriate scale for the project.
- Make design decisions about what materials to use for creating bedroom furnishings.
- Use previous design plans to transfer and construct the bedroom, using materials and tools.
- Bring in materials to supplement what they have been given in class.
- Evaluate their own work.

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)
Say to students, "We've just spent several days working on a virtual bedroom design. Why do we need to create a physical model? Are there limitations to a virtual model that make construction of a physical model necessary? If so, what are they?" Then tell students to take out all the materials and drawings that are needed to start building the physical model.

Checklist:
Finished room drawing (front perspective in Google SketchUp)
Completed pricing information sheet
Printout of materials or wall coverings necessary to complete the room
Materials brought from home, as needed
(Note: If students are lacking materials, the group should continue and one person should be sent to acquire what is needed while other tasks are begun.)

Key ideas to be addressed (based on math and technology standards)
Math

- Add and subtract fractions with unlike denominators. (6.N.16)
- Add, subtract, multiply, and divide mixed numbers with unlike denominators. (6.N.18)
- Estimate a percent of quantity (0% to 100%). (6.N.26)
- Identify radius, diameter, chords, and central angles of a circle. (6.G.5)
- Understand the relationship between the diameter and the radius of a circle. (6.G.6)
- Use a ruler to measure to the nearest inch, ½ inch, ¼ inch, and 1/8 inch. (5.M.1)
- Identify customary equivalent units of length. (5.M.2)
- Convert measurement within a given system. (5.M.5)
- Determine what tools and techniques are needed to measure lengths and angles with an appropriate level of precision. (5.M.6)
- Express equivalent ratios as a proportion. (6.N.7)
- Verify the proportionality, using the rule stating that the product of the means equals the product of the extremes. (6.N.10)

- Use mathematics to show and understand physical phenomena (e.g., make and interpret scale drawings of figures or scale models of objects). (7.R.9)
- Calculate distance, using a map scale. (7.M.2)
- Identify the two-dimensional shapes that make up the faces and bases of three-dimensional shapes (prisms, cylinders, cones, and pyramids). (7.G.3)

Technology Standard 5.1: Engineering design is an iterative process involving *modeling* and *optimization* used to develop technological solutions to problems within given constraints.

Technology Standard 5.2: Technological tools, materials, and other resources should be selected on the basis of safety, cost, availability, appropriateness, and environmental impact; technological processes change energy, information, and material resources into more useful forms.

Technology Standard 5.6: Technology can have positive and negative impacts on individuals, society, and the environment and humans have the capability and responsibility to constrain or promote technological development.

- Describe how technology can have positive and negative effects on the environment and on the way people live and work.

Technology Standard 5.7: Project management is essential to ensuring that technological endeavors are profitable and that products and systems are of high quality and built safely, on schedule, and within budget.

Instructional Hints

Have kits prepared with the minimum required materials to make the bedroom design:

Enough mat board to build walls and floor
(1) 3/16" x 3/16" x 36" balsa for furniture
(1) 3/16" x 1/8" x 36" balsa for furniture
(1) 1/16" x 3" x 36" balsa for furniture
(1) 8" x 10" piece of mirrored paper for windows
Assorted special papers for interior design
Choice of felt, wood-textured foam, or marble-textured foam for flooring
Assorted tools provided by the instructor
Encourage students to bring in found materials from outside or home (swatches, color).

Have students lay out their windows on the walls.

Using previous knowledge, they will sketch the outline of the window(s).**
Students will submit the walls to the teacher.
The teacher will use a cutting tool to do the inside cuts.
(**Optionally give students a 4" x 6" piece of mirrored paper.)

Have students assemble the walls, using hot glue guns.
Have students apply coverings to the inside walls and then the floor.
Have students create furnishings to put in the room and glue them down.

All furnishings must be to scale.
Inform students that using cutout patterns may aid in construction.

Have students create a name card and do a final check of the room.

The name card should not obstruct a front-perspective view of the room.
The room is photographed by the teacher.

Key Questions
What building strategies do you plan on using to construct your room?
What is everyone's assigned job/task?
What do your responsibilities within the group entail?
What is the role of scale in your physical model?
How many days do you have to complete construction?

Summary Questions
How well does the virtual model match up with the physical model?
How do you think your physical model would have come out if you had not created a virtual model first?
Were any modifications necessary when creating the physical model versus the virtual model? If so, what modifications were made and why?

How understanding will be assessed (formative and summative)
Formative
Was the project finished on time?
On a scale of 1 to 5, 5 being perfect, how closely do the physical and virtual models match? Are the models accurate and to scale (especially in regard to the furniture and the way it fits in the space)?
How did you use mathematics to improve the physical model during the actual construction phase?
How did you consider aesthetics when preparing the final design?
Are students performing their respective duties, and is equipment being used safely and properly?
Are students practicing conservation of materials during the construction phase?

Summative
Use the grading rubric to rate your room.

Unit 8: Group Presentations to Class, Post-assessment, Debriefing

Objectives
Students will:

- Open and print their front-perspective drawing, "The Group Bedroom Design," in landscape orientation.
- Open and print their pricing information sheet in Excel.
- Evaluate their own work, using the rubric.
- Staple the assessment rubric (as the front page) to the perspective drawing and the pricing information sheet.
- Take a digital picture of the model and include the names of the students in the group.
- Complete a posttest.
- Display model, drawings, work photos, room photos, and other completed work.
- View all group displays.
- Dress in professional attire and present their group work to the class.
- Demonstrate their knowledge of the process with discussions related to obstacles and explain how the obstacles were overcome and why certain design decisions were made.
- Hand in the model and all paperwork related to the project after class reflections.

Present the task in an engaging way (ask a provocative question, establish a need, relate to prior work, etc.)

Show video clips of a variety of presentations, including unusual ones. Examples follow:

Steve Job's iPhone Presentation
http://events.apple.com.edgesuite.net/0806wdt546x/event/index.html
http://www.apple.com/quicktime/qtv/mwsf07/
Honda Presentation
http://www.albinoblacksheep.com/flash/honda

How did you react to the video clips?
What would you include in a presentation to your classmates that expresses what you have done in this project?

Instructional Hints

Discuss presentation methods and appropriate dress.
Administer post-assessment.

Key Questions
What is the purpose of professional attire?
Explain reasons for displaying model, drawings, work photos, room photos, and other completed work.
Demonstrate your knowledge of the process with discussions related to obstacles, and explain how the obstacles were overcome and why certain design decisions were made.
What is the reason for taking the posttest?

Summary Questions
How can this activity be used in your life?
Explain the most valuable experience you were engaged in while working on this project.
What are the necessary steps for planning a successful presentation?
In the development of a presentation, what are the key ideas that should be addressed before the actual presentation is given? Give a variety of examples.

How understanding will be assessed (formative and summative)
Understanding will be assessed through the rubric, the post-assessment, and the student survey.

Appendix 1. Corresponding STL (Standards for Technological Literacy) Used in the Unit Instruction

Flex Unit:	Standards 3, 6, 8, 9, 10
Unit 1:	Standards 3, 6, 9
Unit 2:	Standards 3, 6, 9, 11
Unit 3:	Standards 3, 6, 8, 9, 10, 11
Unit 4:	Standards 3, 6, 9, 11
Unit 5:	Standards 3, 6, 9, 20
Unit 6:	Standards 3, 6, 8, 9, 11, 20
Unit 7:	Standards 3, 6, 8, 9, 11, 20
Unit 8:	Standards 3, 9, 11

The Nature of Technology

Standard 3. Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

Technology and Society

Standard 6. Students will develop an understanding of the role of society in the development and use of technology.

Design

Standard 8. Students will develop an understanding of the attributes of design.
Standard 9. Students will develop an understanding of engineering design.
Standard 10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Abilities for a Technological World

Standard 11. Students will develop abilities to apply the design process.

The Designed World

Standard 20. Students will develop an understanding of and be able to select and use construction technologies.

Appendix 2. Expert Technology Teachers Participating in the Bedroom Design Development and Field Testing and Project Administrators/Consultants

Teacher	Grade Level	School	Email Addresses/School Phone Numbers
Nicholas Cimorelli	8, 9–12	East Rockaway Junior Senior HS	ncimorelli@eastrockawayschools.org 516 887-8300
Chris Connors	7 & 8	Herricks Middle School	cconnors@herricks.org 516 625-6460
Joseph Fili	8, 9–12	Wantagh Middle School	filij@wantaghschools.org 516 679-6490
Dave Gordon	7–8	JW Dodd Middle School, Freeport	dgordon@freeportschools.org 631 867-5280
Jordan Jankowski	6–8	Commack Middle School	jjankowski@commack.k12.ny.us 631 858-3500
Thomas Kleint	6–8	HB Thompson, Syosset	tkleint@syosset.k12.ny.us 516 364-5760
Chris Malanga (Lead Instructor)	7–8	Riverhead Middle School	chris.malanga@riverhead.net 631 369-6756
Joanne S. Messina	7 & 8	Woodland Middle School, East Meadow	jschiano@eastmeadow.k12.ny.us 516 564-6523
James Ng	7 & 8	Grand Ave. Middle School, Baldwin	liteecher@hotmail.com 516 992-1100
Kevin Oswald	K–12	South Woods Middle School, Syosset	koswald1@optonline.net 516 364-5621
Stephen Phillips	7–8	Copiague Middle School	sphillips1@copiague.net 631 842-4011
John Rodriquez		Edmund Miles Middle School, Amityville	johrodri@optonline.net 631 789-6200
Arthur Schnee	7–8	Grand Ave. Middle School, Baldwin	arthurschnee@yahoo.com 516 992-1100
Barry Spainer	8	Wisdom Lane Middle School	bspainer@levittown.k12.ny.us
Jim Wandzilak	7 & 8	JW Dodd Middle School, Freeport	3montauk@optonline.net/jwandzilak @freeportschools.org 516 867-5280

MSTP Project Administration & Consultants				
Dr. M. David Burghardt	Project Director	Hofstra University		m.d.burghardt@hofstra.edu 516 463-5550
Mike Hacker	Project Coordinator	Hofstra University		mhacker@nycap.rr.com 518 724-6437
Lois Miceli	Admin. Assistant	Hofstra University		Lois.M.Miceli@hofstra.edu 516 463-6482
Linda Walker	Math Consultant			walkerl2@embarqmail.com
Dr. David Crismond	Engineering Tech Consultant	City College of NY		dcrismond@ccny.cuny.edu