Title: *Roominate*, Unit/Workshop
Subject: STEM [Science, Technology, Engineering, Math]
Topic: Architecture, Engineering, Design, Building,and Art.
Grade: K-4 **Designer:** Amy Turner

Stage 1- Desired Results

Established Goals: MA Curriculum Frameworks Standards

Engineering Design:

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change in order to define a simple design problem that an be solved by developing or improving an object or tool.*
K-2-ETS1-2. Generate multiple solutions to a design problem and make a drawing (plan) to represent one or more of the solutions.*
K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same design problem to compare the strengths and weaknesses of how each object performs.*
3-5-ETS1-1. Define a simple design problem that reflects a need or a want. Include criteria for success and constraints on materials, time or cost that a potential solution must meet.*
3-5-ETS1-2. Generate several possible solutions to a design problem. Compare each solution based on how well each is likely to meet the criteria and constraints of the design problem.*
3-5-ETS1-4(MA). Gather information using various informational resources on possible solutions to a design problem. Present different representations of a design solution.

Math: Measurement and Data

K.MD.1 - Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
1.MD. 2 - Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps.
2.MD. 1- Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
2.MD. 2 - Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen.
2.MD. 3 - Estimate lengths using units of inches, feet, centimeters, and meters.
2.MD. 4 - Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.
3.MD. 5- Recognize area as an attribute of plane figures and understand concepts of area measurement.
a. A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area.
b. A plane figure which can be covered without gaps or overlaps by n unit squares is said to have an area of n square units.
3.MD. 6 – Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).
3.MD. 7 – Relate area to the operations of multiplication and addition.
a. Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths.
b. Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real-world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning.
c. Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths a and b + c is the sum of a × b and a × c. Use area models to represent the distributive property in mathematical reasoning.
d. Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real-world problems.

3.MD. 8 - Solve real-world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.
4.MD. 2- Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale
4.MD. 3 - Apply the area and perimeter formulas for rectangles in real-world and mathematical problems. For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor
4.MD. 5- Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement: a. An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a "one-degree angle," and can be used to measure angles. b. An angle that turns through n one-degree angles is said to have an angle measure of n degrees.
4.MD. 6 - Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

Math: Geometry

K.G.5 - Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes.
K.G.6 - Compose simple shapes to form larger shapes. For example, "Can you join these two triangles with full sides touching to make a rectangle?"
1.G.1 - Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes that possess defining attributes.
1.G.2 - Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.
2.G.1 - Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.
3.G.1 - Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories
4.G.1- Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.
4.G.2 - Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.
4.G.3 - Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

ELA/Literacy Connections

W. K.2. Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they

name what they are writing about and supply some information about the topic.
W.1.2. Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.
W.2.2. Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.
W.3.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly. a. Introduce a topic and group related information together; include illustrations when useful to aiding comprehension. b. Develop the topic with facts, definitions, and details. c. Use linking words and phrases (e.g., also, another, and, more, but) to connect ideas within categories of information. d. Provide a concluding statement or section.
W.4.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
a. Introduce a topic clearly and group related information in paragraphs and sections; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.
b. Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.
c. Link ideas within categories of information using words and phrases (e.g., another, for example, also, because).
d. Use precise language and domain-specific vocabulary to inform about or explain the topic.
e. Provide a concluding statement or section related to the information or explanation presented.

Massachusetts Arts Strands and Standards 1-10 for PreK-12

The Arts Disciplines: Visual Arts (for additional specific tasks for PreK-4 see MA Curriculum Standards)
Standard 1 *Methods, Materials, and Techniques*. Students will demonstrate knowledge of the methods, materials, and techniques unique to the visual arts.
Standard 2 *Elements and Principles of Design.* Students will demonstrate knowledge of the elements and principles of design.
Standard 3 *Observation, Abstraction, Invention, and Expression*. Students will demonstrate their powers of observation, abstraction, invention, and expression in a variety of media, materials, and techniques.
Standard 4 *Drafting, Revising, and Exhibiting*. Students will demonstrate knowledge of the processes of creating and exhibiting artwork: drafts, critique, self-assessment, refinement, and exhibit preparation.
Standard 5 *Critical Response*. Students will describe and analyze their own work and the work of others using appropriate visual arts vocabulary. When appropriate, students will connect their analysis to interpretation and evaluation.
Standard 6 *Purposes and Meanings in the Arts*. Students will describe the purposes for which works of dance, music, theatre, visual arts, and architecture were and are created, and, when appropriate, interpret their meanings.
Standard 7 *Roles of Artists in Communities*. Students will describe the roles of artists, patrons, cultural organizations, and arts institutions in societies of the past and present.
Standard 8 *Concepts of Style, Stylistic Influence, and Stylistic Change*. Students will demonstrate their understanding of styles, stylistic influence, and stylistic change by identifying when and where art works were created, and by analyzing characteristic features of art works from various historical periods, cultures, and genres.
Standard 9 *Inventions, Technologies, and the Arts*. Students will describe and analyze how performing and visual artists use and have used materials, inventions, and technologies in their work.
Standard 10 *Interdisciplinary Connections*. Students will apply their knowledge of the arts to the study of English language arts, foreign languages, health, history and social science, mathematics, and science and technology/engineering.

Understanding(s) *Students will understand that…* U1 - Rooms are designed and created for	**Essential Question(s):** How do you determine the design of a room?

different purposes. U2 - Designs are representations of wants and needs for specific use of a room U3 - Sketching, drawing, and measuring are necessary for accuracy in engineering design. U4 - Materials used impact the design and engineering of a structure U5 - People can solve a problem through engineering and comparing and testing designs with knowledge	How does the use/purpose of the room impact the engineering and design? What impact do the materials used have on the outcome of the design?
Students will… -Learn about planning, designing and building a structure, space or object -Develop spatial and fine motor skills -Engage in hands-on problem solving -Learn basic circuitry - Reason abstractly to construct a model room as it would be in the real world.	*Students will be able to…* -Design (sketch), build, and test a model of the design (using trial and error). -Demonstrate their understanding of engineering and architecture by designing, building and decorating a room for a purpose. -Apply engineering, building and design skills to solve real world problems by creating a 3D model.

Stage 2- Assessment Evidence

Performance Task(s)

1. Journal or Notebook of ideas, brainstorming/imagining, labeled pictures, sketches, drawings, clippings, objects
2. Plan – (sketch or drawing) showing type of room/space/object to be built and what belongs in the space.
3. Design – sketch of how the room/space or object will look when completed. [Extension may include different views-plan view from above, elevation view from the front/side/back, section view from when you enter the room or other perspective within the room]
4. 3D model (Roominate construction) of "real life" room, space or object to be built
5. Decorated completed Roominate 3D model including accessories
6. Write a reflection on the design/building process including what steps were followed to complete design. What would you do the same/differently? Did you have any stumbling blocks? How did you solve them? Would you do this again? What would you create? Would you recommend this to a friend?

Key Criteria

- Designing is a process that begins with an idea.
- Engineers, architects, and designers work from imagined ideas to sketch, plan and build a structure.

- Trial and error are part of the process of designing to create the best solution.

Other Evidence/Extensions

- Scale your design using graph paper (remember to keep a key- 1 inch square on graph paper equals 1 square foot in the real world)
- Determine the square footage of the design or total area (use dimensions and area formula or measure with tiles)
- Design a room for a "customer" (interview the customer, sketch a plan for the design and include all items to be in room, present your plan to the customer, revise plan, when customer approves the design build the room using the Roominate kit. Then have the customer write a review of your work.
- Advanced Roominaters may choose to work in together to plan a town by first brainstorming what buildings and areas are needed and sketch, plan, design and build the town.
- Digital pictures and or individual picture portfolios created by instructor/students to document the design process from beginning to end. The digital pictures/portfolio will serve as part of a student's assessment and as a keepsake of the experience (all structures will be dismantled at the end of the unit/workshop).
- Invite an architect, designer or engineer in to speak with the group during Session 3 or 4 to enhance understanding and connection to design.

Stage 3- Learning Plan

Overview

These lessons/sessions are to be use with the Roominate Kits, designed by Alice Brooks and Bettina Chen to inspire the next generation of innovators. Roominate was designed for girls, however all students are welcome to enjoy the hands-on learning experience. The lessons/sessions are a structure or guide that may be used to support, **not replace** curriculum in the classroom, or to use as a stand-alone extended activity/workshop. The Roominate Kits are **toys** designed to inspire, engage and encourage hands-on problem solving through open-ended play. Each lesson/session can be used in a classroom setting in conjunction with curriculum or during an extended workshop activity time. The lessons/sessions are intended for approximately 45 minutes to an hour. The time, session duration and session content may be adjusted for the age of the students, curriculum content, extension activities and expected outcome. The lessons/sessions in the unit/workshop were created to show that there is a process that architects and designers follow from the beginning, idea stage, to the completed project. The focus of this unit/workshop is intended to guide the students in the process (imagine, investigate, plan, design, construct, decorate) and for the students to have ample hands-on time each lesson/session with the kits.

Materials

Prior to the first lesson/session, materials should be gathered, prepared, labeled, organized and placed in a specified area for easy access and use. This is a suggested list; adjust the list to your needs.

- Roominate Kits. 1 for each student or pair
- Plastic container/bag for storage of Roominate Kit contents. 1 for each student or pair labeled with name(s)
- Notebook for ideas/sketches. 1 per student, labeled with name
- For whole group use: graph paper and plain paper for sketches/designs, pencils, colored pencils,

crayons, markers, glue/glue sticks, tape, scissors, rulers, protractors, magazines for ideas and to cut pictures for "idea/sketch" notebook, "good junk" (materials, recycle materials for design and decorating)

- Teacher/Student Access to: projector technology (e.g., SmartBoard, Ladybug, projector), books, magazines and computers/iPads for design programs and websites.
- **A camera for taking LOTS of pictures** throughout the process for documentation and to create a digital portfolio for students. This is necessary since at the end of the unit/workshop all structures will be broken down and used for another project.

Suggested Resources

Websites

- Design Squad for ideas and innovation www.pbskids.org/designsquad
- Museum of Modern Art for art and design ideas from past to present. www.moma.org/interactives/destination
- SketchUp Make is a downloadable program for Windows or Mac. Make sure you have permission for downloads. Educators can get a free SketchUp Pro educator license. www.sketchup.com/products/sketchup-make

YouTube videos

- #LetGirlsBuild https://www.youtube.com/watch?v=G3eaJKps9Y4
- Roominate workshop with Katherine: Make it Spin! https://www.youtube.com/watch?v=kUrPK1TCXlI
- Roominate workshop with Katherine: Make it Light Up!
- https://www.youtube.com/watch?v=PqfwqFoP-_Y

Books Choose one of these books to read during the introduction of the unit to help inspire students. You may use the other stories as needed throughout the unit/workshop.

- The Most Magnificent Thing by Ashley Spires
- Rosie Revere, Engineer by Andrea Beaty
- Iggy Peck, Architect by Andrea Beaty

Session 1: Introduction, Imagine, and Investigate. What is an Engineer? What is an Architect? What is a Designer? What is Roominate? What does STEM have to do with all of them?

Approximate time: 45 minutes – 1 hour

Key Vocabulary: engineer, architect, design, designer, S.T.E.M., plan

Activity: Create an "Ideas Notebook"

Book Resources (choose one): The Most Magnificent Thing by Ashley Spires, Rosie Revere, Engineer by Andrea Beaty, or Iggy Peck, Architect by Andrea Beaty

Pre-planning: If possible invite an architect or designer to visit and present during Session 3 or 4

YouTube: #LetGirlsBuild (1 minute) https://www.youtube.com/watch?v=G3eaJKps9Y4

Notes:

- Before the session begins have the kits and container/bag and idea/sketch notebooks labeled and grouped for each individual/pair for quick distribution after whole group introduction.
- Show YouTube video #LetGirlsBuild and then discuss the video (STEM jobs) and that the students will be able to create a room and build just like the girl in the video.
- Begin a KWL chart: What can STEM do for you? Define STEM and list the possible STEM jobs, courses, topics, ideas, etc. Define any job descriptions or terms brought up. List everything, all ideas matter and count.
- Discuss KWL chart and have students discuss what the STEM jobs reveal about our culture. What types of students/people have these jobs?
- Complete the KWL chart with responses to what children want to know about STEM and jobs and careers involving STEM. Save the KWL for Session 5 to complete the L.
- Choose one of the book titles and read the book. Make sure to discuss how each of the characters faces obstacles and "failure", yet they go on to persevere and create great things, and so can each one of them. You may read the other books throughout the unit/workshop as you need.
- After the story discuss how there is a process for designing and building. Have students reflect on what they saw and heard in the story. Tell them they will follow the process (imagine/brainstorm, research/investigate, plan, design, build, decorate) to create a 3D room or structure. It all starts with imagination or an idea (brainstorming all ideas) and today they will brainstorm and begin researching and investigating their ideas. Now distribute the materials from the #1 of this lesson. Tell students about the materials. Tell them that the "idea notebook" is for them to write and draw **all** their ideas and cut or glue in other ideas for their project. Important!! Write down **Everything!** Never discard any ideas or drawings and always label each version and date so you will be able to go back to it, just like a professional.
- Remember to take digital pictures for the student's portfolios.
- Students begin to brainstorm ideas in their notebooks and investigate ideas. Students explore their Roominate Kits.
- Have students clean up and review the session. Students should keep adding to their Idea Notebooks and write any thoughts, feelings or ideas they may have for their design.

Session 2: Planning

Approximate time: 45 minutes – 1 hour

Key Vocabulary: plan, sketch

Activity: Create a plan for your room.

Web resources: Design Squad for ideas and innovation www.pbskids.org/designsquad; Museum of

Modern Art for art and design ideas from past to present. www.moma.org/interactives/destination

Notes:

- Begin by reviewing the process (imagine/brainstorm, research/investigate, plan, design, build, decorate), and answer any questions from last session. (5 minutes)
- Explain to students that architects work from plans. Tell students that plans show the type of space to be built and what belongs in that space. Remind students to keep all versions of plans/sketches/drawings and label/code and date so they can find them. (5 minutes)
- Today students will: (15-20 minutes)
    - Decide what type of space they will design from your "idea notebook" and brainstorming.
    - List all the things that will go in the room (e.g., furniture, lamps, appliances, counters, etc.). Visualize what goes in the room you will build.
    - Decide how the room will be used and who will use it. What is the room used for? What does the occupant like or dislike? How do you want the room to feel when you are in it?
    - Students may use Web resources, magazines, books, etc.
    - Sketch ideas of what the room should look like including placement of what things are in the room. Sketch different views of the room.
    - Review your notes and check your plan. Make a list of everything you want in the room. Show someone your plan and see if they have suggestions.

- Remember to take digital pictures for the student's portfolios.
- Students explore and create with their Roominate kits.
- Review the session and clean up. Students should continue to add to their Idea Notebooks and write down any new inspirations, thoughts or feelings about design or materials.

Session 3: Design

Approximate time: 45 minutes – 1 hour

Key Vocabulary: design

Activity: Create a design layout from the plan from Session 2

Additional materials: Graph paper, rulers, blank sheets of paper

YouTube Videos:

Roominate workshop with Katherine: Make it Spin!
https://www.youtube.com/watch?v=kUrPK1TCXlI
Roominate workshop with Katherine: Make it Light Up!
https://www.youtube.com/watch?v=PqfwqFoP-_Y

Notes:

- Begin by reviewing Session 2's plan, notes and ideas.
- Design is the way something looks or works. Today you will create a design layout of your room based on your ideas and plan.

- Students will:
    - Sketch how things in their room will be arranged. During this students should think about where furniture and other objects go in the room. Will they fit? Think about the size of all things that are needed in the room. Where will the doors and windows be placed? Where are the outlets and switches?
    - Sketch the items in the room on the layout. What sizes and colors are the items in the room? The kit has a motor and light; will you incorporate those things in your room? How? Where?
    - Sketch what your room will look like when it is finished. What are your favorite styles and colors? Bring all your ideas together!

- Remember to take digital pictures for the student's portfolios.
- Watch the two YouTube videos to help prepare for wiring lighting and fans for the new space.
- Explore and create with the Roominate kit for your room design and construction.
- Review the session and clean up. Students should continue to add to their Idea Notebooks and write down any new inspirations, thoughts or feelings about materials. Gather additional materials for decorating.

Sessions 4 and 5: Construction/Decorating

Approximate time: 2 hours

Activity: Build and revise their 3D Roominate structure/space from their design layout.

Notes:

- Begin the lesson by reviewing prior session. Some students may need more time for their design layout while others may be ready for building and decorating.
- First have students begin construction by assembling the frame of the room using the Roominate kit. Follow the plan or design they created making sure to check and include everything.
- Next add windows, doors, ceilings, stairs and other structural elements.
- Then build furniture and other objects for the space.
- Place objects in the room. Do things fit the way you planned? If not, that's ok. Professionals often need to make changes as they go. Keep tweaking the design.
- Be creative. Use recycled materials for objects in your space. Repurpose things for other uses.
- Remember to take digital pictures for the student's portfolios.
- Decorate and color your Roominate space. Add paint, pictures or artwork to the walls. Create rugs, furniture use fabric with patterns to pull the room together. Add lighting and install floors. Think about using the motor to make a fan or other object that moves.
- Bring students together during Session 5 and fill in the L in the KWL chart
- Once you have tweaked and revised your space and you are happy with the outcome you have successfully completed your project. As with all things tell students they may update or change things to suit their needs.
- Review the session and clean up. Students should continue to add to their Idea Notebooks and write down any new inspirations, thoughts or feelings about materials. Gather additional materials for decorating

Session 6: Conclusion

Approximate time: 1 hour

Activity: Complete structure/space construction and decorating.

Open House: Students set up all 3D Roominate structures/spaces and invite families, friends and community members to view the final engineered and design products from the "professional" STEM architect students.

Additional materials: Notebooks or lined paper for reflections

Notes:

- Begin by having each student review, add finishing details and complete work.
- Set up the "Open House." At this time, students may visit other participants' structures and discuss their designs.
- Have students write a reflection and hand it in to the instructor.
- Write a reflection on the design/building process including what steps were followed to complete design. What would you do the same/differently? Did you have any stumbling blocks? How did you solve them? Would you do this again? What would you create? Would you recommend this to a friend? What was your favorite design a friend used?
- Invite guests into the Open House for the end of the session. Be sure to take lots of pictures! Students will greet guests, tell about their design, how materials influenced their architectural plan and space, the goals of their structure, etc. Students will answer questions.
- When the Open House is over, be sure that each student has had a picture with their final created space for his/her portfolio. Next, have students dismantle their creations and place all parts in the containers or bags. Then, clean up the work area.
- Teacher may do a self-reflection or survey parents about the unit/workshop to assist in future planning of the unit/workshop.