

# 3D Dream Backyard

Connecting Area, Perimeter & Design  
in an Engineering Challenge!

Common Core  
Aligned!



Writing & Blogging  
Activity Included!

- **A note to the teacher:** This lesson is a creative and engaging way to get students
- excited about area and perimeter by integrating these mathematical concepts with
- engineering! Students will have a blast getting to use their imaginations to design and build
- while gaining a solid understanding of key math concepts. After students have built their 3D
- Dream Backyards, they follow up with a writing activity & extension!

## LESSON PLAN

### next generation standards:

**K-2-ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

**ETS1.B:** Developing Possible Solutions- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)

### COMMON CORE STANDARDS:

**3.MD.C.7** Relate area to the operations of multiplication and addition.

**3.MD.C.6** Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).

**3.MD.C.5** Recognize area as an attribute of plane figures and understand concepts of area measurement.

**3.MD.D.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

### materials:

- 18x12 large construction paper (two per student, white or very light color)
- Sheet of cardboard (one per student, same size or slightly larger than construction paper)
- Meter Stick (at least one for every other student in your class).
- Sharpies
- Building materials for 3-D models (possible materials- construction paper, card stock, index cards, tissue paper, markers, colored pencils, "clay", various arts and crafts supplies

\*During the 3-D building of their models the kids will come up with various ways in which to create and show the different items in their yards. The more variety of materials you provide the more creative your student's models will be.

## LESSON ENGAGEMENT:

Search images of lavish backyards (Michael Jackson's Never land Ranch is a great one). Show the students pictures of these different backyards. Have students close their eyes.

Teacher- *"We're going to do a visualization exercise. I want you to close your eyes and imagine that you can have the backyard of your dreams. It can be any size you want and have anything you want inside it. I want you to picture the different types of things you'd have in your backyard. What would you and your family/friends be able to do? What would it look like? How big would it be?"*

After students have had a chance to brainstorm in their heads what their "Dream Backyard" would look like, hand out a large white piece of construction paper to each student and have them draw a sketch of what they would want their dream backyard to look like. After students have had a chance to draw, have them flip over the paper and do short writing passage describing their backyards. This activity is designed to simply get the students brainstorming ideas for main part of the lesson. The amount of time and detail you want students to put into this portion of the lesson is up to you!

## LESSON PART ONE: BUILDING THE BOARDS

In some ways this can be the most difficult part of the lesson, especially if its not properly modeled and scaffold for students. Depending on the age and ability of your students you may want to complete this portion of the lesson on your own and give students their boards with the grid system complete. With that being said if you choose to make the boards for yourself you'll need to get those done before starting the lesson.

Another way to scaffold this portion of the lesson is by making the inch marks along all four sides of the construction paper and then having students use a ruler to connect the marks. This is a way to help scaffold this portion of the lesson for students without having to make the entire board for each of the students yourself.

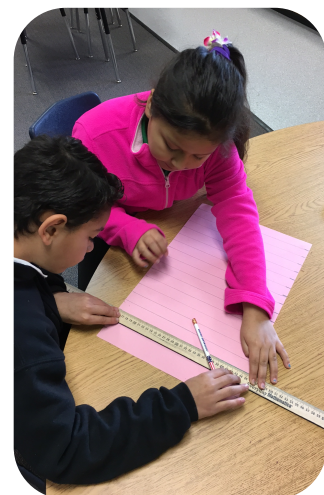
If you choose to have students conduct this part of the lesson encourage them to go SLOW and take their time when making their marks. The marks must be made exactly on the inch line. Even being off an  $\frac{1}{8}$  of an inch on each mark will eventually lead to the board being incorrect. It is very important that you carefully model how to do this part of the lesson for your students. Before you have them do it on their own.

\*Have students work in pairs while making their boards.

**Step 1**– Have students start at one corner of their paper and measure one inch. Students will then make a mark every inch along all four sides of their paper.

**Step 2**– Have one student draw the lines and the other student hold the ruler. It's really important that the student holding the meter stick has it lined up exactly on the inch mark. Students will then connect the inch marks on each side of the paper creating a one-inch grid across their entire piece of construction paper.

**Step 3**– Repeat the process so that each student has their own piece of construction paper with a one-inch grid across the surface.



## LESSON PART TWO: INTRODUCE ITEMS & REQUIREMENTS

Item	Area (sq. units)
Pool	20 sq. units
Hot tub	8 sq. units
Bounce House	16 sq. units
Table Set (table, chairs)	9 sq. units
Basketball Court	15 sq. units
Soccer/ Football Field	60 sq. units
Basketball Court	40 sq. units
Garden	10 sq. units
Tree	6 sq. units
Stable/Field (horses)	60 sq. units
Trampoline	12 sq. units
Roller Coaster	50 sq. units
Dog House	10 sq. units
Swing Set	10 sq. units
Jungle Gym	14 sq. units
Slide	12 sq. units

-Put the items sheet up on the overhead so that students can see the different things they can choose from to go in their backyards. Briefly discuss the area of each item. Each of the items they plot will need to be represented as a rectangle.

- One requirement for their backyards is that every item must have at least one square unit in between them. Meaning the perimeter of any of their items cannot be touching another item. When explaining it to students I related it to the fact that if they were to build this backyard in real life they would need room for grass and a place to walk in between each item. Students may have as items in in their backyards as they want as long as there is one square unit between every item.

## LESSON PART THREE: COMPLETING THE ITEMS SHEET

Students will need to fill out each section of their Items Sheet before they start to plot the items onto their construction paper.

The Items Sheet will include...

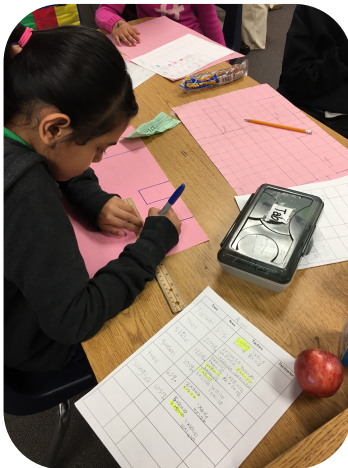
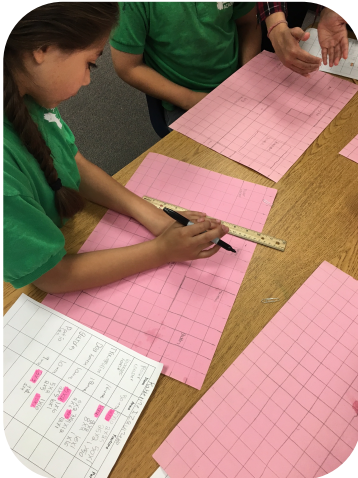
- Name of the item
- Area of the item
- All the factors that could make up the area of the item (i.e.-  
Area= 12 sq. units-  
1x12, 12x1, 3x4, 4x3, 2x6, 6x2)
- Perimeter

Item	Area	Factors	Perimeter
Example: Basketball Court	15 sq. ft.	1 x 15, 3 x 5	34

\*You can have the students figure out the perimeter before plotting the items on their construction paper, based on the size/type of rectangle they choose for each item or you can allow them to plot the rectangles on their construction paper and then find the perimeter.

After students have finished filling out their items sheet with all of the parts listed above, have them highlight the factor they are going to use when constructing their rectangle on the construction paper. For example if the area of an item is 12 square units and they want the item to run horizontally across their page then they would highlight the factor 2x6, which would indicate two rows with six in each row. The factor they choose will depend on where and how they're going to place all the items on their backyards. For younger students, I allow them to complete the perimeter portion after they have drawn the items in their backyard so it is easier to count. If you would like to challenge them, older students should be able to use the factors they have chosen for their rectangle/item to determine the perimeter.

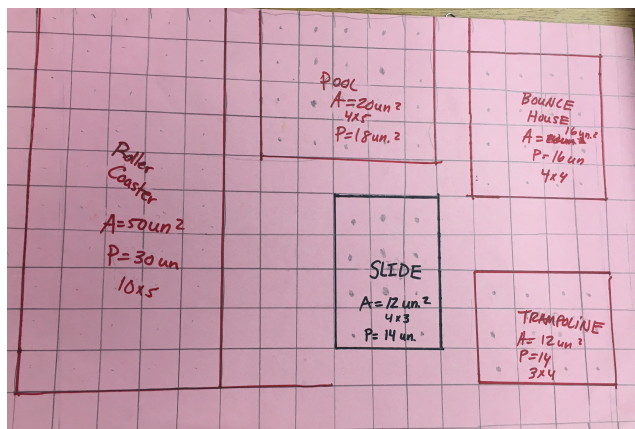
## LESSON PART FOUR: PLOTTING



Now that students have filled out their items sheet it is time for them to plot the different items in their backyards. Have students trace the outline, in pencil, of each item and plot them on their backyards. Model a few items in a teacher example on the board. Encourage students to write lightly so it's easier to erase if they make a mistake. Students need to label every item/rectangle with the name of item, the area, perimeter and the factor (multiplication problem) that goes along with it.

They need to have the teacher check their work before outlining with pen or marker. Once students have finished plotting and labeling all of their items, have them turn it into you to check them off and then have them use a ruler to outline and trace all of the rectangles and labels with a black marker or sharpie.

When checking students work be sure that their items sheet (with the highlighted factor) match the shape of the rectangle and its labels before they trace everything in marker.



## LESSON PART FIVE: BUILDING 3-D MODELS

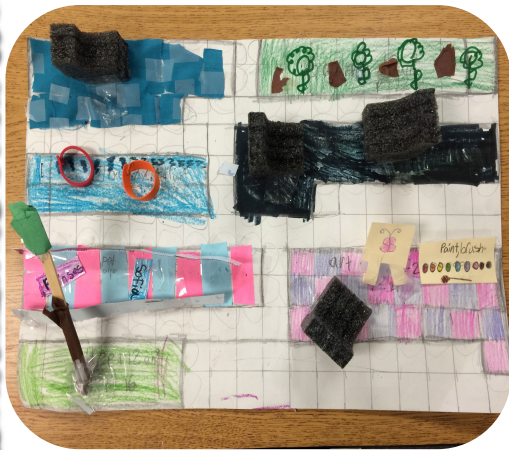
Now that the “hard” part is finished, students will have a blast building the 3-D models of their backyards. Glue the construction paper onto the cardboard to give them a more solid foundation to build on.

Before my students start to build I have them work through the Engineering Design Process for each item they are going to build. Their **challenge or problem** is to build a model of a particular item. Then they will **brainstorm** possible ways to build it, which materials they could use, what they want it to look like etc. Then they come up with a **plan** for how to build it. They will draw a quick sketch of the item and label the materials they will use to build it. Next they will actually start to **engineer** the 3-D model of that item in their backyard. Finally they

can make improvements to their models as needed. Depending on your experience teaching engineering in the class and your students' experience in working through the Engineering Design Process this part of the lesson may be a lot less "structured." If this is the case provide students with various materials and allow them to simply build! If you would like to provide guidance for students through this process, we have included a step-by-step handout for students to help them follow the engineering design process for this project. Go over this sheet with your students. I have my students keep their notes and sketches in their science notebooks.

### note to the teacher:

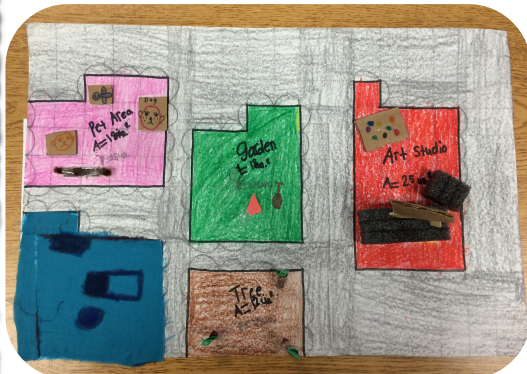
## 3-D MODEL EXEMPLARS



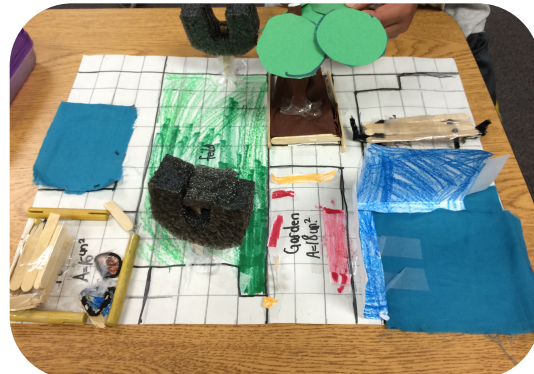
All students love to build and use their creativity and imagination to create something. I found that when I introduced the engineering component into this lesson my students better retained the mathematical concepts that went along with it because they were more engaged and excited about the activity as a whole. Students need creative outlets to apply their core content skills towards and this lesson is a great way for students to take the mathematical concepts of area, perimeter, measurement and multiplication and apply them in a fun engaging manner.



As students begin to make their backyards three-dimensional storing the models can become an issue because you'll no longer be able to stack the boards without damaging them. Before students start to build it's important to find them a place to store their models, especially if you are going to have them work on them over multiple days.

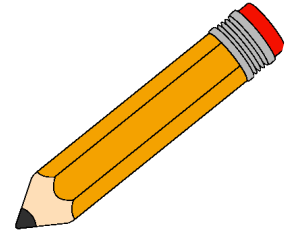


This activity is great to conduct during your math or S.T.E.M. block but can turn into a "Fun Friday" or P.L.T. (personal learning time) activity. My students love to build their models and make them more and more detailed. This activity can be done during that "free time" of your week and students can work on their models for as long as you have time for.



## LESSON PART SIX: WRITING/BLOGGING COMPONENT

Introduce the writing activity to the students. Completing the invitation on the worksheet might be a good stopping point for your students and your class. I choose to extend this part and use the invitation as a template to have students map out the information that they would like to use on an invitation, and then have them create their own. Depending on the resources available to



**Let's Party!**

When: \_\_\_\_\_  
Where: \_\_\_\_\_  
Why: \_\_\_\_\_

What we'll do:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

you, you could have your students develop the invitations with art and craft supplies, or even use websites like [evite.com](http://evite.com) or [punchbowl.com](http://punchbowl.com). If your students are proficient in using word or publisher, they can even create their own invitations.

Finally, if your students have a blog, you can have students take photos of their backyard designs, upload them onto the blog, along with their invitations, and provide explanations on their favorite features in their backyard.

## BACKYARD ITEMS & DIMENSIONS

Item	Area (sq. units)
Pool	20 sq. units
Jacuzzi	8 sq. units
Bounce House	16 sq. units
Patio Set (table, chairs)	9 sq. units
Basketball Court	15 sq. units
Soccer/ Football Field	60 sq. units
Basketball Court	40 sq. units
Garden	10 sq. units
Tree	6 sq. units
Stable/Field (horses)	60 sq. units
Trampoline	12 sq. units
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# BUILDING A 3D MODEL: FOLLOWING THE ENGINEERING DESIGN PROCESS FOR STUDENTS

## CHALLENGE:

- Use your 2-d Dream Backyard to create a 3-D model of your Dream Backyard using the materials provided by your teacher.



## STEP ONE: BRAINSTORM

- Select an item from your backyard
- List the materials in the classroom you think you might be able to build it with
- Quick sketch 2-3 ways you might want the item to look like, and how you might build it. Write these notes in your notebook.

## STEP TWO: PLAN

- Choose ONE sketch from your brainstorm to build
- Add more detail to the sketch by labeling the parts with the materials you will use to build them.

## STEP THREE: BUILD

- Build a 3-d model of your item using your plan and the materials listed on your plan.

## STEP FOUR: IMPROVE

- If you need to make changes to your plan, return to your sketch and make changes on your plan so that they are the same as the item you have created.

REPEAT THIS PROCESS FOR EACH ITEM IN YOUR DREAM BACKYARD

# Writing Activity: Throw a Party in Your Dream Backyard

Name: \_\_\_\_\_

**Directions:** Once your backyard is complete, it's time to invite your friends and family over for a party so they can see all the hard work you've done! You will need to create a guest list and a party invitation listing and describing the activities that you're planning for the party using the items in your backyard. Write your guest list on the back of this sheet.

Let's Party!

When: \_\_\_\_\_

Where: \_\_\_\_\_

Why: \_\_\_\_\_

What we'll do:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Extension:** Use the information on this invitation as a template to design and create your own invitation using art materials, online card templates, word or publisher.