

ARTFUL CONNECTIONS WITH MATH GRADE 5

Powers of Ten Scale Drawing 2 - 3 sessions - 90 minutes each

Guiding Question: How can I scale up an image by powers of ten?

Lesson Goal: Create a drawing of an object to scale and, using a grid, scale the drawing up two times by a power of 10.

Learning Objectives:

- Understand powers of 10 and the relationship to place value.
- Learn how to scale up or down an image.
- Learn how to translate an object into a realistic drawing of the same scale.
- Practice drawing realistically from observation.
- Practice collaborating to create a large-scale artwork (optional).

Common Core Standards in Mathematics

Understand the place value system.

[CCSS.MATH.CONTENT.5.NBT.A.1](#)

Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and $\frac{1}{10}$ of what it represents in the place to its left.

[CCSS.MATH.CONTENT.5.NBT.A.2](#)

Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

Visual Art Content Standards

Communication and Expression Through Original Works of Art

2.4 Create an expressive abstract composition based on real objects.

Make Informed Judgments

4.3 Develop and use specific criteria as individuals and in groups to assess works of art.

4.4 Assess their own works of art, using specific criteria, and describe what changes they would make for improvement.

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Standards for Visual Arts

Anchor Standard 2: Organize and develop artistic ideas and work.

VA:Cr2.1.5a - Experiment and develop skills in multiple art-making techniques and approaches through practice.

VA:Cr2.3.5a - Identify, describe, and visually document places and/or objects of personal significance.

Materials and Tools:

Drawing paper, tiny (cut to size: 2" x 1.5", grid with .5 inch squares) Or bring photocopies of this size square with this size grid.

Transparent plastic sheets (cut to approximately: 5" x 5", grid with .5 inch squares using fine point Sharpie - one per student needed)

Watercolor paper (cut to size: 20" x 15")

No. 2 pencils sharpened

Pencil sharpeners (optional)

Watercolor paint

Watercolor brushes

Cups for water

Rulers

Masking tape

Scissors

A selection of small, relatively flat objects with small details. Wrappers, small hand tools, small toys, office supplies, stamps, etc.

Small cardboard squares (objects will be taped down to this)

Optional for session 3:

Photocopies of one student's watercolor painting

Drawing paper

Ebony pencils or vine charcoal

Session 1 - Create Drawing 1:1 Scale

Access Prior Knowledge:

- What do you know about scale?
- What are some things in our world that are made much bigger than life? Why?
- How can we translate something 3D into something 2D?

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Math Lesson - Powers of Ten:

1. Revisit place value with the class. Write a multi-digit number on the board, up to 10 Million, and ask students to name each place value.
2. Write a new multi-digit number on the board, this time using the same digit in each place. Ask what the value of the digit is in each place. (For instance, in the number 777,777.777, point to the seven in the thousands place. What is its value? 7,000 or $7 \times 1,000$).
3. If we have a value such as $7 \times 1,000$ - what is another way to write this? 7×10^3
4. Let's look at the 7 in the one's place. We know its value is 7. What would I need to do to make this have the same value as the 7 in the tens place (70)?
5. Walk students through the idea that each place value is ten times the one before.
6. Define the concept: "exponentially bigger" as a language reference.

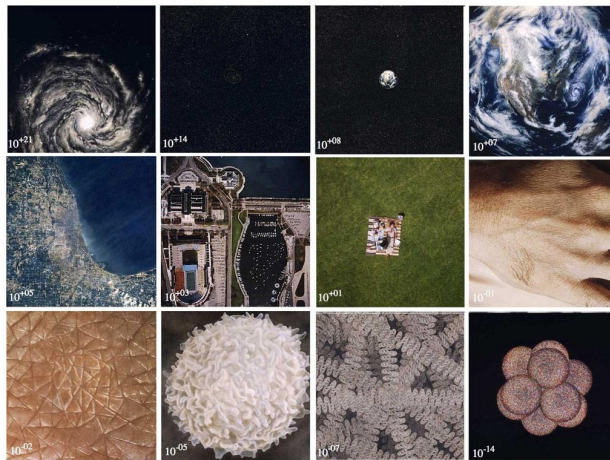
Art Observation - Charles and Ray Eames, Film &

Link: <https://www.youtube.com/watch?v=0fKBhvDjuy0>

Watch this short film and ask your students the following questions:

- What did you notice about this film?
- What happened in the film?
- When do you think this film was made? (now, in the recent past, or long, long ago?)
- Where did the images in the film come from?
- Think for a moment about whether there was anything that surprised you as we moved through scaling up and down from our, human scale. What surprised you?
- What did you notice about powers of ten?
- Which direction is more interesting to you: scaling up or scaling down? Why?
- If you could make a movie in one of these scales, which one would you choose? What would the movie be about?

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Eames Studio, Powers of 10, Film still, 1977

Observe the following image and ask your students these questions:

- What is happening in this picture?
- What tools is this man using? How is he using them?
- How do you think these tools work? (explain that this is a way of using a grid to observe something 3D and make it into a 2D drawing before photography).
- What materials did the artist use to make this drawing of a man drawing?
- Why do you think an artist would want to show a method of drawing?



Albrecht Durer, Illustration of using a grid to draw

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Art Activity - Drawing to Scale

Steps:

1. Note: If possible, before the first session of this project, have students bring a small object from home. It should be relatively flat and have some small details to observe. A stamp or a small hand tool or a wrapper or a small toy would be ideal. Ask students to bring something small that has some significance to them.
2. If students do not have objects of their own, let them choose from a selection you have brought to class.
3. Demonstrate how to set up the transparent grid over the object and tape it in place on the cardboard. Demonstrate how to “tape off” the extra parts of the grid and object so that only the window for drawing is visible.
4. Discuss composition. The way students place the object within the window will create the composition. Consider the shapes the object makes and point out the negative and positive space of the object in the frame. It can be interesting to place an object so that it goes out of the frame. At the same time, make sure the frame is not mostly empty.



5. Students set up their objects.
6. Demonstrate how to translate what is visible in each square onto the gridded paper of the same size. Explain that one can see where certain parts of the object overlap the grid and use these points for reference while drawing. Use smooth shading, and demonstrate how to create a variety of light and dark pencil

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marks. This is also an opportunity to introduce different shading techniques: hatching, cross-hatching, stippling.

7. Students draw their object with detail in pencil on the small, gridded paper.
8. If students finish early, they can set up and draw a second object. This way they can choose whichever they prefer as they begin to scale up the image in the next class.

Closure:

- What have you learned about scale?
- Which parts of your drawing will be interesting to see on a larger scale?
- How was it for you to make a drawing the actual size of the object?

Session 2 - Create 1:10 Scale Painting

Access Prior Knowledge:

- What do you remember about powers of 10 from our last class?
- What can you tell me about the video we watched?
- How are we going to scale up your actual size drawings?

Art and Math Activity - Watercolor Painting

Steps:

1. Introduction: show sample project and explain how the watercolor drawing was made from the actual size drawing. Point out in the sample how shapes within each square of the original drawing were translated into the larger squares.
2. The first step will be to grid the watercolor paper. (Some teachers may prefer to prepare the grid for the students ahead of time).
3. Ask students: "What is the measurement of each square on your original drawing? What will be the measurement of each square on the larger drawing?"
4. Demonstrate how to measure and mark out 5 inch intervals on each edge of the watercolor paper, and how to connect the lines with the straight edge of the ruler. Continue to reinforce that each square is 10 times the small squares on their original drawing.
5. Students receive watercolor paper, pencils, and rulers and create their grid.
6. Ask students, "What if I were beginning with a drawing on the large gridded paper, and I wanted to make it the size of the small drawing... What would I need

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to do to the measurement?" Walk students through the idea that the opposite of a multiple of ten is $1/10$.

7. Demonstrate how to observe shapes and proportions of form within each square of the original drawing and how to render them with a pencil in the larger grid. This will be a line drawing only. Shading is not required.
8. Students create their larger pencil drawing.
9. Demonstrate using watercolor paint to create washes and lines and mix colors they see in their object. Students may practice mixing colors in their notebook that they see in their object.
10. Students add color to their drawings using observation.

Math Lesson - Reducing by powers of 10

1. Review the relationship between the large grid and the small grid. If we are scaling up we are multiplying by 10, and if we are scaling down we are dividing by 10. This looks like $1/10$.
2. Extend this idea again to the concept of place value. Write a multi-digit number on the board with the same digit in each place value. "If I move to the right, (down in value), how does the value of the digit change?"
3. "If I wanted to scale down the actual-size drawing, how would I find the measurement that each square would need to be?"

Sharing:

- Pair share: Discuss with your partner what you feel is successful about your artwork and what you would change.
- Choose two artworks to look at with the class and compare. "What are similarities in these two pieces? What did each artist do differently?"

Note: To create a large collaborative drawing in a third session, choose a student's work at the end of Session 2 that the whole class will scale up. Choose a drawing (or two) with a lot of detail, or facilitate a class vote on which drawing(s) to use. Photocopy the drawing(s) in preparation for the last session. The grid may need to be made finer in order to have reasonable size squares for the students to draw.

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Session 3 (Optional) - Create Large Collaborative Drawing

Access Prior Knowledge:

- Write a multi-digit number on the board. Ask students to explain the relationship between adjacent place values.
- What would we have to do to create a drawing ten times the size of our watercolor paintings?

Art Observation - Chuck Close? (To reinforce the idea of scaling up by preparing individual squares for a grid)

Art and Math Activity - Collaborative Drawing

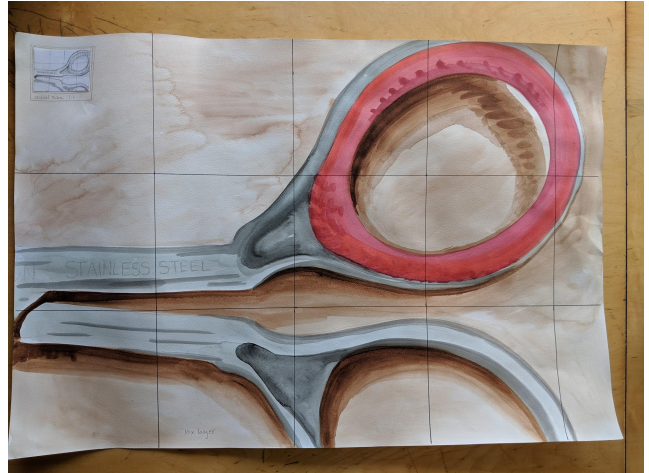
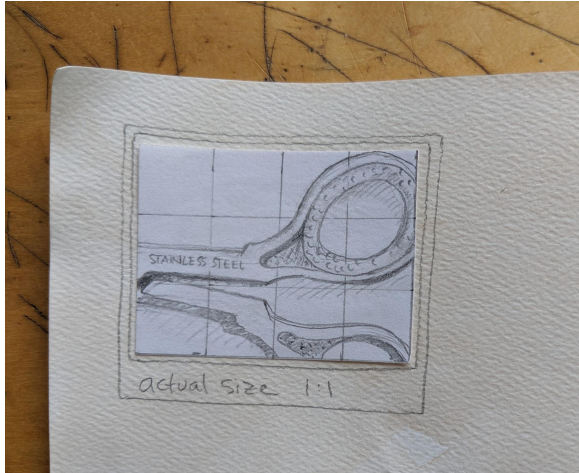
Steps:

1. Review good collaborative habits in preparation for this collaborative project.
2. As in the previous session, ask students to figure out the measurements needed to scale up the drawing by a multiple of ten. “What would be the measurement of each square?”
3. “What is a good size for us to work with?” Brainstorm with students how to approach scaling up the drawing. Help them to see that if we want to work with smaller pieces of paper, the grid will need to be made finer. (If dividing the original grid, use a different color or different kind of line so that the further divisions are easily distinguished).
4. Support whichever strategy students decide upon. Smaller size paper can be taped together and cut to the right size if they decide to use larger squares.
5. Give out photocopies of the image to be scaled up that was chosen in the last session. Students may need to add further grid lines to the photocopy in order to define the square that they will be working with.
6. Remind students to be aware of where the edges of different shapes intersect with grid lines and/or the edges of their square.
7. Using ebony pencil and/or charcoal, students create individual squares of the original painting.
8. When squares are complete, tape them together on a large, blank wall, or lay them together on the ground. The drawings together should be approximately 16.5 feet wide and 12.5 feet tall.

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Reflection:

- What is your impression of this artwork?
- What does making this artwork show you about multiples of ten?
- Is this result as you imagined it? Why or why not?
- What are the advantages of collaboration?



Sample Project

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