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| **Lesson Title :** Similar Polygons | **Unit #:** | **Lesson #:** | **Activity #:**1 |
| **Activity Title:** Bike Trail to Scale Design |

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| **Estimated Lesson Duration:** | 1 class period (50 minutes) |
| **Estimated Activity Duration:** | 3 class periods (50 minutes each)  |

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| **Setting:** | Classroom (preferably one with large tables for group work) |

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| **Activity Objectives:**1. Students should be able to identify the scale ratio when given a scaled drawing.
2. Students should be able to identify the scale ratio between two similar shapes.
3. Students should be able to use ratios and proportions to determine the dimensions of similar shapes.
4. Students should be able to use a scale to create drawings/plans/blueprints when given actual dimensions of large items.
5. Students should become familiar with how scale factors, proportions, and ratios apply to real life designs.
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| **Activity Guiding Questions:** 1. What is a scale as used in drawings and maps?
2. How do you determine the scale ratio between two similar shapes?
3. How do you use the scale ratios and proportions to find dimensions of similar shapes?
4. How can you use a given scale to create a blueprint or scaled drawing?
5. Where can you find scales being used?
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| **Next Generation Science Standards (NGSS)**  |
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| **Science and Engineering Practices (Check all that apply)**  | **Crosscutting Concepts (Check all that apply)** |
| ☐ Asking questions (for science) and defining problems (for engineering) | ☐ Patterns |
| ☐ Developing and using models | ☐ Cause and effect |
| ☐ Planning and carrying out investigations | ☐ Scale, proportion, and quantity |
| ☐ Analyzing and interpreting data | ☐ Systems and system models |
| ☐ Using mathematics and computational thinking | ☐ Energy and matter: Flows, cycles, and conservation |
| ☐ Constructing explanations (for science) and designing solutions (for engineering) | ☐ Structure and function.  |
| ☐ Engaging in argument from evidence | ☐ Stability and change.  |
| ☐ Obtaining, evaluating, and communicating information  |  |

| **Ohio’s New Learning Standards for Science (ONLS)** |
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| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| ☐ Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| ☐ Demonstrating Science Knowledge **(D)** |
| ☐ Interpreting and Communicating Science Concepts **(C)** |
| ☐ Recalling Accurate Science **(R)** |

| **Common Core State Standards -- Mathematics (CCSS)** |
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| **Standards for Mathematical Practice (Check all that apply)** |
| ☐ Make sense of problems and persevere in solving them | ☐ Useappropriate tools strategically |
| ☐ Reason abstractly and quantitatively | ☐ Attendto precision |
| ☐ Construct viable arguments and critique the reasoning of others | ☐ Look for and make use of structure |
| ☐ Model with mathematics | ☐ Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, ONLS and/or CCSS):**[CCSS.Math.Content.HSG-MG.A.3](http://www.corestandards.org/Math/Content/HSG/MG/A/3)[CCSS.Math.Content.HSG-SRT.A.1b](http://www.corestandards.org/Math/Content/HSG/SRT/A/1/b) |

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies)1\_BikeTrailtoScale\_ActivityTemplate\_KQuinter\_0131141a\_Bike Trail to Scale\_PreAssessment\_KQuinter\_0131141b\_BikeTrailtoScale\_ReviewPowerpoint\_KQuinter\_0131141c\_BikeTrailtoScale\_Handout1\_KQuinter\_0131141d\_BikeTrailtoScale\_Handout2\_KQuinter\_0131141e\_BikeTrailtoScale\_Handout3\_KQuinter\_0212141f\_BikeTrailtoScale\_ActivitySolutionsMap\_KQuinter\_0131141g\_BikeTrailtoScale\_PostAssessment1\_KQuinter\_0131141h\_BikeTrailtoScale\_PeerEvaluation\_KQuinter\_0131141i\_BikeTrailtoScale\_PostAssessment2\_KQuinter\_013114[http://cagisonline.hamilton-co.org/cagisonline/index.html#](http://cagisonline.hamilton-co.org/cagisonline/index.html)Materials Needed:1 Large poster of Handout2 PER groupTracing paperProtractorsRulersPencils/Paper/Calculator for calculationsProjector for PowerPointDrafting Compasses (if possible) |

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| **Teacher Advance Preparation:**Teachers will need to be sure the students have had an introduction to scales, ratios, and proportions of similar shapes. Teachers will also need to be sure the students know how to use protractors. Rulers, protractors, tracing paper, and larger versions of 1c\_BikeTrailtoScale\_Handout2 must be obtained prior to the activity. |

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| **Activity Procedures:**Day 1: 1. Give the students the pre-activity assessment at the beginning of class. (10-15 minutes)
2. Ask if any of the students can explain: (10 minutes)
	1. What it means to draw something to scale
	2. Why scaling is important to know
3. Show the PowerPoint presentation with the scaling examples (10 minutes)
	1. Explain a little bit about a scale factor and what the scale on the maps means/how to use it
	2. Discuss how scaling is used in engineering
4. Give the students Handout1 & discuss the project
5. Split them into groups of about 4 and allow them to begin planning their designs
6. If there is time, the students may be given the larger Handout2 to begin working on their designs

Day 2:1. Have the students work on their project design (1 full class period)

Day 3:1. Have the students present and defend their designs (15 minutes – 5 min. per group)
2. Have the students complete PostAssessment1 to see how they do compared to the PreAssessment (10 minutes)
3. Have the students complete PostAssessment2 (15 minutes)
4. Discussion
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**Formative Assessments:**

1g\_BikeTrailtoScale\_PostAssessment2\_KQuinter\_013114

**Summative Assessments:**

1a\_Bike Trail to Scale\_PreAssessment\_KQuinter\_013114

1f\_BikeTrailtoScale\_PostAssessment1\_KQuinter\_013114

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| **Differentiation:** There was not much of a need to modify parts of this activity to support the needs of different learners. However, I did have to explain some things visually (drawing/showing pictures) to the students while others understood the project scope completely just by reading the handout. |

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| **Reflection:** I was very pleased with how much the students enjoyed this activity. They were all excited to draw their own designs even though they all thought the toughest part was determining the scale factor with numbers that were not so easy to use. I loved that they struggled with this because in the real world, engineers do not get to work with “pretty” and “clean” numbers most of the time. In the end, they all figured out the scale factors themselves and it was great to see that happen. Assessments: The pre/post assessment was not difficult enough to gain any really useful data from. If I were to do this activity again I would make the pre/post assessment more challenging.Many students had difficulty with the idea that angles do not change when shapes are scaled. I would adjust the activity to account for more of this concept within it.Many students asked for a budget to go along with the activity. If I had been allotted more time in the classroom for this activity I would have given them a budget to work with and cost estimations for every sq. ft. of trees they would need to cut down or for certain amounts of land that would need to be cut/filled on sloped areas, etc.Overall I was very happy with how well the project went and enjoyed seeing how engaged the students were in their designs while discussing the best options for each part of their designs. |