STATE COMMON CORE STANDARDS

Transition Tasks

for Mathematics
Grade 8

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Table of Contents

Introduction . . . . *v*

The Number System Task

8.NS.1: Mowing Lawns 1

Expressions and Equations Tasks

8.EE.3: How Many Times in a Millennium? 7

8.EE.5.1: How Much Money Will I Save? 15

8.EE.5.2: Rolling Tennis Balls 27

8.EE.7(a): Cell Phone Plans 35

Geometry Tasks

8.G.2: Gamers for Life 44

8.G.7: Get the Robot on the Stage 52

8.G.9: Out of This World 59

Statistics and Probability Task

8.SP.1: Effects of Urbanization and Logging on Watersheds 66

Introduction

Use these engaging problem-solving tasks to help transition your mathematics program to the knowledge and skills required by the Common Core State Standards for Mathematics.

This collection of tasks addresses some of the new, rigorous content found in the Common Core State Standards (CCSS) for eighth grade. The tasks support students in developing and using the Mathematical Practices that are a fundamental part of the CCSS. You can implement these tasks periodically throughout the school year to infuse any math program with the content and skills of the CCSS.

These tasks generally take 30 to 45 minutes and can be used to replace class work or guided practice during selected class periods. Depending on the background knowledge and structure of your class, however, the tasks could take less or more time. To aid with your planning, tasks are divided into two parts. This flexible structure allows you to differentiate according to your students' needs—some classes or advanced students may need only one class period for both parts, while others may need to defer Part 2 for another day or altogether. Use your own judgment regarding the amount of time your students will need to complete Parts 1 and 2. Another strategy for compressing the time necessary to complete a task is to divide the problems or calculation associated with a task among students or small groups of students. Then students can "pool" their information and proceed with solving the task.

Each Transition Task is set in a meaningful real-world context to engage student interest and reinforce the relevance of mathematics. Each is tightly aligned to a specific standard from the Grade 8 CCSS. The tasks provide Teacher Notes with Implementation Suggestions that include ideas for Introducing, Monitoring/Facilitating, and Debriefing the tasks in order to engage students in meaningful discourse. Debriefing the tasks helps students develop and enhance their understanding of important mathematics, as well as their reasoning and communication skills. The Teacher Notes also offer specific strategies for Differentiation, Technology Connections, and Recommended Resources to access online.

Student pages present the problem-solving tasks in familiar and intriguing contexts, and require collaboration, problem solving, reasoning, and communication. You may choose to assign the tasks with little scaffolding (by removing the sequence of steps/questions after the task), or with the series of "coaching" questions that currently follow each task to lead students through the important steps of the problem.

We developed these Transition Tasks at the request of math educators and with advice and feedback from math supervisors and middle-school math teachers. Please let us know how they work in your classroom. We'd love suggestions for improving the tasks, or topics and contexts for creating additional tasks. Visit us at www.walch.com, follow us on Twitter (@WalchEd), or e-mail suggestions to customerservice@walch.com.

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Effects of Urbanization and Logging on Watersheds

Common Core State Standard

Investigate patterns of association in bivariate data.

8.SP.1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

Task Overview

Background

Students often struggle when working with bivariate data despite their ability to plot accurately in four quadrants. This task helps students internalize the process of creating and interpreting scatter plots for patterns and associations while drawing their attention to the effects of development on the environment and watersheds.

The task also provides practice with:

- converting bivariate data into coordinates
- reasoning and justifying conclusions

Implementation Suggestions

For Part 1, students can work individually or in pairs. For Parts 2 and 3, split the class into two groups so that half the students work on Part 2 and half the students work on Part 3. Bring the whole class back together to debrief Parts 2 and 3 together.

Alternatively, for Parts 1 and 2, students may work individually, in pairs, or in small groups to complete one or both parts of the task. Part 3 is optional if time allows or could be used for students who finish early.

Introduction

Introduce the task by asking students about patterns, trends, and associations. Ask students to give some examples of bivariate (two-variable) data that they know exhibits patterns, trends, or associations. Students might suggest that there is an association between height and weight, education and earning potential, age and sleep, or any other various bivariate data groups. If students are having trouble coming up with examples, you might want to suggest the aforementioned

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associations. Ask students about their understanding of positive and negative associations and how these associations would appear on a graph. Ask students to talk about the difference in appearance between linear and nonlinear graphs. Elicit prior knowledge of water pollution and the effects of development on watersheds.

One way to measure the disturbance to the environment from urbanization and logging is to analyze the quantity and quality of macroinvertebrates in the streams near developed and undeveloped land areas.

Macroinvertebrates are animals that do not have a backbone and can be seen without the aid of a microscope. The health of such organisms is measured by their ability to thrive in their natural environment. This measurement score is called the Benthic Index of Biotic Integrity (B-IBI). For the purpose of simplifying the task to a level the students will understand, this score name has been changed to "species health score."

The "development score" used in this task refers to the level of development by humans of a given environment or area. A lower score indicates a low level of development; high scores indicate highly developed areas. The different land areas listed in Part 1 are rural, suburban, and urban areas around Puget Sound in Washington state.

Logging also disturbs watersheds. After a storm, water flows heavily into watersheds. The flow of water is affected by human factors such as development. Without trees and other plant life to soak up rainwater from storms, the water runs directly into the streams, carrying pollutants and debris. Officials for the H.J. Andrews Experimental Forest in Blue River, Oregon, studied the impact of water discharge from storm events on logged and un-logged areas to determine the effect of clear-cutting and road construction on watersheds. Those data are used in Part 2. The water flow into the streams is measured in cubic meters per second over the land mass area.

Monitoring/Facilitating the Task

Ask questions and prompt student thinking so that they:

- Recognize which data set goes on the *x*-axis and which data set goes on the *y*-axis. The best choice is for "Development score" to go on the *x*-axis and the total "Species health score" to go on the *y*-axis because, in this case, "Development score" is the explanatory (independent) variable and "Species health score" is the response (dependent) variable. It is possible that the axes could be reversed.
- Plot points accurately and choose appropriate scales. An appropriate scale for the *x*-axis is from 0 to 70 in increments of 10. The *y*-axis scale could go from 0 to 50 in increments of 5. Scales may vary slightly. Encourage students to use the entire grid provided.
- Explain their reasoning in determining patterns, associations, clustering, and outliers.

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- Identify the difference between a linear and nonlinear pattern.
- First look at the data mathematically and then supply the contextual meaning.
- Support their conclusions with arguments based on the data.

Debriefing the Task

Part 1

- Students will be creating and interpreting scatter plots.
- For question 1, students could have chosen either data set to place on the *x*-axis. Ask for student examples that set up the graph in each way. Ask students to explain their choice of which data set to place on the *x*-axis. If more than one student or group of students chose one variable over the other to place on the *x*-axis, encourage discussion about the reasons for choosing the *x*-axis variable. The better choice is to have “Development score” on the *x*-axis because this is what is being explained, while “Species health score” is the response to development in the area (“Development score”).
- For question 2, prompt students to report out differences in describing the patterns they saw. Some students might see the data differently and can help others to look at the data differently than they originally recorded.
- In question 3, some students might see clustering while others may not. Either answer is correct, but the defense is more important than the answer. Students might suggest that there is clustering because they see the data being grouped together toward the upper left-hand corner. Other students might see that the data is spread out over the coordinate plane.
- Question 4 has a clear answer of linear. Encourage those who answered “linear” to explain their thinking.
- For question 5, encourage student discussion about the presence or absence of outliers. Some students might think that the data point (60, 9) is an outlier. While this point is slightly separated from the rest of the data, it still follows the negative association and the linear trend, so it appears as though it is not an outlier. Prompt students to think about how the pattern would change if the data point were removed; help them to see that the pattern wouldn’t change. Explain that an outlier often changes the pattern or deviates from the pattern, and this data point does neither.
- Question 6 gives students the opportunity to synthesize the meaning of the first five questions in terms of the context of the problem. This question asks students to make meaning of the patterns and associations.

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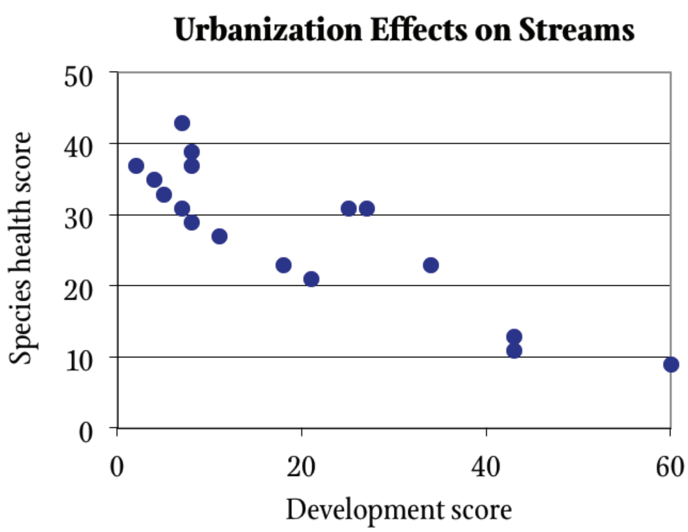
Part 2

- In this part, students will be interpreting scatter plots.
- Question 7 gives students the opportunity to contrast this pattern with the pattern from question 1 in Part 1. Encourage students to compare and contrast the two patterns. Both patterns are linear, but the pattern from Part 1 has a negative association, whereas the pattern in question 7 has a positive association.
- Question 8 shows some clustering at the bottom left of the graph. Encourage students to report out how they made meaning of this clustering. Prompt students to give various explanations. Some students might see that the difference between water flow in smaller areas is less drastic than in larger ones. Others might conclude that there are more areas that are smaller in surface area for comparison.
- In question 9, students will most likely report that the model is linear. If students think that the model is nonlinear, ask them to explain their thinking. The data do appear to curve slightly toward the upper right of the graph, but a linear model would still work. Encourage students to defend their responses.
- The data in question 10 could be interpreted as having or not having any outliers. If students suggested a linear model, then they might think that point (1.65, 1.8) is an outlier because the data appears to curve a bit with this point; if the point were removed, the data would better fit a straight line. However, even with that point the data follows a linear trend with a positive association. Encourage discussion among students with different answers.
- Question 11 gives students the opportunity to synthesize the meaning of the previous five questions in terms of the context of each problem. This question asks students to make meaning of the patterns and associations.
- For question 12, students are asked to interpret the meaning of the data analysis by drawing a conclusion and taking a position of whether or not to develop the land. This question synthesizes information from both Parts 1 and 2. Encourage students to make this synthesis and discuss their conclusions.
- Assess understanding by expanding the parameters used in the task by using different data sets. Other data sets can be found on the Quantitative Environmental Learning Project Web site, listed under Recommended Resources.

Part 3

- In this part, students will be interpreting scatter plots and synthesizing conclusions from Part 1 and also from Part 3 itself.
- Questions 13 and 14 clearly show a nonlinear trend in the data. Some students might recognize this as exponential decay.
- Question 15 gives students the opportunity to synthesize the data and make meaning of the data in terms of the context of the problem. This question also asks students to draw upon their conclusions from Part 1. Encourage discussion of the students' conclusions and supporting arguments.

Answer Key

1. 

2. The data appear to decrease as the developed area increases. The data go from the top left toward the bottom right, indicating a negative association.
3. The data appear to cluster a little bit at the start of the graph in the upper left corner and then spread out toward the bottom right, but because the clustering isn't truly clear, the graph could also be interpreted as having no clustering. Be sure that students defend their response.
4. A linear model appears to be a better fit for the data than a nonlinear model since the data roughly follows a straight line going from the top left of the graph to the bottom right (negative association or negative slope).
5. There do not appear to be any outliers since all the data points roughly follow a linear model with a negative association.

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6. As the development increases, the health of the water species decreases. This means that development is harming the watershed.
7. The data appear to go from the bottom left toward the top right with some clustering in the bottom left, suggesting a positive association.
8. The data appear to cluster near the bottom left corner of the graph. This means that, for smaller surface areas, the logging has less effect on the watershed and the water flow is roughly the same between logged and un-logged areas. However, since the data spreads out for larger surface areas of logged areas, there appears to be greater water flow into the watershed for those logged areas.
9. A linear model appears to be a better fit for the data than a nonlinear model since the data roughly follow a straight line going from the bottom left of the graph to the top right (positive association or positive slope).
10. There do not appear to be any outliers since all the data points roughly follow a pattern and none stick out from that positive linear association pattern. However, some students might report that the last data point in the upper right corner is an outlier since it appears to be set apart from the rest of the data. Be sure students justify their answers.
11. The data suggests, since the pattern is positive and linear, that both logged and un-logged areas experience greater water flow with more volume of water (rain). However, analyzing the scatter plot more carefully reveals that in most cases for the same amount of rain volume, there is more flow in logged areas than un-logged areas. This means that there is more water flowing into watersheds near logged areas than un-logged areas. This water could potentially be carrying pollutants.
12. Answers will vary. Be sure that students defend their answers and support their position using correct terminology. Sample answer: The town should not develop the land because this would increase the amount of storm water draining into the stream. Based on the conclusions from Part 1, this means that more pollutants would be introduced and the health of the water species would decline.
13. The data falls to the right.
14. A nonlinear model would better fit the data because the data does not follow the pattern of a straight line; it's curved.
15. The more rain there is, the more water flows into the watershed. This data is based on an un-logged area, so if the area were to be logged the water flow would increase and introduce more pollutants into the watershed. Based on the data from Part 1, increased pollutants and greater water runoff into the watershed decrease the health of the water. If the area were to be logged and the water discharge recorded, the graph would most likely shift up.

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Differentiation

Some students may benefit from the use of graphing calculators and/or a spreadsheet for Part 1.

If you break up the students into two groups to complete Parts 2 and 3, struggling students might find Part 3 easier to complete because the association is more clear in Part 3 than in Part 2. If all students complete Parts 1 and 2, Part 3 may be used as an extension or given to students who finish early.

If students finish early, have them develop a PowerPoint to present to the "town council" regarding the development of a land parcel. Have students use the data and their conclusions from the task to support their position to either develop or not develop the land.

Technology Connection

Students could use a graphing calculator or a spreadsheet to create their scatter plots.

Choices for Students

Following the introduction, offer students the opportunity to analyze their own data. Several data sets can be found at the Quantitative Environmental Learning Project Web site listed in the Recommended Resources.

Meaningful Context

Urbanization is disturbing the environment. This can be seen in data collected from streams, rivers, and lakes. This data is often plotted using scatter plots for the bivariate data and analyzed for clustering, outliers, positive or negative association, linear association, and nonlinear association.

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Recommended Resources

- Purplemath.com: Scatterplots and Regressions
  www.walch.com/rr/CCTTG8ScatterPlots
  This site provides a lesson on creating scatter plots and interpreting them. Examples of positive, negative, linear, nonlinear, and no associations are provided, as well as instruction for creating a line of best fit.
- Quantitative Environmental Learning Project
  www.walch.com/rr/CCTTG8EnvironmentData
  This site offers data on several environmental issues as well as data summaries and scatter plots. This resource is useful for students who wish to make alternate selections of data for studying patterns and association in scatter plots.
- U.S. Environmental Protection Agency: Biological Indicators of Watershed Health—Benthic Macroinvertebrates in Our Waters
  www.walch.com/rr/CCTTG8WatershedHealth
  This site provides pictures and links to descriptions of common macroinvertebrates found in water.

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8.SP.1 Task • Statistics and Probability
Effects of Urbanization and Logging on Watersheds

Part 1

Does building on undeveloped land affect the water supply? The table below records the amount of development around several watersheds. It also shows how healthy the species are in each watershed. You will create a scatter plot of the data. Then, you will see if the scatter plot shows any damage to the watersheds.

- "Development score" shows the amount of buildings, sidewalks, etc., in the area. Areas with more development have higher scores.
- "Species health score" represents the health of organisms found in watersheds. Healthier organisms have higher scores.

Development of Watersheds in Puget Sound

Name of watershed	Development score	Species health score
Thornton Creek #3	60	9
Kelsey Creek	43	11
Juanita Creek #3	43	13
Schneider Creek	34	23
North Creek	27	31
Swamp Creek	25	31
Coal Creek	21	21
Percival Creek #2	18	23
Percival Creek #1	11	27
Covington Creek	8	37
Little Anderson Creek	8	39
Big Beef Creek	8	29
Seabeck Creek	7	31
Rock Creek	7	43
Stavis Creek	5	33
Carey Creek	4	35
Big Anderson Creek	2	37

Data adapted from: www.walch.com/CCTTG8PugetWatersheds

continued

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8.SP.1 Task • Statistics and Probability

Effects of Urbanization and Logging on Watersheds

1. Create a scatter plot of the data. Label the axes and add a title for your graph on the lines provided.

2. Do you notice any patterns in the data? Explain.

3. Does the data look like it has any clusters? Explain.

continued

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4. Do you think the data follows a linear or nonlinear model? ____________________
   Explain your thinking.

5. Do there appear to be any outliers? If so, where are they?

6. What can you conclude from the data table and scatter plot?

continued

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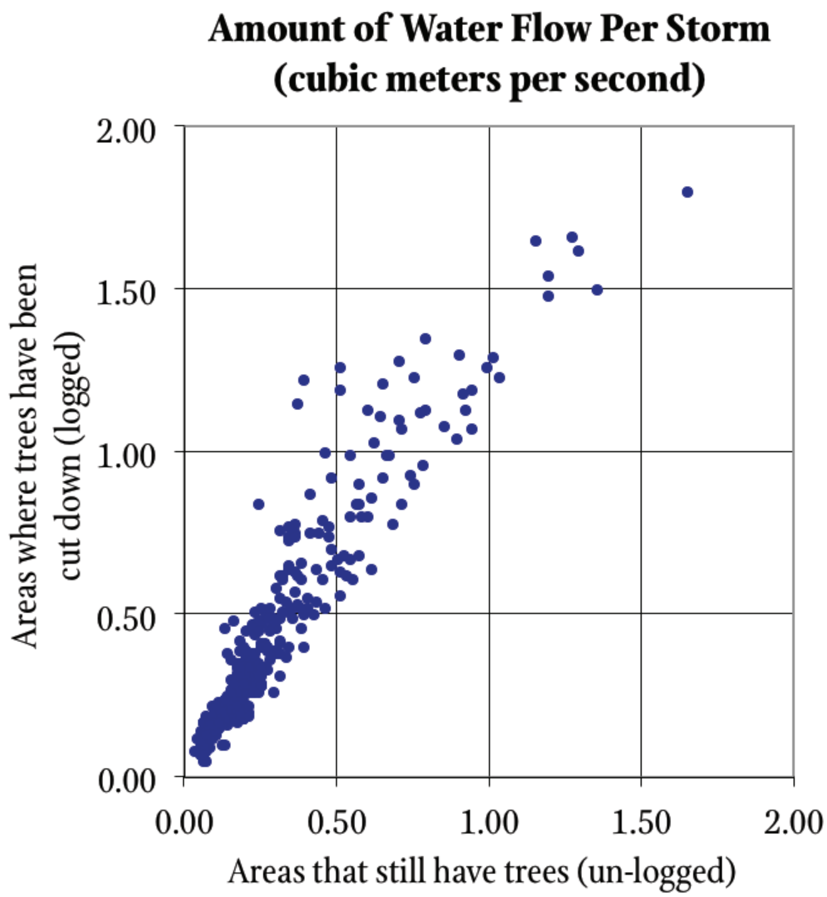
Part 2

Your town is considering a development project. Your job is to find out how the development will affect the watershed. The graph below compares how much storm water flows into watersheds in areas with trees and without trees. The *x*-axis represents water flow over land that hasn't been logged. The *y*-axis shows water flow over land that has been logged.

What can you conclude from this graph about how development affects water flow? Would you support the proposed development based on this data? Use your discoveries from Part 1 and this part to support your position.



Data adapted from: www.walch.com/CCTTG8StormFlow

7. Do you notice any patterns in the data? Explain.

continued

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8. Does the data look like it has any clusters? Explain in terms of the context of this problem.

9. Do you think the data follows a linear or nonlinear model? ____________________
Explain your thinking.

10. Do there appear to be any outliers? If so, where are they?

11. What can you conclude from the scatter plot?

12. Would you support the proposed development? Use data and conclusions from Parts 1 and 2 to support your answer.

continued

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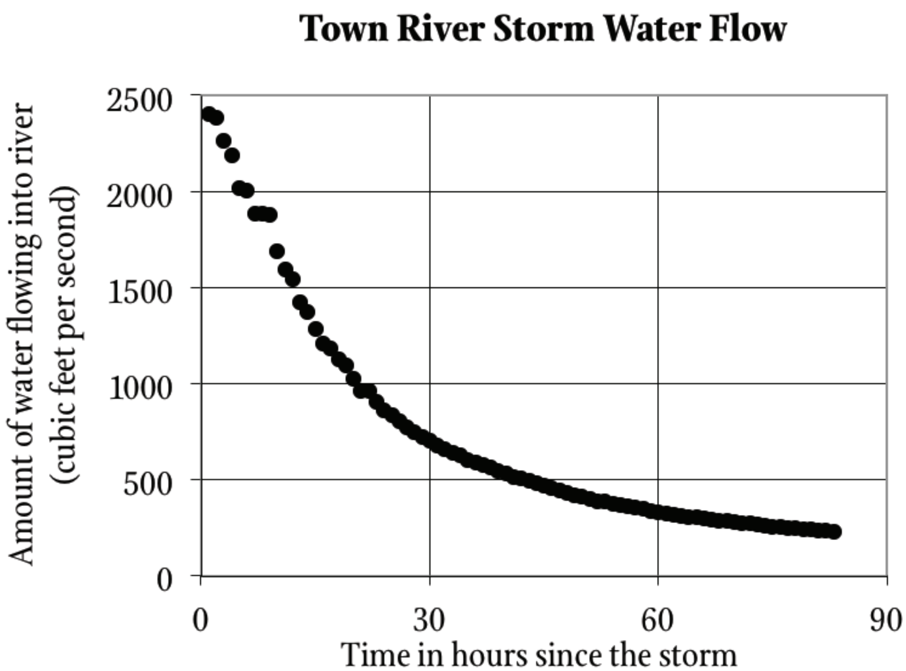
Part 3

Your town is considering a new housing development. To build it, part of the forest around the town's river would be cut down. The river is the watershed that provides the town's drinking water. You have been asked to determine how the development will affect the amount of storm water that flows into the river. In the graph below, the *y*-axis represents how much water ran into the river after a recent major storm. The *x*-axis shows the time in hours after the storm.

Based on your summary from Part 1 and the graph below, what can you conclude about the future health of the watershed if the development is approved? Use your discoveries from Part 1 and this part to defend your position.



Data adapted from: www.walch.com/CCTTG8RiverStormFlow

13. Do you notice any patterns in the data? Explain.

continued

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14. Do you think the data follows a linear or nonlinear model? ____________________
Explain your thinking.

15. Based on your analysis of the data from Parts 1 and 3, what can you conclude about the effect on this watershed if the land is developed? How do you think the scatter plot would change if the forest were logged?

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