SPINOFFS

Spinoffs are relatively short learning modules inspired by the LTAs. They can be easily implemented to support student learning in courses ranging from prealgebra through calculus. The Spinoffs typically give students an opportunity to use mathematics in a real world context.

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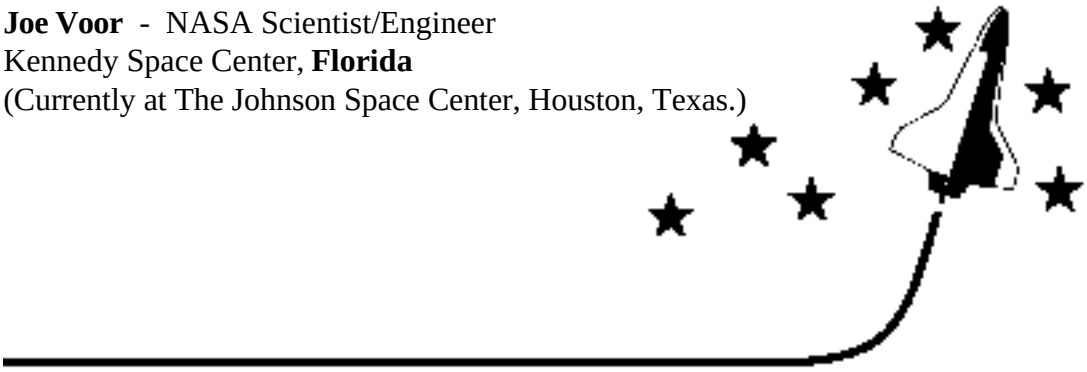

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SPINOFF 5B

Slugging It Out

You did such an excellent job on the first problem as a risk assessor that your skill is greatly admired throughout NASA. Because of your talents and skills, you are selected to do some additional analysis of the Hansom Landfill Site. Here is a more detailed description of the site:

> The Hansom Dam Landfill is located approximately one mile south of the Visitor's Center on the southern side of Ransom Road, one mile west of the intersection of Ransom Road and Kennedy Parkway South. The site is bordered to the north by Ransom Road, to the east by a General Services Administration storage yard, and to the west and south by a wetland that flows into the Indian River. Directly west of the site is a drainage trench, which eventually flows into the Indian River. Underneath the soil at the landfill is a reservoir of groundwater.

Hazardous waste deposited at a landfill can result in the potential for pollution of groundwater under the landfill. When it rains on the landfill, water flows through the landfill site and could eventually end up in the groundwater below the landfill. As the water flows through the landfill, it will pick up any soluble chemical compounds in the landfill and carry these chemicals into the groundwater. If this process is continued over a long period of time, it can create serious contamination of the groundwater. The Hansom Landfill is over 30 years old, and therefore the potential for significant contamination exists. The landfill site is closed to the public. However, since the groundwater eventually seeps into the Indian River, the presence of contaminants could have an effect on industrial workers, residents and recreators.

NASA has ordered a series of tests to determine the rate at which the groundwater seeps into the river water. The type of test ordered is called a **slug test**. This is how a slug test works. A hole is dug into the ground until groundwater is reached. A tube is inserted into the hole, and into the tube is inserted a piece of lead called a **slug**. As the slug is lowered into the groundwater, the level of the groundwater will rise. This process is called displacement. It is the same process that occurs when you drop a small rock into a can of water – the water will rise after the rock is dropped into it. However, unlike the can of water, the rock surrounding the groundwater reservoir is not watertight! The rock will allow some of the groundwater to seep into it. This is of concern, since eventually this groundwater may make its way to other water sources used by humans. If the groundwater in the reservoir is contaminated, this could present a potential health hazard to anyone using these other sources of water. When the slug is dropped into the water, initially the water will rise to a high level. However as the water seeps into the rock surrounding the reservoir, the level of the water will fall over time. You are concerned with the rate at which the water seeps into the rock surrounding the reservoir. This rate is referred to as the permeability of the rock.

Three wells were dug at the Hansom landfill, and the following tables give some of the data derived from slug tests at each well:

Slug Test Data From Well #1

Time (minutes)	**Displacement** (feet)
0	2.704
0.2083	2.000
0.3250	1.919
0.7666	1.696
1	1.6
1.6	1.403
2.2	1.241
3.4	0.997
4.2	0.871
5	0.764
6.4	0.623

Slug Test Data From Well #2

Time (minutes)	**Displacement** (feet)
0	2.380
.065	1.398
.1817	0.982
.315	0.693
.4983	0.460
.615	0.364
.6817	0.324
.7483	0.258
.8317	0.192
1.03	0.136
1.23	0.106

Slug Test Data From Well #3

Time (minutes)	**Displacement** (feet)
0	1.899
0.1	1.509
0.1583	1.144
0.1916	0.982
0.2416	0.790
0.3083	0.597
0.4666	0.364
0.55	0.298
0.6333	0.258
0.8	0.197
0.9333	0.1967

For the data collected from each well, do the following exercises.

1) Draw a scatterplot of the data. Does the data look linear? Why or why not?
2) Using a ruler, sketch what you feel is the best fit line from your data. Describe how you made this decision. Determine the slope and y-intercept of your line.
3) Pick two of your data points and use this to create a line. Try to choose two points that will create a best fit line for your data.
4) Using your calculator, find the best fit linear regression line. Label the variables with appropriate units.

Final Analysis: Determine the units for the independent variable and the units for the dependent variable for your best fit line. What does the slope of the line represent? What are the units for the slope? How is this related to the idea of permeability discussed earlier? Which of the wells is located in the most permeable rock? Which is located in the least permeable rock?