

2009 Team Project Question for the WSMC State Mathematics Contest: Grow Beasts!

Math is central to the process of quantitative measurement. When we take repeated measurements of something that is changing we can assemble a record of the change. If the change is at all systematic we may be able to use the record to predict what will happen next. When we do this we use math to create a "model" of the phenomenon. This year the team project is all about creating a model of growth and using that model to predict change.

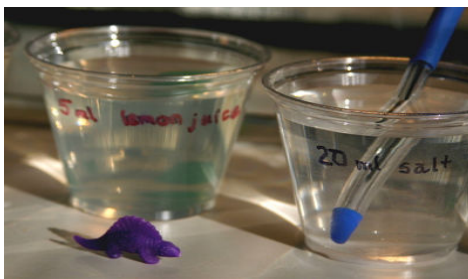


**Got a Team?
Got a team sponsor/coach?**

In order to participate in the contest, contact Dr. Mark Roddy at Seattle University with your school's name and mailing address, your team members' names and grades, and contact information for your team coach and at least one member of your team.

We will send you Grow Beasts!

**Mark Roddy - College of
Education - Seattle University
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(206)296-5765**



Grow Beasts "Grow Beasts" are small toys made from a super-absorbent polyacrylamide polymer. When placed in a liquid they absorb it and gradually expand. The expansion process can take several days. When they are removed from the liquid, evaporation begins and the Grow Beast shrinks. This can also take several days but the Grow Beast will eventually return to more or less its original shape and size. The growth / shrinkage process can be repeated a few times before the Grow Beast deteriorates too much.

Team Task If you take part in the team project this year your team will be sent a dozen Grow Beasts with which to experiment. Your job will be to develop models of growth that enable you to predict how big a Grow Beast will be at any given time as it grows over the course of 96 hours (four days). To make things more interesting, consider this: Grow Beasts grow differently depending on the medium in which they grow. That is, a Grow Beast grown in ketchup will probably not grow at the same rate as one growing in hot tea. You will need to develop a model that enables you to predict the effects of adding lemon juice or salt to the water in which the Grow Beast grows.

You have between now and early March, 2009 to experiment with your Grow Beasts and to develop your understanding of how varying amounts of lemon juice or salt added to 500 milliliters of water will affect the growth rate of a Grow Beast. You will need to develop mathematical models that enable you to predict a Grow Beast's length

at any time given: the starting length and the amount of lemon juice in the water, or the starting length and the amount of salt in the water.

On March 2nd we will announce the conditions we will use to grow a Grow Beast for 96 hours. That is, you will be told the Grow Beast's starting length and the amount of iodized table salt or lemon juice (not both) that will be added to 500 milliliters of water. If we add salt, the volume of salt added will be somewhere in the range, 5 cubic centimeters - 50 cubic centimeters. If we add lemon juice, the volume added will be somewhere in the range, 5 milliliters - 50 milliliters. Temperature has a lot to do with how fast Grow Beasts grow. We will maintain ours at about 25 degrees C (plus or minus 2 degrees). We will let the Grow Beast grow for 96 hours (4 days) and its length will be measured to the nearest millimeter every 6 hours.

We will use Scicilia brand lemon juice and Morton brand iodized table salt.

These have been chosen because they are widely available. For example, at Safeway we found the lemon juice available near the fresh lemons in the produce section. If you cannot obtain either of these let me know and we will send some to you.



Your job will be to use the initial conditions we give you on March 2nd and your mathematical models derived through experimentation with the Grow Beasts to come up with a set of predictions for the length of our Grow Beast every 6 hours as it grows for 96 hours. You will need to send your predictions and your full report to us within 24 hours of the time when we publish the initial conditions.

The Report Your report will consist of two parts. Both parts will be weighted equally in the scoring of the project. The first part is simply a set of 16 predicted lengths covering the entire 96-hour period of growth. That is, your predictions for the length of the Grow Beast at 6 hours, at 12 hours, at 18 hours, ... and at 96 hours. The accuracy of these predictions will account for 50% of the points you get for the report. These predictions must be part of the report AND the predictions must be e-mailed separately to Mark Roddy, director of the WSMC Team Project, at mroddy@seattleu.edu. (See "[The Sequence](#)" below.)

The second part of the report will consist of a clear and thorough explanation of the models you created for Grow Beast growth as it is affected by

- a.) the starting length and the amount of lemon juice, or
- b.) the starting length and the amount of salt.

As stated above, you will need two mathematical models. The first should enable you to take a starting length (between 3 cm and 5 cm) and an amount of lemon juice (between 5 ml and 50 ml) and predict the resultant Grow Beast lengths for 4 days. The second model should enable you to take a starting length (between 3 and 5 cm), and an amount of salt (between 5 cc and 50 cc) and predict the resultant Grow Beast lengths for 4 days. The points for this part of the report will be determined according to the rubric ([scoring guide](#)) linked as a pdf document below. As always, your ability to use relevant mathematics and to explain your understanding of what you have done and why you did it will be central.

Part one of The Report, which consists of your growth predictions, must be e-mailed to Mark Roddy (mroddy@seattleu.edu) within 24 hours of the announcement of the initial conditions at noon on March 2nd, 2009. By

that time you must also send 3 copies of the entire written report, including the growth predictions, to your regional director.

The Display On the day of the contest, you will set up and "staff" a display where you will talk with people about your investigation. You should have some sort of visual display that summarizes the highlights of your investigation. This, however, is only part of the process. More importantly, you should be prepared to summarize the results generally and to answer specific questions from judges and students about your work.

The Presentation On the day of the contest, your team will give a very brief (approximately five minutes) presentation summarizing your investigation. The evaluation of the presentation will focus on your communication skills more than on the quality of the mathematics, which receives primary emphasis in the report and during the display.

The Sequence:

February 23rd at 12PM (noon): The conditions under which the Regional Contest Grow Beast will be grown will be published on this Web page at noon. You will then have 24 hours to send your 16 predictions (one for every 6th hour of the 4 day period of growth) to mroddy@seattleu.edu. You may send the predictions in the body of an e-mail message or as an attached Word (.doc or .docx) or .pdf file. Also within 24 hours you must also send three (3) copies of your report (≤ 10 pages) including your predictions to your regional director.

(NOTE: This date was changed from 3/02/09 to 2/23/09 to accommodate WASL testing.)

March 11th: The WSMC Regional Contests take place.

(NOTE: The contest date was changed from 3/18/09 to 3/11/09 to accommodate WASL testing.)

March 23rd at 12PM (noon): For those who advance to the State Contest, the conditions under which the State Contest Grow Beast will be grown will be published on this Web page at noon. You have 24 hours to send your 16 predictions (one for every 6th hour of the 4 day period of growth) to mroddy@seattleu.edu. You must also send one (1) copy of your report including your predicted lengths to Jim Miller, State Contest Director. The report may contain up to two pages of additional material (≤ 12 pages in all) explaining any revisions you made to your models for the State Contest. Mail your report to the State Contest Director, Jim Miller at this address:

Jim Miller
201 Elk Haven Rd
Cle Elum, WA 98922

April 18th: The WSMC State Contest takes place.

Resources:

Wiki Space A wiki space has been set up to enable teams to share data, results, questions, etc. (A [wiki space](#) is a Web page that can be edited by anyone who is a member of that space.) This will enable you to share data and ideas with other teams across the state. In order to access the contest wiki space, go to:

<http://wsmcteamproject2009.wikispaces.com/> The space is easy to join and to use. It will allow you to share data, results and ideas. This should result in a much better model. Give it a try!

Growth Charts The mathematical models you create may be similar to those used to model human growth. Click on the link below. On the resulting page, scroll down to find, for example, charts modeling the height and weight of girls or boys from age 2 to 20. This is the result of thousands of measurements taken over time. Because there have been so many measurements the chart shows growth curves for various percentile groups. Yours will likely be simpler with only one growth curve, yet similar.

http://www.cdc.gov/nchs/about/major/nhanes/growthcharts/clinical_charts.htm

Here are a couple of charts showing growth rates for some Grow Beasts grown in various circumstances in the summer of 2008. Both Grow Beasts were removed from their liquids after about 90 or 100 hours. They show both growth and shrinkage. For purposes of the contest your concern will be only with the growth phase of the process.

