End of Module Questions:

1. When Mt. St. Helens erupted in 1980, many non-geologists asked when Mt. Rainier is going to erupt. What model were these non-geologists using as the basis for their question?

   The assumption seems to be that whatever caused the eruption of St. Helens could cause an eruption of Rainier, so the model must have included a shared cause of eruptions for the two mountains. This is conjecture, but most likely these folks were thinking that these volcanoes were connected under the ground in some way (such as being fed by the same magma chamber). They probably thought that an eruption in one mountain would have an effect on the other mountain. One could imagine other models but all would have a physical connection between the two mountains.

b) Imagine you are back in 1980, after the big eruption of St. Helens. What evidence could you use to test the model of these non-geologists? Assume that your test can not be to wait to see if Rainier erupts.

   Two different approaches to test their model:
   1) Are the rocks erupted by the two mountains the same composition? If the rocks formed are different (and they are slightly different) then one common magma chamber would be unlikely.
   2) In the past have the volcanoes erupted at the same time? When St. Helens has erupted, did Rainier erupt too? (The answer is no—there is no evidence of one volcano causing the other to erupt).

2) Prior to 1492 most people had a model of the Earth that indicated if Columbus sailed west that he would fall off the Earth. What was the model used by these people. How did they develop their model?

   The Earth was flat. Direct observation—the land and sea look flat. When ships sailed away they disappeared at the horizon and many times did not return.

3) If global warming continues, one concern is the productivity of farm lands in North America, the breadbasket of the world. Imagine an experiment in which researchers plant soy beans seeds that are randomly mixed to insure that differences in genetics is not a factor in the results. The researchers plant the soy beans in two plots that receive the same amount of rain, sunlight, fertilizer, etc. In one of these plots the soil is heated artificially to 4 degrees C higher than the other plot. After 2 months, the height of ten randomly selected plants is measured in centimeters. The results are below:

   What is the dependent variable in this experiment? **The height of the plants.**
   What is the independent variable in this experiment? **The temperature of the soil (heat vs. no heat)**

<table>
<thead>
<tr>
<th>(cm)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat</td>
<td>15</td>
<td>12</td>
<td>14</td>
<td>17</td>
<td>16</td>
<td>15</td>
<td>14</td>
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<td>19</td>
<td>12</td>
</tr>
<tr>
<td>No heat</td>
<td>16</td>
<td>14</td>
<td>20</td>
<td>12</td>
<td>10</td>
<td>18</td>
<td>10</td>
<td>14</td>
<td>14</td>
<td>12</td>
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</tbody>
</table>
Is there evidence to suggest that increased heat will have a significant effect on the growth of soy beans? Explain your reasoning.

The average growth for the heated soil was 15 cm, while the average growth for the non-heated soil was 14 cm. Is this difference in average growth sufficient to say that the difference is significant?

To answer this completely we need some statistics, but since we do not expect that level of math background in this class, we can look at the variations of the data. Notice that the spread of data is wide, especially for the non-heated plants (10cm - 20cm). The average difference of one centimeter between the heated and non-heat treatments is very small in relation to this spread of the data, so we could say that the difference is not significant.

If the average difference in growth between the two treatments (like heated and non-heated) was 10 cm, and the range in the data was on the order of 4 or 5 cm and there were 100 measurements for each treatment, then is very likely that the difference would be significant.