Answers

1. a. The 4 treatments are : 1 = (BHA, 100), 2 = (BHA, 400), 3 = (BHT, 100), 4 = (BHT, 400).

b. The experimental units are the 16 samples of meat.

c. Put 16 numbers in a hat corresponding to the 16 samples of meat. Draw out 4 numbers for the samples to be assigned to treatment 1, another 4 numbers for the samples to be assigned to treatment 2, etc. Here is one example.

Treatment	Sample
BHA, 100	4, 3, 14, 12
BHA, 400	10, 14, 5, 16
BHT, 100	2, 8, 1, 11
BHT, 400	13, 9, 6, 7

d. We would use batch as a blocking factor. We would assign the four samples from each batch randomly to the four treatments. Here is one way this could be done.

Treatment	Sample number Batch 1	Batch 2	Batch 3	Batch 4
BHA, 100	2	1	3	1
BHA, 400	3	4	1	3
BHT, 100	4	3	4	2
BHT, 400	1	2	2	4

2. Plan 1 is better. If there are any differences between the growth chambers in terms of condition, or where it is placed in the lab, or anything else that could affect how it performs, then having both varieties in each chamber will allow the unique characteristics of each chamber to affect the varieties the same way. For instance, if the temperature knob on growth chamber 1 sets the temperature slightly higher than indicated by the dial, this greater temperature would affect the growth of the two varieties within the chamber the same way so that the relative comparison between varieties would be unchanged.

With Plan 2, any differences between the chambers will be completely confounded with the treatments, so if we see a difference in growth between the two varieties, we will not be sure whether to attribute the difference to the varieties themselves, or the differences between chambers, or a combination of the two.

3. Differences in the ambient environment from morning to afternoon could affect the result. For instance, if it is a lot warmer in the afternoon that in the morning, the higher outside temperature might affect how the freezer performs. This effect would be completely confounded with the effect of air flow making it impossible to know whether differences in freezing time would be due to the flow, the change in ambient environment, or both.

One fix-up would be to do 5 batches at high flow and 5 at low flow in the morning, and then do the same in the afternoon. Suppose it takes 15 minutes to complete a run. We could form blocks of 30 minutes in which to complete a runs of high and low flow as shown below. This pattern would be repeated in the afternoon giving us 10 blocks of two treatments each.

	8:00 AM		8:30 AM		9:00 AM		9:30 AM		10:00 AM	
order	1	2	3	4	5	6	7	8	9	10
flow	low	high	high	low	high	low	low	high	low	high

An engineer might complain that this is too hard to do or too expensive and take a short cut such as running all low flow first in the morning and all high flow next in the morning, then repeating this pattern in the afternoon. While this would be better than the original plan, it still has the problem that bias could occur as outside conditions change throughout the day.