Unit 4: Chemical Reactions

Chromatography Lab

Guiding Question: How can paper chromatography help us describe how certain substances interact with paper

Do Now: Read the “Background” section on your PT.

Pay particular attention to paragraph 4, beginning “Food dues” (this is a typo and should read “Food dyes”).

The use of color additives increased dramatically in the United States in the second half of the the nineteenth century. As the economy became more industrial, fewer people lived on farms, city populations grew, and people became more dependent on mass produced foods.

Food dyes were initially used to make food more visually appealing to the consumer and, in some cases, to mask poor-quality, inferior, or imitation foods. For example, meat was colored to appear fresh long after it would have naturally turned brown. Jams and jellies were colored to give the impression of higher fruit content than they actually contained. Some food was colored to look like something else—imitation crab meat, for example. Many food colorings and additives were later discovered to be harmful or toxic.

Food colorants were initialy added to food with little or no health testing. In 1907, the USDA reduced the number of synthetic food dyes approved for use from 695 to just seven. Only two of the original dyes from 1907 are still accepted for use today. Five others have been added between 1907 and 1971. Only seven dyes are approved for use in the United States today. All of the FD&C approved food dyes are charged, water-soluble organic compounds that bind to natural ionic and polar sites in large food molecules, including proteins and carbohydrates.

Food dyes can [illegible] and identified by paper chroma[illegible] Paper chromatography is an [illegible]ple of a more general type of chromatography called *ads[illegible] chromatography*. The paper acts as an adsorbent, a solid which is capable of attracting and [illegible]ding the [illegible]mponents in a mixture (see Figure 1). The mixture to be separated is "spotted" o[illegible] surface of the paper and a solvent is allowed to seep or flow through the paper by capil[illegible]ry action. If one of the components in the mixture is more strongly adsorbed onto the paper [illegible]han another, it will move up the paper more slowly than the solvent. Components that are not [illegible]trongly adsorbed onto the paper will move up the paper at a faster rate. This "partitioning" of [illegible] components of a mixture between the paper and the solvent separates the components an[illegible] giv[illegible]ise to different bands or spots. If the components of the mixture are colored, like f[illegible] dyes o[illegible]nents in an ink, the colored bands are easily distinguished.

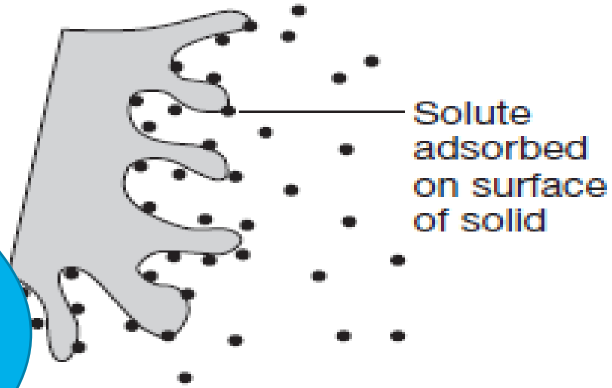


Figure 1. Adsorption of solute particles onto the surface of a solid.

The distanc[illegible]le moves along the chromatography paper is [illegible] to the overall distance the solvent travels—this ratio is called the R_f or rat[illegible] are more highly charged, that is, have more ionic binding sites and are more polar, will be attracted to the paper more strongly and will have lower R_f values.

Purpose

- The purpose of today’s lab is to help you describe how polarity affects how a substance interacts with paper.

- You will be writing a lab report using the evidence from today’s lab.
  - Lab report rough draft is due first thing Friday.
  - We will be doing peer review in class on Friday, 3/16.

What are we doing?

- We will be applying different inks and dyes to determine how polarity affects their interactions with paper.
- Once the chromatograph has “run”, we can measure how far the ink/dye has moved.

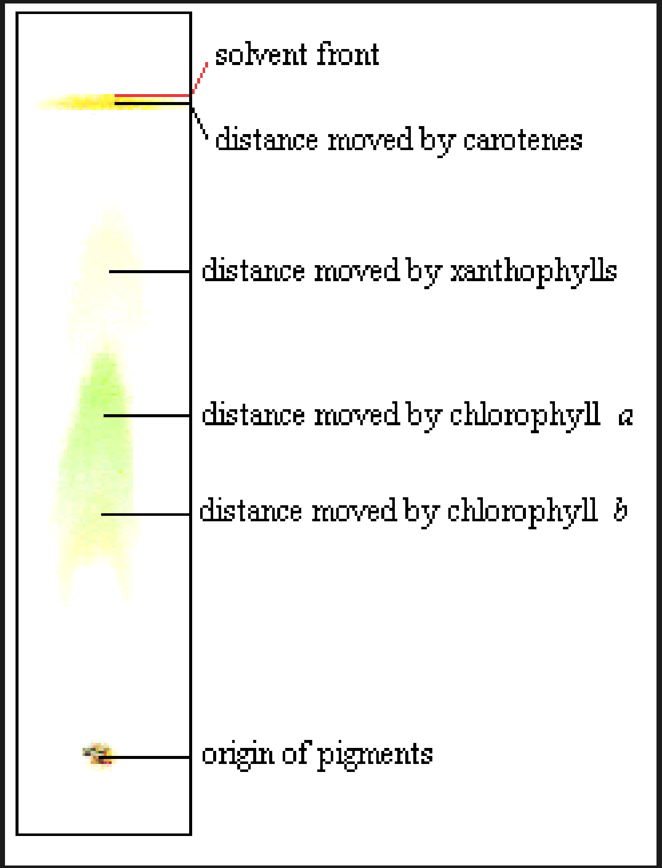
$$R_f = \frac{\text{distance of the center of the sample spot from the origin}}{\text{distance of the solvent front from the origin}}$$

- We will measure how far the sample and the solvent have moved to determine the R_f value.
  - The R_f value tells you if the sample is polar or nonpolar.

Calculations:

- In the results summary table below you are asked to calculate the R_f values for all the dots or bands on your finished chromatogram. Please show your work for these calculations in the space below.

$$R_f = \frac{\text{distance of the center of the sample spot from the origin}}{\text{distance of the solvent front from the origin}}$$



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Food dyes can be separated and identified by paper chromatography. Paper chromatography is an example of a more general type of chromatography called *adsorption chromatography*. The paper acts as an adsorbent, a solid which is capable of attracting and binding the components in a mixture (see Figure 1). The mixture to be separated is "spotted" onto the surface of the paper and a solvent is allowed to seep or flow through the paper by capillary action. If one of the components in the mixture is more strongly adsorbed onto the paper than another, it will move up the paper more slowly than the solvent. Components that are not strongly adsorbed onto the paper will move up the paper at a faster rate. This "partitioning" of the components of a mixture between the paper and the solvent separates the components and gives rise to different bands or spots. If the components of the mixture are colored, like food dyes or pigments in an ink, the colored bands are easily distinguished.

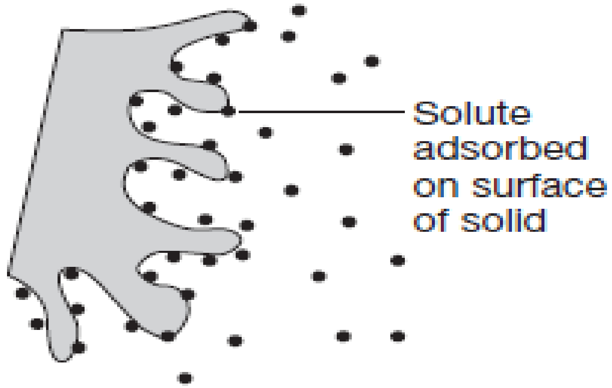
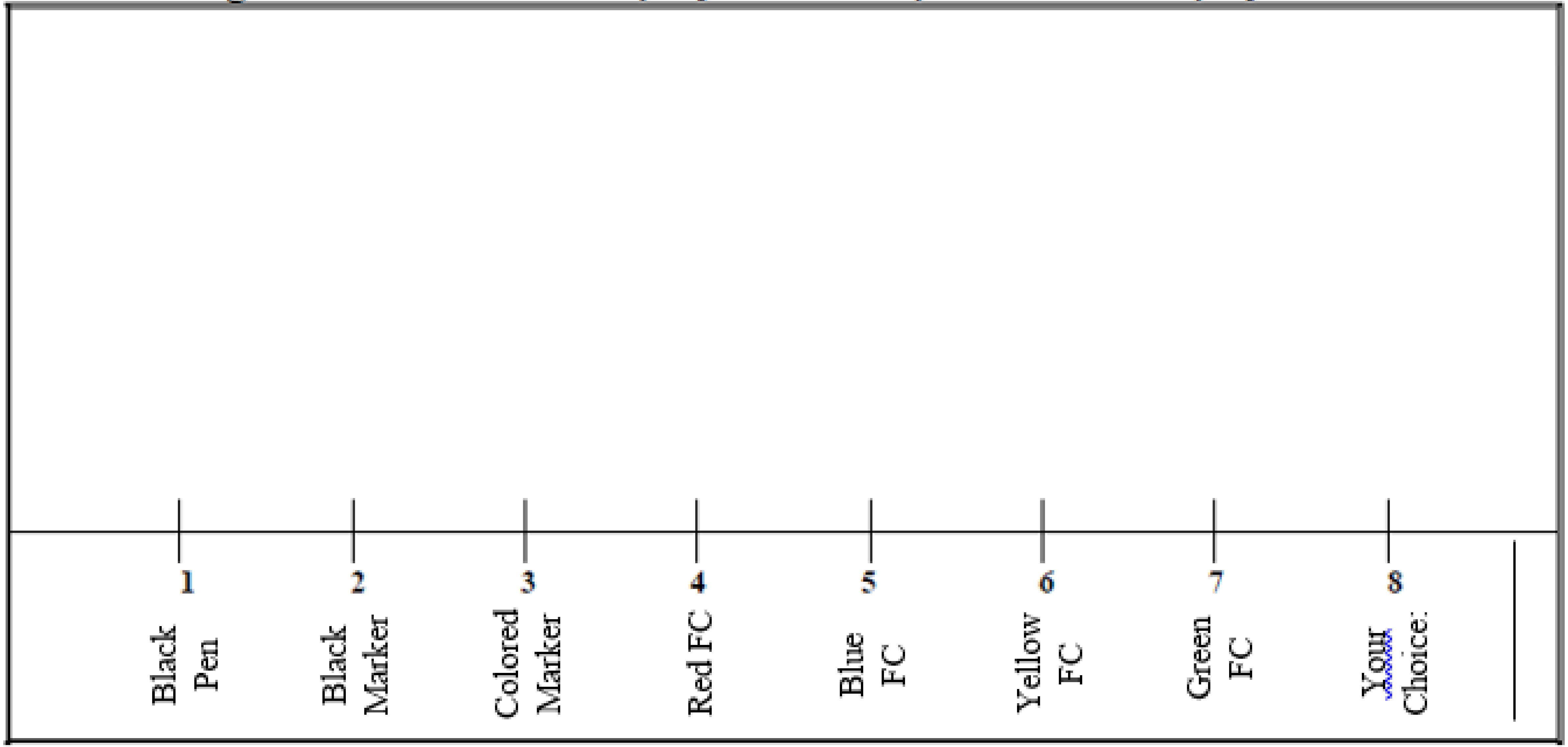
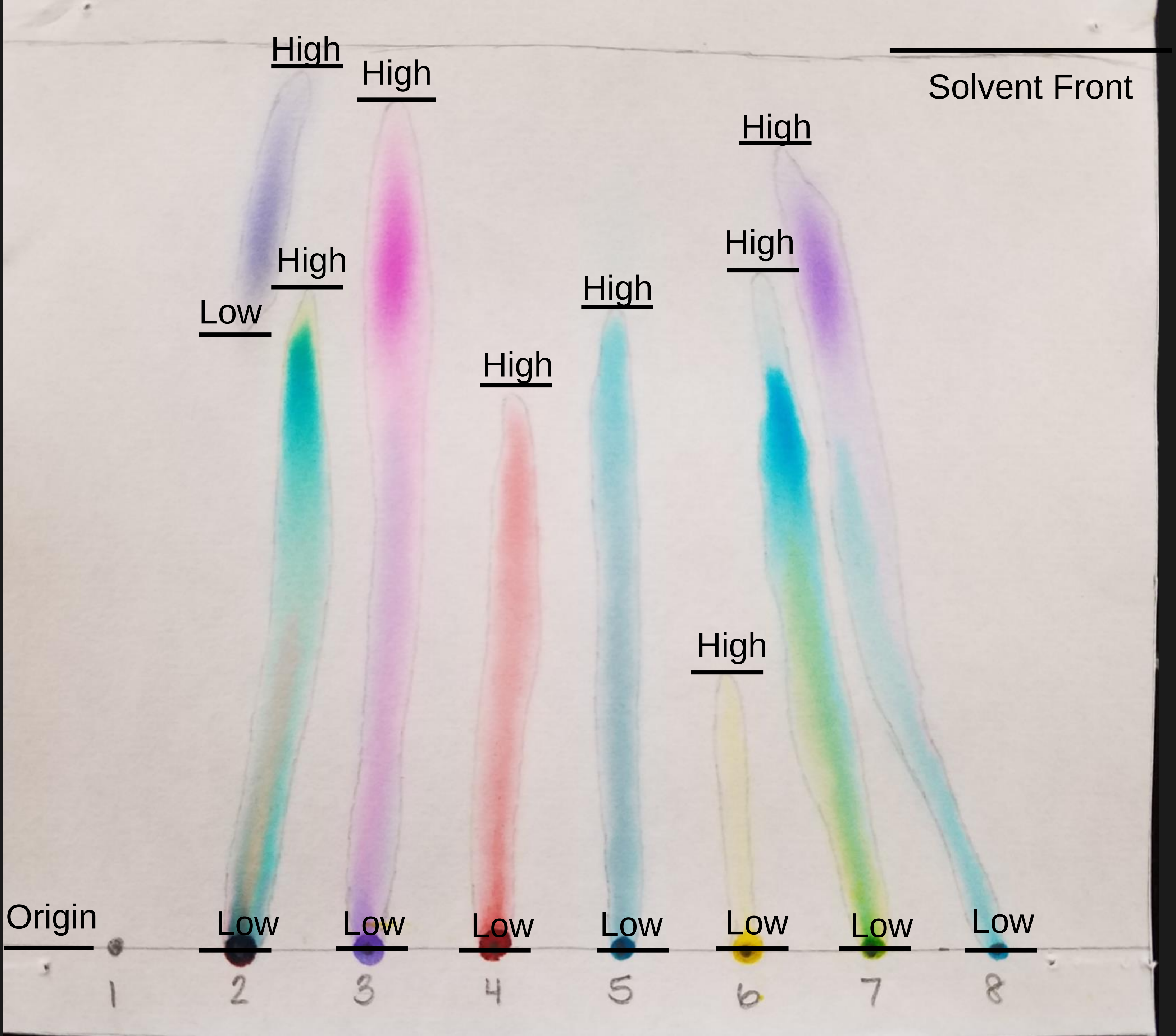


Figure 1. Adsorption of solute particles onto the surface of a solid.

The distance a sample moves along the chromatography paper is compared to the overall distance the solvent travels—this ratio is called the R_f or rate of flow. In general, food dye molecules that are more highly charged, that is, have more ionic binding sites and are more polar, will be attracted to the paper more strongly and will have lower R_f values.

Chromatogram: Recreate as accurately as possible. Identify & label each food dye spot (ie Red 3, Red 40 etc)




Solvent Front
High
High
High
High
High
High
High
High
High
Low
Origin
Low
Low
Low
Low
Low
Low
Low
1
2
3
4
5
6
7
8

Distance Traveled by Solvent Front: ____________________

Pigment	Color of Spot (list all if more than one)	Distance Traveled	R_f	Polar or Nonpolar?
Black Pen	High			
	Low			
Black Marker	High			
	Low			
Colored Marker	High			
	Low			
Red Food Coloring	High			
	Low			
Blue Food Coloring	High			
	Low			
Yellow Food Coloring	High			
	Low			
Green Food Coloring	High			
	Low			
Your Choice:	High			
	Low			

To Do:

- Collect your data
  - Take a picture of the chromatography paper– this needs to be added to your formal lab report.
  - Do all calculations for Rate of Flow– this can be done on paper or using the computer.
- Work on your formal lab report
  - Title Page
  - Claim/ Hypothesis
  - Experiment- Materials/ Procedure
  - Data
  - CER paragraph

ROUGH DRAFT DUE TOMORROW for peer review.