Chemistry 121 Assessment Project:

Significant Figures

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Three parts to EVERY measurement:

1.	Number
2.	Unit
3.	Significant Figures

Examples:	
55.6 cm	3 sig figs
<mark>5 cc</mark>	1 sig fig

30. nL 2 sig figs

Inexact numbers lead to the necessity of significant figures.

Q. Where do inexact numbers come from in a chemistry lab?

A. Inexact numbers come about from the limitations of the instruments that we use to measure our data.

• For example, with a ruler, we only have so many markings before we have to guess the length of the material. So we are limited by the number of markings on our instrument.



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Q. Where do inexact numbers come from in a chemistry lab?

A. Inexact numbers come about from the limitations of the instruments that we use to measure our data.

- For example, with a ruler, we only have so many markings before we have to guess the length of the material. So we are limited by the number of markings on our instrument.
- One way to describe these limitations of our instruments is called instrumental precision.
 - 1/10 th of the smallest markings on our instrument.
 - Gives us the last significant digit, aka our guesstimated digit (between the smallest markings).
- What is the smallest number that we can guess based on the instrument that we are using?
- Significant figures include all confident digits plus one estimated digit





Inexact numbers lead to the necessity of significant figures.

If a student reports a value of 0.1001 g, which of the following mass balances must the student have used?





0.0000 g

0.00 g

Determining significant figures for students is often challenging.

1. Several rules for evaluating significant figures in numbers.

Example: Zeros are significant in certain situations and not in others.

2. Different rules for tracking significant figures in calculations.

Example: Addition and subtraction are different than multiplication and division.

3. Significant figure evaluations sometimes vary from mathematical principles previously learned.

Example: Presence of a decimal may change the number of significant figures.

Assessment Project Goals:

1. Evaluate the students understanding of significant figures during the quarter.

2. Look for correlations between several different factors, such as overall course grade, course format, demographics, etc. that may allow for a better understanding of student knowledge gaps and lead to ways to fill in these gaps.

Assessment Project Goals:

- 1. Evaluate the students understanding of significant figures during the quarter.
 - -> Data Collection: Winter Quarter 2018
 - Understanding over Time: Beginning, Middle, End (1 instructor)
 - Multiple Instructors: Beginning and End (3 instructors)
 - Different Course Formats: Daily Meeting (2 instructors) and Hybrid (1 instructor)
 - -> Preliminary Data Analysis: Spring Quarter 2018 Student data was excluded if:
 - the student dropped the course
 - the student was not taking the lab and lecture portion of the course (some re-take)
 - the student did not take one of the evaluations during the quarter

Understanding over Time: Beginning, Middle, End (1 instructor)

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Understanding over Time: Beginning, Middle, End (1 instructor)

Figure 2. Trends for Correct Answers for Significant Figure Questions for 46 Students



Multiple Instructors: Beginning and End (3 instructors)

Multiple Instructors: Beginning and End (3 instructors)



Multiple Instructors: Beginning and End (3 instructors)



Different Course Formats: Daily Meeting (2 instructors) and Hybrid (1 instructor)

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Different Course Formats: Daily Meeting (2 instructors) and Hybrid (1 instructor)



Preliminary Analysis Thoughts?

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- 1. Further information may be desired.
 - More data (different quarters)?
 - Drop-out percentage?
 - Initial prep vs. Final exam prep?
 - Self-learning?
 - Number of students re-taking chem 121 (across each section and hybrid vs. daily)?
 - Any other correlations between students in each section?
 - Lead to future assessment projects (link to Chem 171)
- 2. Look for correlations between several different factors, such as overall course grade, course format, demographics, etc. that may allow for a better understanding of student knowledge gaps and lead to ways to fill in these gaps.

Determining significant figures for students is often challenging.

Significant Figures (sig figs): All digits plus one estimated digit (last digit)

- 1. Non-zero digits: ALWAYS significant
- 2. Zero:
 - Significant:
 - 1. Between 2 non-zero digits
 - 2. At the end of a number with a decimal point
 - NOT significant:
 - 1. Beginning of a number
 - 2. At the end of a number without a decimal point
- 3. In multiplication and division: Answer has the same number of sig figs as the number with the FEWEST SIG FIGS.
- 4. In addition and subtraction: Answer has the same number of decimal places as the original number with the FEWEST DECIMAL PLACES.

	3.4	145	56.78			
2 s	† sf	1 3 sf	4 sf			
	305	104.5	56.700	10.		
↑ 3 sf	4	↑ sf	∱ 5 sf	† 2 sf		
0.0056 0.2 350 10						
1		1	t	1		
2 s	sf	1 sf	2 sf	1 sf		
10.2 - 1.645 = 8.555 = 8.6						
tenths		tenths				
thousandths						