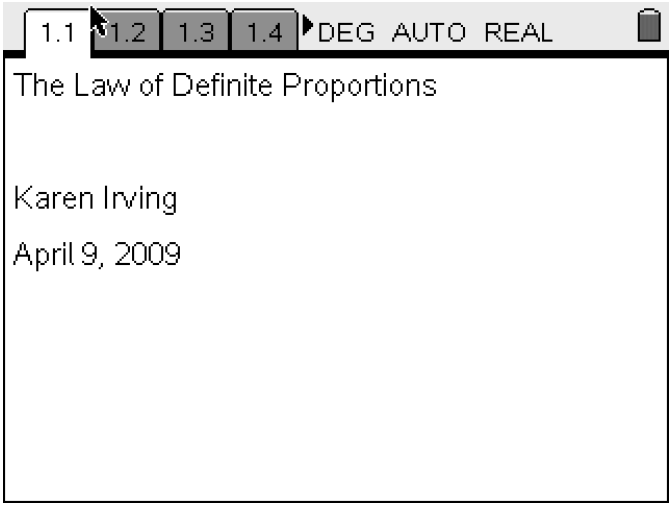
Law of Definite Proportions (LDP)

The law of definite proportions states that all pure samples of a chemical compound contain exactly the same proportion of elements by mass. The French chemist Joseph Proust conducted several experiments between 1798 and 1804 to make this discovery. At the time (before Dalton had proposed his atomic theory), the law was controversial.

This activity is designed for the Nspire handheld and intends to help students increase their understanding of this law through application of the information to a set of unknown samples. Students will make claims and provide evidence for those claims.

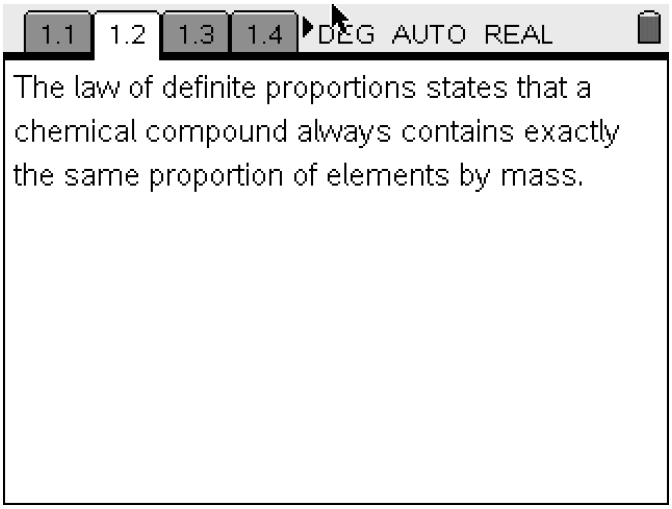
Introduction

1. Open the LDPS.tns file.



2. Read and think about the Law of Definite Proportions.

   Q1: How is a chemical compound different from an element?



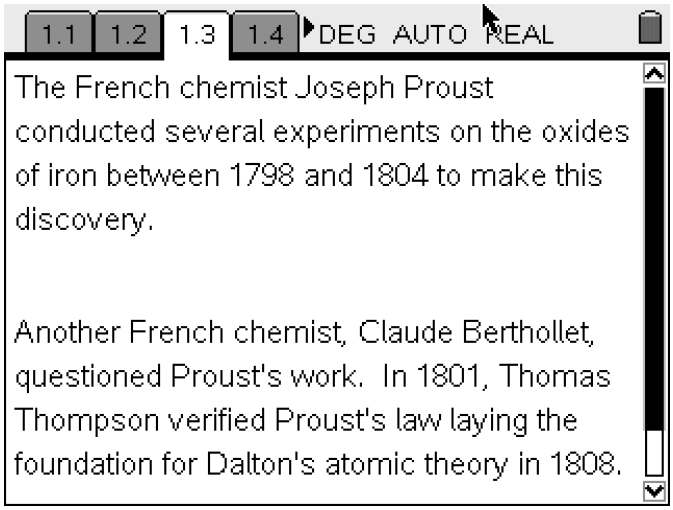
3. The development of the LDP represents an interesting demonstration of the nature of science.

   Q2: Was the LDP discovered before or after Dalton's atomic theory?

   Q3: Did all other scientists accept the LDP when it was first proposed?

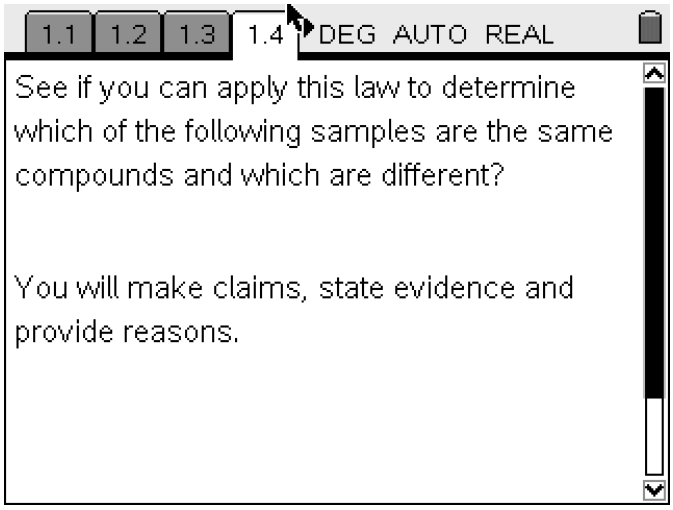
   Q4: Why did Thompson need to verify Proust's work?

   Q5: How did Dalton build on Proust's work?



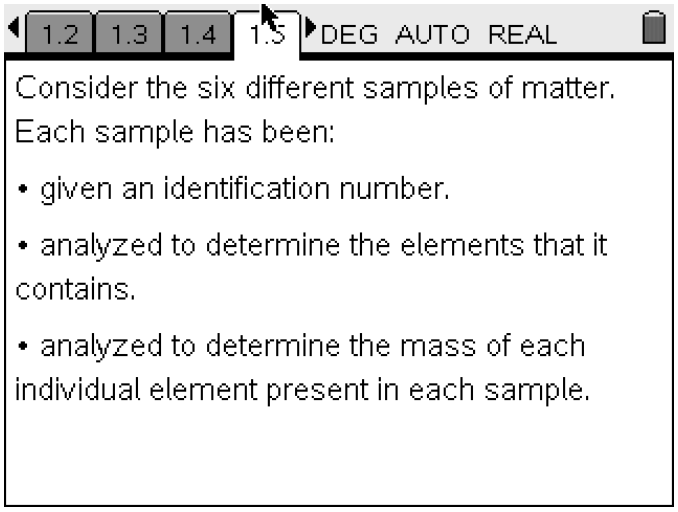
4. Q6: What is a claim?

   Q7: What is the difference between a claim, evidence and a reason?

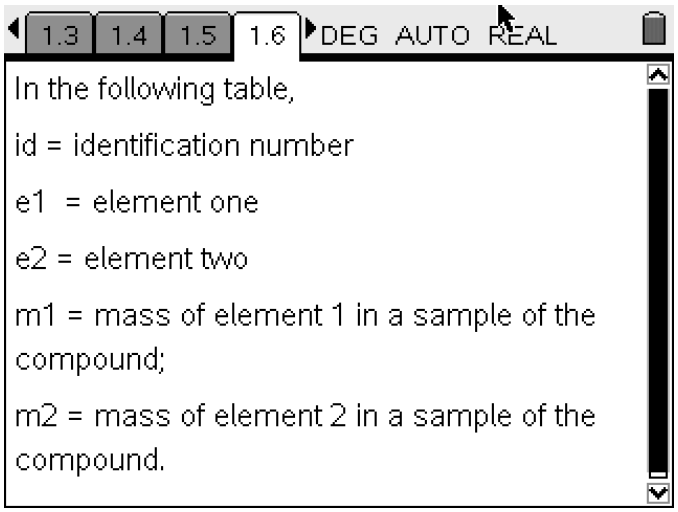


5. In this activity, you will be asked to consider six different samples of matter.

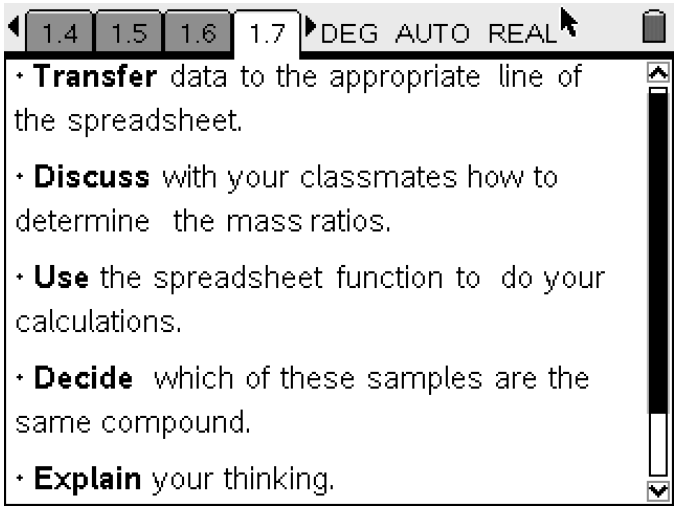
   - Each sample has been given an identification number.
   - Each sample has been analyzed to determine the elements that it contains.
   - An analysis has determined the mass of each individual element present in each sample.



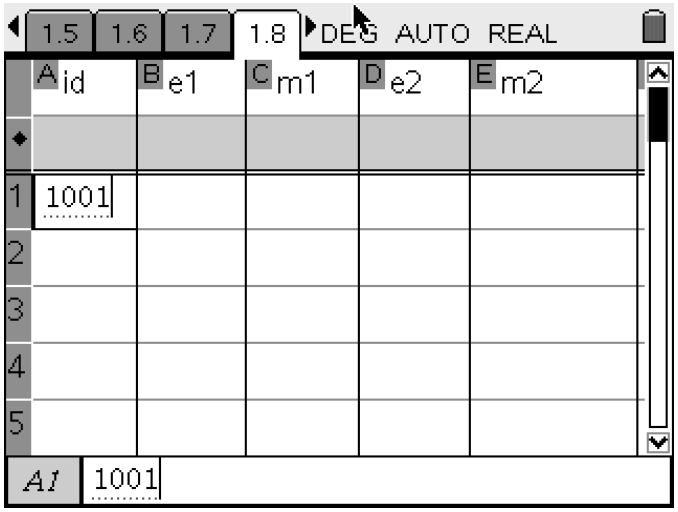
6. A spreadsheet has been created for you with the following column headings. Be sure you understand what information is stored in each column before you begin calculations.



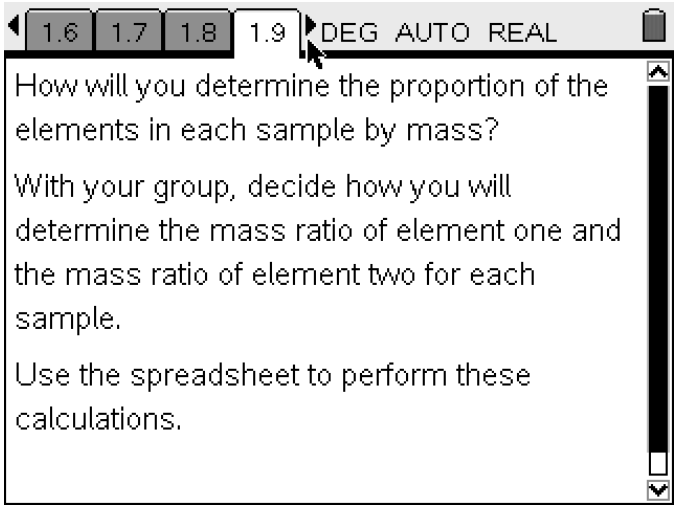
7. You will:
   - Transfer data to the appropriate line of the spreadsheet (next screen).
   - Discuss with your classmates how to determine the mass ratios for each sample.
   - Use the spreadsheet function to do your calculations.
   - Decide which samples are the same compounds.
   - Explain your thinking.



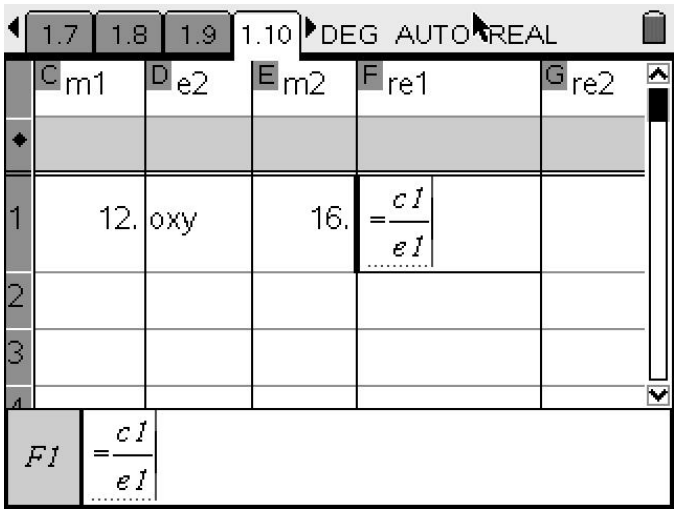
8. Transfer appropriate data to each column. When you enter mass data, include a decimal point after the mass value. For example, 16 should be entered 16. If you neglect to add the decimal point, your calculation may appear in fraction rather than decimal form.



9. With your group, decide how best to determine the ratio of each element present in the sample. You may want to figure out the total weight of the sample. You might prefer to use ratios, or to convert your ratio values to percent values.



10. In the table shown here, re1 refers to the ratio of element 1. Check out the *F#* line to see one way the calculation could be done. Use column G to find re2, ratio of element 2.



11. Review Proust's Law of Definite Proportions.

You might prefer to transfer your data to the table below in order to see it better.

Q8. What claims can you make regarding these six samples? Be sure to provide an explanation for each claim.

Sample ID	Element 1	Element 2	Ratio Element 1	Ratio Element 2
#1001				
#1002				
#1003				
#1004				
#1005				
#1006				

12. For each claim include the following:

Claim #: A statement of what you claim to be true based on the information available.
Evidence: The evidence that you have to support your claim.
Reasoning: How does the evidence support the claim?

For example, You might claim:

Claim 1: Samples 1001 and 1002 are the same compound.
Evidence: Sample 1001 contains two elements. Sample 1002 contains two elements.
Reasoning: All samples with two elements are the same compound.

This particular example includes accurate but insufficient evidence and non-scientific reasoning. The claim is not supported by this evidence and line of reasoning.

For your claims, use evidence from your calculations and given data and the law of definite proportions to identify samples of the same compound as well as sample of different compounds in the sample set.

Claim #1:

Evidence:

Reasoning:

Claim # 2:

Evidence:

Reasoning:

Claim # 3:

Evidence:

Reasoning:

Claim # 4:

Evidence:

Reasoning:

Claim # 5:

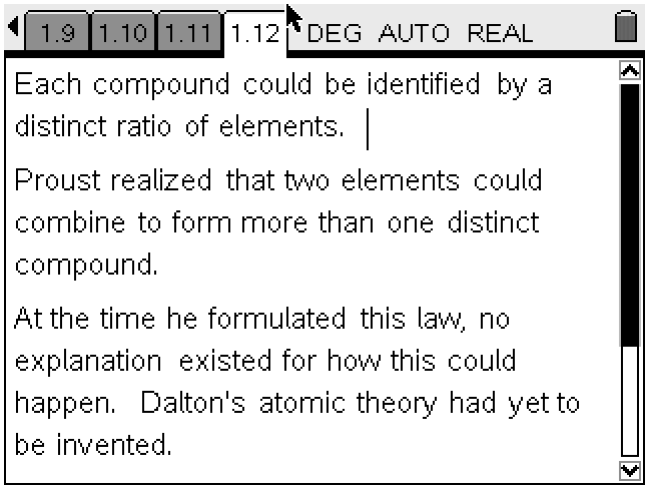
Evidence:

Reasoning:

12 Summing up

Q9. What does Proust's Law of Definite Proportions mean?

Q10. How does this discovery demonstrate the nature of science?



Assessment of student learning

Checking up:

Which of the following samples are the same compounds? Explain why?

Sample	Element 1	Element 2	Ratio element 1	Ratio element 2
A	N	O	.226	.774
B	N	H	.226	.774
C	N	O	.304	.696
D	N	O	.226	.774
E	H	O	.111	.889

Response:

Claim:

Evidence:

Reasoning:

SAMPLE ID 1001 Elements: Carbon: 12.0 g Oxygen: 16.0 g	SAMPLE ID 1002 Elements: Carbon: 12.0 g Oxygen: 32.0 g
SAMPLE ID 1003 Elements: Nitrogen: 14.0 g Oxygen: 16.0 g	SAMPLE ID 1004 Elements: Carbon: 6.00 g Oxygen: 8.00 g
SAMPLE ID 1005 Elements: Carbon: 6.00 g Nitrogen: 7.00 g	SAMPLE ID 1006 Elements: Carbon: 3.00 g Oxygen: 8.00 g