

Title: Percent Composition of Ductile Iron

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Externship Business: [Waupaca Foundry, Plant 4](#)

Overview / Description:

Ductile iron, also called spheroidal graphite iron, is a type of graphite-rich cast iron. Due to the nodular graphite inclusions, ductile iron has a larger impact and is stress resistance, thus it is used for automobile parts.

Students will solve percent composition problems after learning about the process of making ductile iron at Waupaca Foundry.

Subject(s):

Chemistry in The Community

Grade Level(s):

Grades 10-12

Learning goals/objectives:

After completing this activity, students should be able to:

- Calculate the percentage by mass of iron in various metal alloys
 - From mass data
 - From chemical formula

Type of Activity (check all that apply):

- X Individual
- X Small Group

Teaching Strategies (check all that apply or include new strategies):

- X Discussion
- X Partner work
- X Use of Technology
- X Performance Assessment

Content Standards:

Wisconsin Standards for Science

Physical Science:

Standard SCI.PS1: Students use science and engineering practices, crosscutting concepts, and an understanding of matter

and its interactions to make sense of phenomena and solve problems.

- **HS-PS1-3:** Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Crosscutting Concept:

Standard SCI.CC4: Students use science and engineering practices, disciplinary core ideas, and an understanding of systems and models to make sense of phenomena and solve problems.

Standard SCI.CC4h: Students investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They also design systems to do specific tasks.

Model Academic Standards for School Counseling

Academic Development Domain

Content Standard C: Students will understand the relationship of academics to the world of work, and to life at home and in the community.

- Core Performance Standard 1: Understand how to relate school to life experiences.

Length of Time and length of class periods: One 90-minute class period

Materials List (linked if online resource please):

- Sample Alloy(s) from Waupaca Foundry
 - Pig-iron sample
- Calculator
- Data on sample compositions from foundry

Directions (Step-by-Step):

1. Lesson introductory scenario: “Imagine you are a chemist who has just finished the synthesis of a new compound. You have purified your product. Now you must verify the

composition of your new compound and determine its molecular formula. You can use an analytical procedure to determine the relative masses of each element in the compound and calculate the percent composition.”

2. In pairs, students will be given four samples of known composition which were obtained from Waupaca Foundry (or a foundry near your school district.) The foundry should also share data on the compositions of the samples.
3. Metal One and Metal Two will have mass data for each sample. Students should use the following formula to solve for percent composition:

$$\% \text{ mass of element} = \frac{\text{mass of element}}{\text{mass of compound}} \times 100 = \% \text{ composition}$$

4. For the remaining two samples, the teacher should provide the actual chemical formula. Students will then use the following formula to solve for percent composition:

$$\% \text{ mass} = \frac{\text{mass of element in 1 mole compound}}{\text{molar mass of compound}} \times 100 = \% \text{ composition}$$

Wrap-Up:

After students have demonstrated that they can solve for percent composition, teacher will administer the [% Composition Quiz](#) as a summative assessment.

Formative/Summative Assessment:

- Formative assessment: Monitor students work during practice time.
- Summative assessment: [% Composition Quiz](#)

Extension Activity for differentiation:

For students needing additional explanation or practice, the following resources may be used:

- [Percent Composition Explained](#)
- [Additional Practice](#)
- [Percent Composition](#)

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% Composition Quiz

Name:

Calculate the following % compositions:

1. Calcium Phosphate

2. Iron (II) Sulfate

Use complete sentences to answer:

3. Explain the importance of alloys in the ductile iron.