

Green Eggs and Ham

Why do the yolks of some hard-boiled eggs turn greenish in color?

Background: The yolk of an egg contains *iron*. The white of an egg contains *sulfur* in the bonds of the protein. When you cook an egg the sulfur is released from the protein in the form of *hydrogen sulfide* gas. The smell of cooking egg is due to the hydrogen sulfide gas. ***Gas is less soluble in hot solutions and is more soluble in colder solutions.*** As you boil an egg, the egg begins to heat up faster on the outside causing the hydrogen sulfide gas to move toward the center of the egg where it is cooler and more soluble. When the hydrogen sulfide gas reaches the yolk it immediately begins to react with the iron in the yolk to form the iron (II) sulfide, which is a green color. To prevent the yolk from turning green you need to get the hydrogen sulfide gas to move away from the center so it can't react with the iron in the yolk. To do this you need to make the outside of an egg cooler than the inside so that the hydrogen sulfide gas will migrate outwards. *(The green compound is not harmful in anyway but most people would prefer a bright yellow yolk to a green one.*

Materials:

- 2 eggs
- Boiling water
- Cold water

Procedure:

1. In a pot of boiling water, carefully place two eggs. Boil for 15 minutes.
2. At the end of the 15 minutes, remove the container from the heat source. Remove one egg and place it in a container of cold water. Leave the other egg in the hot water that it was boiled in.
3. Let the eggs sit in the water for about 30 minutes. Add ice to the cold-water container if necessary to maintain a cool temperature.
4. Peel both eggs and remove the yolks. Try to remove the yolks whole. Observe the results.

Analysis:

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| 1. What is the formula for the gas that reacts with the iron in the yolk to produce the green color? | 2. What is the formula for the green compound that is formed on the yolk? |
| _____ | _____ |

3. Write the balanced chemical equation for the formation of green compound on the surface of an egg yolk.

4. If you had 4.65 moles of hydrogen gas and sufficient sulfur, how much hydrogen sulfide would be produced?

5. If the reaction produced 237.5 g of iron (II) sulfide, how many moles of hydrogen would be needed?