

Candy Glass Recipe:

Making sugar glass is a very simple. It is essentially a mixture of sugar(s) and water heated to the right temperature to first dissolve the sugar and then boil off most of the water, stopping at the appropriate temperature to form a “glass” on cooling. The temperature at which we stop boiling the mixture is directly linked to the residual water content which must be low enough to form the glass state of a hard candy. If the temperature is too low a softer, non glass, taffy-like candy will result instead (or even just a syrup). Some care must be taken to avoid having the highly concentrated sugar solution form sugar crystals on cooling rather than remain in the “frozen liquid” state of the glass. Stirring can initiate this crystallization in high sucrose recipes. We will discuss crystallization in more detail later. For now let us begin with the simple recipe for hard candy below. It uses a mixture of sugars so crystallization is less likely to occur and should not pose any problem if you follow the recipe and avoid excess stirring.



Some of the ingredients and equipment you will need for the making of candy glass.

Recipe:

	Weight (metric grams)	approx. US volume measure
Cane sugar (sucrose)	120 g	½ cup
Karo corn syrup	60 g	~ ¼ cup
Water	20 g	4 teaspoons (2/3 oz)



In Preparation:



In addition to the ingredients listed above you will want to have the following equipment available:

- candy thermometer (digital recommended)
- 1 quart sauce pan (or 400 ml Pyrex beaker)
- spoon
- dish of cold water for testing the “doneness”
(soft ball / hard ball)
- notepad and pen to record temperature and test data

Making the candy glass:

Combine the water and sugars in a 1qt saucepan, mix and heat until the mixture boil.



Keep a thermometer in the sauce pan and note the temperature at which the mixture begins to boil (rapidly). $T_{\text{boiling}} = \underline{\hspace{2cm}}$.



Is it above the boiling point of water (100 C)? Can you explain why?



After the mixture has boiled for a while, notice when it becomes clear. Record the temperature for clearing. $T_{\text{clearing}} = \underline{\hspace{2cm}}$.

(This is an approximate measure of the solubility temperature for this mixture).

Testing for done (hard crack):

The temperature will rise as the water boils away. Once boiling begins, the temperature will rise slowly at first but as the water becomes less the temperature will begin to rise more quickly. You will want to go to about 150 C to get a good hard crack candy, but let's test for done-ness the old fashioned way and get some experimental data along the way.

At the beginning of heating notice how the hot liquid just drips from the spoon like a normal syrupy liquid. But as the heating continues (temperature above about 120) you should begin to notice how the liquid dripping from the spoon will thicken. Eventually you will see small threads forming from the ends of the drops as they fall from the spoon. As the boiling continues (and temperature rises) you should see more and more threadlike behavior. This indicates that a glass network is forming.

Ball Test: You can use the old fashioned method to test for done-ness. Once the threads begin to form, drop some of the hot syrup from the spoon into a dish of cold water. A "soft ball" will form when enough water has been removed to make a "taffy" (approx 130 C). As you continue heating the drops falling in the cold water will become hard and crunch when bitten into. (Be careful to let cool before putting into mouth). As the candy approaches 150 C, you will be able to hear a distinct "crack" as the drop of hot mixture fall into the cold water. This is called the "crack" state and your syrup is ready to make a good hard candy (sugar glass) when cooled.

For more candy glass recipes and candy glass experiments, visit our glass education webpage at www.lehigh.edu/imi/libraryglassedu.html

Some useful conversions:

1 cup sugar = 210 grams (measured by author)
= 225 grams (from <http://www.recipegoldmine.com/kitchart/kitchart2.html>)

1 cup Karo = 315 grams (measured by author)

1 cup water = 8 oz. = 237 ml = 237 g water



Understanding Glass – the Science and Applications

Some questions for reflection:

Make a list of some examples of glass that you are familiar with.

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Make a list of the properties of glass based on the list above and our discussion.

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Recall how a crystal, such as ice, melts. Compare its melting behavior to the way a glassy material, like hard candy, plastics or window (soda lime silica) glass melts.

What was the most interesting application of glass that learned about today?

