

# 20C Igneous Rocks

## How are igneous rocks classified?

Geologists divide rocks into three groups—igneous, metamorphic, and sedimentary—based on how they were formed. Igneous rocks are formed from the cooling of magma or lava either on or below Earth's surface. Many igneous rocks consist of mineral crystals. When magma cools, it usually includes the ingredients for more than one kind of mineral. As the magma cools, it begins to form mineral crystals. As the cooling continues, different mineral crystals form. Eventually the last of the cooled magma solidifies, locking all of the crystals in place, forming an igneous rock.

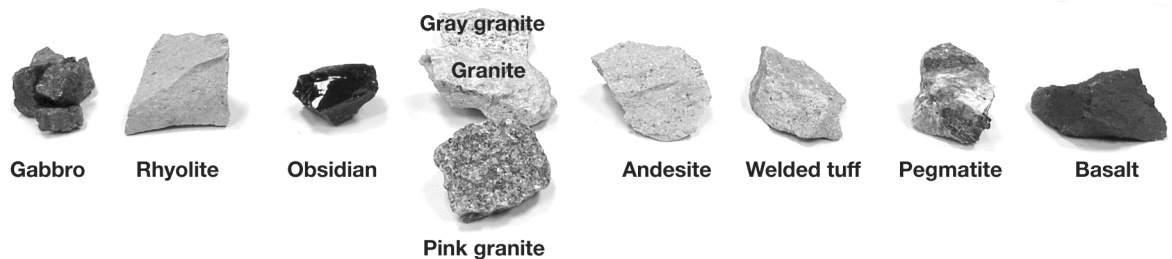
Some igneous rocks do not contain minerals with crystal structures. These rocks are formed when magma cools rapidly on the surface, not allowing the minerals to crystallize. Igneous rocks formed this way are known as volcanic glass. In this investigation you will learn how to classify igneous rocks. You will also determine how crystal size relates to the cooling rate of magma.

### Materials

- Igneous rock samples: gabbro, granite, basalt, andesite, rhyolite, obsidian, tuff, pegmatite
- Hand lens
- 2 small plastic dishes or saucers
- Table salt
- Plastic beverage cup
- Plastic spoon

## 1 Examining igneous rocks

1. Arrange the igneous rock samples on your table so that they can easily be examined.
2. Rocks are classified based on their texture and color. You will be classifying the rocks on your table based on these properties.
3. Use the hand lens and classify each of the rocks according to its color. Some rocks may have more than one color. Be sure to classify all of the colors you see. Record your observations in Table 1 in part 2.
4. Rocks are also classified based on their texture. Geologists define a rock's texture as the shape, size and pattern of the mineral crystals that make up the rock.
5. Classify each of your rock samples based on its texture. Place a check mark in each of the appropriate columns in Table 1 to classify your rock's texture.



**2** Rock classification

Table 1: Rock Classification

	TEXTURE							
	Color(s)	Fine Grained	Coarse Grained	Round	Jagged	Flat layers	Wavy	No Visible Grains
Granite samples								
Basalt								
Obsidian								
Andesite								
Rhyolite								
Gabbro								
Pegmatite								
Tuff								

**3** Stop and think

- a. Which of the rocks you observed were composed of larger, coarse-grained mineral crystals? Did these rocks have any other properties in common?

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- b. Which of the rocks you observed were composed of smaller, fine-grained crystals or no visible crystals at all? Did these rocks have any other properties in common?

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- c. Based on your observations and what you know about the formation of igneous rocks, which rocks do you think formed from magma that cooled quickly? Which of the rocks may have formed from magma that cooled very slowly?

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- d. Based on your answer to question c, predict which rocks may have formed below Earth's surface? Which rocks may have formed on or near the surface?

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#### 4 Doing the experiment

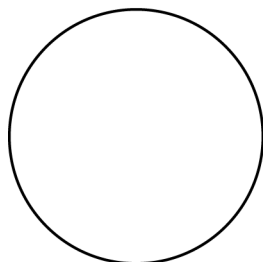
1. Add 4 heaping teaspoons of salt to a plastic beverage cup half-filled with water.
2. Stir this mixture for 1 minute. Not all the salt will dissolve because you have formed a saturated solution. This means the water has dissolved all the salt it can hold.
3. Pour a little of the salt solution into two dishes. Label one dish "warm" and the other "cool."
4. Place the dish labeled "warm" in a warm place such as over a radiator or near a sunny window. Alternatively, you can use a hair dryer to warm the liquid in this dish until it dries up. Operate the hair dryer on low speed at least 60 cm from the dish. You want to warm the salt water without blasting it out of your dish!
5. Place the dish labeled "cool" away from sources of warmth and light.

Make a prediction:

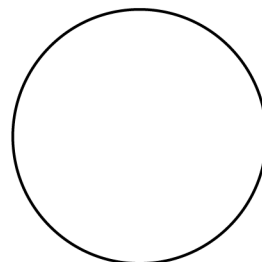
How do you think the crystals will look in each dish after the water has evaporated?

Draw a picture in each of the circles below to illustrate your prediction.

How do you think the crystals will look in each dish  
after the water has evaporated?



Cool



Warm

NOTE: Crystal growth is slow and will take more than one day.

6. Examine both dishes from time to time for the next few days until all the water has evaporated. You may want to record the temperature at each dish's location.
7. Make a table to record your observations.
8. Record the date, time, and the amount of water left in each dish at each observation. Describe the crystals in each dish. Use relative terms such as *slightly*, *more*, and *most* to record these observations. Measure and record the size of the largest crystal in each dish.
9. When the water has evaporated from one of the dishes, make a final inspection of both dishes. Both dishes will have large and small crystals, but one will have the largest crystals. Usually these largest crystals will form near the edges of the dish.
10. Record your final observations in the table you made in step 7 and 8.

## 5 Thinking about what you observed

### Part 1

- a. Which dish had more time to grow crystals? Which dish contained bigger crystals?

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- b. Write a conclusion sentence about the time available for crystals to form and the size of the crystals that form.

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### Part 2

The size of rock crystals depends on the amount of interaction among the materials in the magma that forms the rock. More time allows more interaction. As a result, slow-growing crystals tend to be bigger than fast-growing crystals. Anything that might slow the cooling of magma will provide that time.

- a. List two natural events or conditions on Earth (other than the methods you used in this investigation) that might slow the cooling of magma.

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- b. List two natural events or conditions on Earth that might speed up the cooling of magma.

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## 6 Exploring on your own

- a. Go back to the rock samples you classified earlier in this investigation. Compare the appearance of each sample and look at the observations you made about each rock's texture in Table 1. Based on your work in this part of the investigation, which rocks formed slowly and which rocks formed quickly? Explain your answer to this investigation based on what you learned about crystal growth.

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- b. Igneous rocks that form on Earth's surface are *extrusive* and those that form underground are called *intrusive*. Based on your observations of the igneous rocks, which of the rocks are likely to be extrusive? Which are likely to be intrusive? Explain your answer.

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