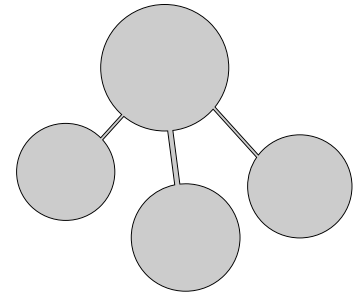


Content-Area Graphic Organizers

SCIENCE

Gina Hamilton



To the Teacher

Graphic organizers can be a versatile tool in your classroom. Organizers offer an easy, straightforward way to visually present a wide range of material. Research suggests that graphic organizers support learning in the classroom for all levels of learners. Gifted students, students on grade level, and students with learning difficulties all benefit from their use. Graphic organizers reduce the cognitive demand on students by helping them access information quickly and clearly. Using graphic organizers, learners can understand content more clearly and can take clear, concise notes. Ultimately, learners find it easier to retain and apply what they've learned.

Graphic organizers help foster higher-level thinking skills. They help students identify main ideas and details in their reading. They make it easier for students to see patterns such as cause and effect, comparing and contrasting, and chronological order. Organizers also help learners master critical-thinking skills by asking them to recall, evaluate, synthesize, analyze, and apply what they've learned. Research suggests that graphic organizers contribute to better test scores because they help students understand relationships between key ideas and enable them to be more focused as they study.

This book shows students how they can use some common graphic organizers as they read and write in science classes. As they become familiar with graphic organizers, they will be able to adapt them to suit their needs.

In the science classroom, graphic organizers help students:

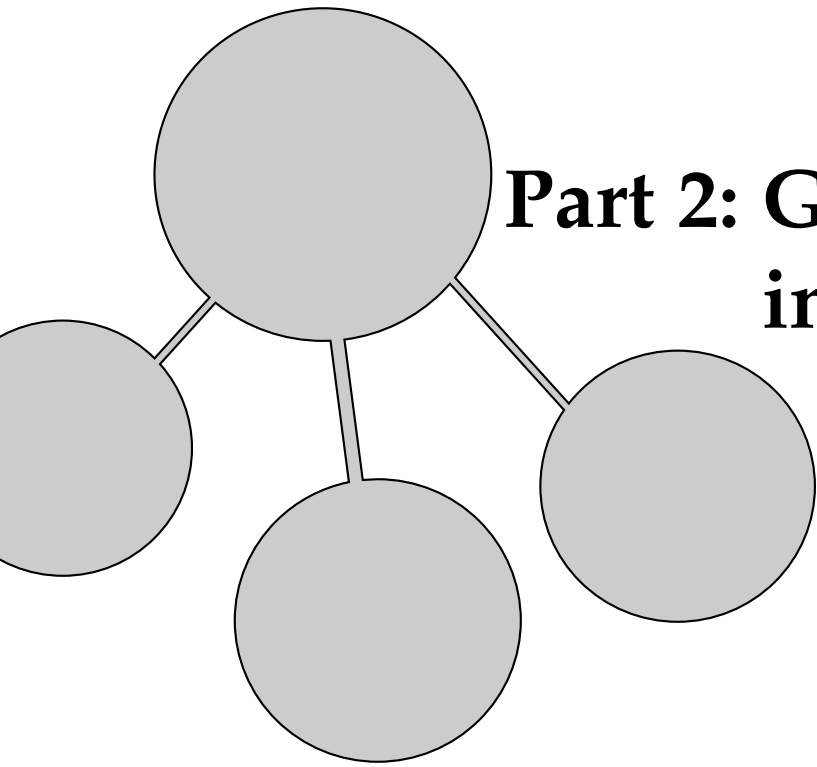
- preview new material
- make connections between new material and prior learning
- recognize patterns and main ideas in reading
- understand the relationships between key ideas
- organize information and take notes
- review material

This book offers graphic organizers suitable for science tasks, grouped according to big-picture skills, such as organizing knowledge and data; classifying information; comparing and contrasting; showing cause and effect; doing labs; and sequencing. Each organizer is introduced with an explanation of its primary uses and structure. Next comes a step-by-step description of how to create the organizer, with a worked-out example that uses text relevant to the content area. Finally, an application section asks students to use the techniques they have just learned to complete a blank organizer with information from a sample text. Throughout, learners are encouraged to customize the organizers to suit their needs. To emphasize the variety of graphic organizers available, an additional organizer suitable for each big-picture skill is introduced briefly at the end of each lesson.

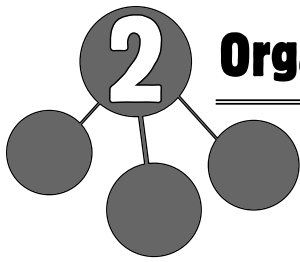
Content-Area Graphic Organizers: Science is easy to use. Simply photocopy and distribute the section on each graphic organizer. Blank copies of the graphic organizers are included at the back of this book so that you can copy them as often as needed. The blank organizers are also available for download at our web site, walch.com.

As learners become familiar with using graphic organizers, they will develop their own approaches and create their own organizers. Encourage them to adapt them, change them, and create their own for more complex strategies and connections.

Remember, there is no one right way to use graphic organizers; the best way is the way that works for each student.



Part 2: Graphic Organizers in Science



Organizing Knowledge and Data

In every area of science, information must be collected and organized. As a student in a science class, you may have to collect and organize information from many sources. Here are the most common:

- Collecting material from books, the Internet, magazines, and journals to write research papers
- Taking notes from observations and organizing them to analyze the data
- Collecting information from multiple sources and combining it into one organized form
- Collecting information from experiments and using it to write lab reports
- Organizing information from surveys
- Organizing information from brainstorming sessions

When you collect information from a source, you need to organize it and be able to recall it. Graphic organizers can help. In this lesson, we will take an in-depth look at two important graphic organizers that can help you organize data and knowledge—a web and a table. We will also take a quick look at another method you can use for brainstorming problems and answers.

Until it is organized, raw data is virtually useless. The reason for this is that there is no true context in raw data. Humans in science, as in every other content area, place meaning on the data they collect.

Here is an example. Let's say that you collect rocks. Each individual rock is beautiful and has specific qualities, such as mass, color, and texture. However, until you organize the rocks in some way, the collection has no meaning. If you group the rocks by categories—igneous, sedimentary, and metamorphic—the collection makes some sense. You might choose to group them in some other way—by mineral content, for instance. The order that you impose has to make sense for the way you want to use the material.

The same thing is true of facts and information. Organizing information and data is the first step to making sense of the material. After it is organized in some way, you can do the harder job of classification.

Webs How you choose to organize information depends largely on what kind of information it is. Some information lends itself more easily to webs, some to charts, and some to other sorting methods.

Webs are graphic organizers that can show how facts or ideas are related. Webs don't just show the information; they show the overall structure of the information and the connections between different pieces of information. Webs can help you associate ideas and make connections you might not otherwise have made. They can also help you group information into categories. You can use webs to summarize an article or a chapter in a book. They are also useful in the early stages of writing an essay, as they can help you organize your material and see how ideas fit together.

Webs are particularly useful when you have information that relates to a main topic but does not fit into a hierarchy.

Webs are also very useful when you are combining data from more than one person. For example, if you are partnered with another student, or grouped together into a field study team, at some point, you have to combine and evaluate the group's data.

Using Webs Use webs when you have a lot of data that can be organized into multiple categories. This is a common feature in science. You can use lines to draw the relationships. One piece of information might relate to several categories. Making a web is a free-flowing process, allowing you to illustrate multiple relationships.

There are many ways to create a web. For each approach, you will need to identify categories that fit your information. You will also define the relationships. This imposition of order need make sense only to you.

In a web, you write the main idea in a circle in the middle of a page. If you know what subtopics you want to consider, write them in circles around the center. Then write all your facts and information about the topic in circles around the subtopics. When you see relationships between different pieces of information, you can draw lines to connect them.

Once all the information has been recorded you can look at the web to see how the pieces of information fit together. Do the related pieces of information suggest categories that you could use to organize the material? Are there any patterns in the web? Do you need any more information to make the pattern complete? If so, what more do you need to find out? Here are some things to keep in mind as you create a web:

- Each piece of information should have its own space on the web.
- Pieces of information that relate to a larger category should be linked to that category. (You might have an idea of the categories you will be watching for

ahead of time, or you might not. Often, during an observation, new relationships and links become clear.)

- Check to see where data points can be cross-referenced. For instance, a single data point might relate to more than one category.

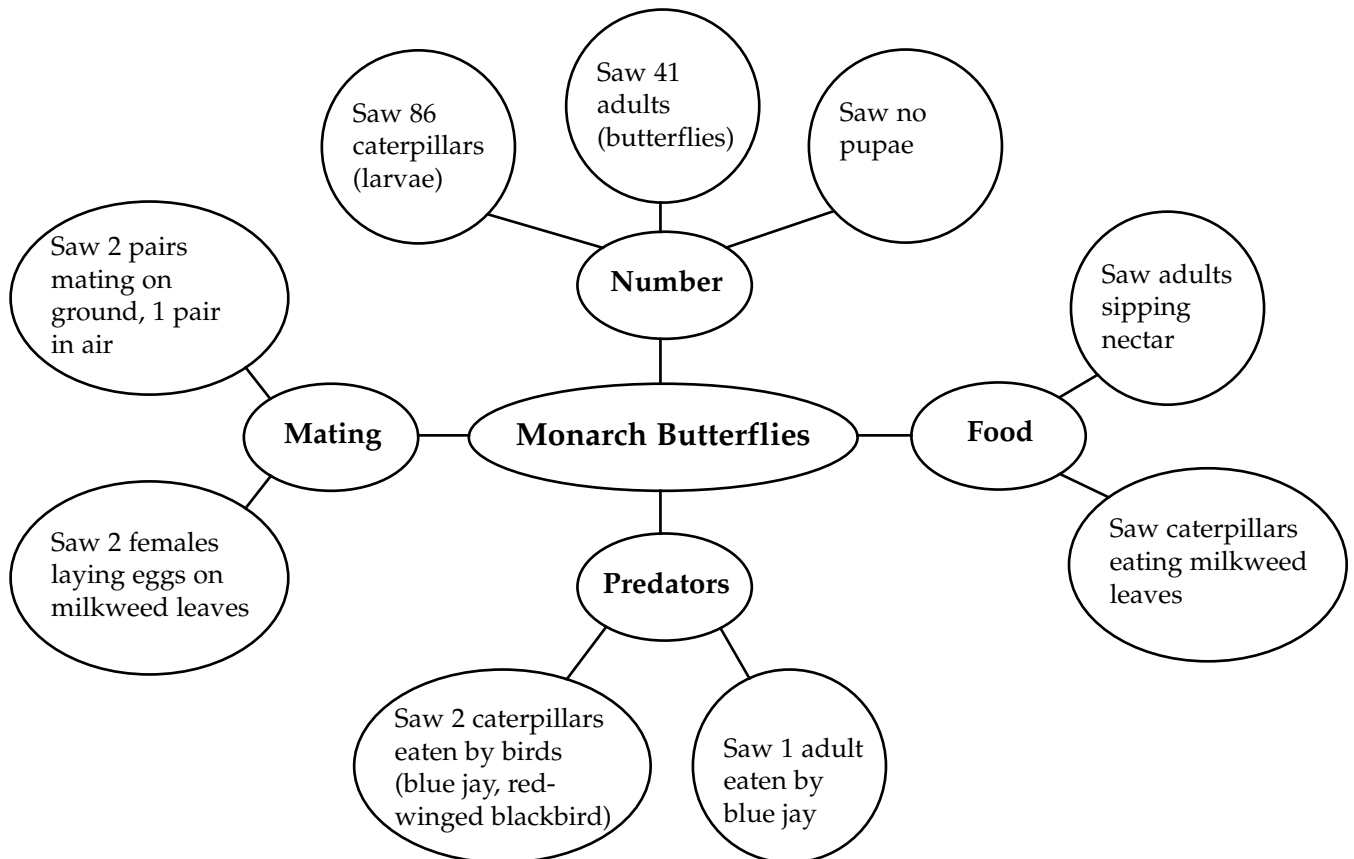
Webs in Action Here are the notes two students made as they observed monarch butterflies in the wild. Read the notes. Then look at the web that follows to see how the students identified categories for their observations and combined them in one web.

Nita

I saw 19 adult butterflies, 47 caterpillars (larvae), and no pupae. All the caterpillars I saw were on milkweed leaves, eating. I saw two caterpillars being eaten by birds (a blue jay and a red-winged blackbird). I saw two pairs of butterflies mating on the ground.

Caren

I saw 22 adults. Some were on flowers, sipping nectar. I saw 39 caterpillars eating milkweed leaves. I looked for monarch pupae but didn't see any. I saw two females laying eggs on the underside of milkweed leaves. I saw one butterfly pair mating in the air. I saw a blue jay eating an adult butterfly.



Application Read the essay on animals of the upper intertidal zone. Then use the web on the following page to categorize the information in the essay. Remember, as you read, you need to identify each piece of relevant information. Next, consider the categories you will use to organize the information. Then you can add the information to the web. Finally, review your web and add any new categories or information you think of.

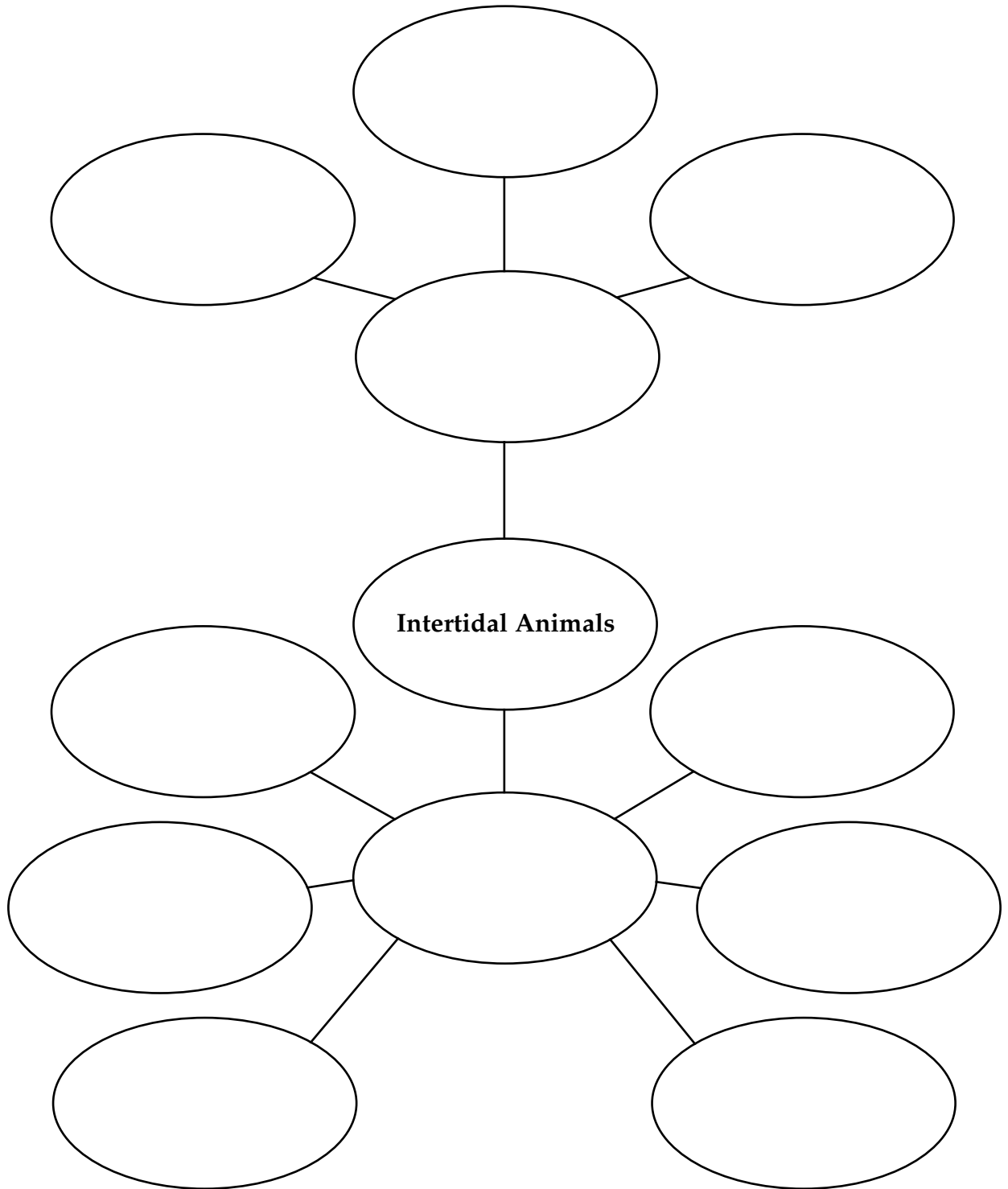
Observations of Intertidal Animals

We went to the Natural Bridges Park to observe animals in the intertidal zone. Because the tide was partially in, we were able to observe only the splash zone and high intertidal zone. We looked at organisms and looked them up in a field guide. We also wrote down which of the two zones we found them in and what their behavior was like.

We started in the splash zone, the highest zone above the water, where I found some gooseneck barnacles. They were attached to the rocks with what looked like some kind of glue, but I knew it was a natural secretion that the barnacles produced so they didn't get swept away. They were closed up. They only open when they are covered with water. The secretion that attaches them to the rocks is produced on their heads, so they are head down. When they open, their legs catch plankton to eat. We also saw a few crabs in the splash zone. They were hiding under rocks, but when disturbed, they scuttled across our path. Some of them were bluish-green. Others were a rusty orange color. We also saw many limpets clinging to the rocks. They seemed completely inactive.

Then we moved down to the high intertidal zone. This area is only covered at the highest tide of the day. We found sea anemones. Some, in high tidepools, were open, and their tentacles were waving. Others were all closed up. We also saw some sponges in the tidepools and a couple of little isopods, which were either young crayfish or lobster; we couldn't tell which. Also, we saw a couple of small fish in one of the tidepools. According to our guide, they were probably young opaleyes. Elsewhere in the high intertidal zone, we saw a lot of mussels. They were also cemented to rock. They were all closed up, too, because they don't open unless covered with water. Under the shelf of a rock, we found a whole bunch of sea stars. They were multiple colors—red, purple, and orange. One of them seemed to be trying to pry open a mussel shell.

Web Use the information in the reading to fill in the web below. Organize it in a way that makes sense to you. Remember, some pieces of information might apply to more than one subcategory. Add or delete boxes and lines as needed.



Tables Another great resource for organizing data is a table. Tables use categories to organize information. When the information you are trying to organize describes several items and attributes they have in common, a table is often a good organizer to use.

A table is simply a grid with rows and columns. Tables are useful because information stored in a table is easy to find—much easier than the same information embedded in text. Because of this, tables are helpful when you need to review material for a quiz or a test.

Using Tables Tables come in all sizes and shapes. The size and shape of a table depends, of course, on what's in it. When you're reading material that you will need to recall later, the first step is to think about how to take notes on it. Should you make a table, or should you take notes in some other form? If what you're reading is a description, a narrative, or a logical argument, it may not lend itself to storage in a table.

Usually, a table has a row (the horizontal part) for each item being listed. The columns (the vertical part) provide places for aspects of the listed items—the things they have in common. The places where the rows and columns meet are called cells. In each cell we write information that fits both the topic of the row—the thing being listed—and the topic of the column—the aspect being examined. To create a table, we make rows and columns to fit the number of items and attributes.

To make a table, start by deciding what items are being listed. Next, determine the categories of information that you will show in the table. Draw a table with the appropriate number of rows and columns for the items and categories. Write the items being listed at the start of each row. Write the aspects being examined at the top of each column.

Once you have the table set up, fill in the cells with information that fits both the row and the column. Finally, give your table a descriptive title.

Tables in Action Here is an article about star classification. Read the article. Then see how the information from the article has been organized in the table that follows.

Star Classification

There are millions of stars in the sky. To study them, astronomers have found ways to classify stars. The most common classification is based on a star's spectrum, or the type of radiation it emits. Using this system, stars are grouped into nine classes. Each class has a letter as a name. In order of decreasing temperature, the classes are OBAFGKM.

The hottest stars are O-type stars. These stars look bluish. Their temperature ranges from 28,000 K to 50,000 K. Their mass is from 20 to 100 times that of the Sun. Most O stars have lifetimes of about 3 to 6

million years. An example of an O-type star is Alnitak, located in the constellation Orion.

Next come B-type stars. These stars look bluish-white. Their surface temperatures range from 10,000 K to 28,000 K. Their mass is from 3 to 20 times that of the Sun. An example of a B-type star is Regulus, found in the constellation Leo.

A-type stars look white. Their surface temperatures range from 7,500 K to 11,000 K. The mass of most A stars ranges from 1.5 to 3 times that of the Sun, but A-type supergiants may have masses up to 16 times that of the Sun. An example of an A-type star is Altair, which is in the constellation Aquila.

F-type stars look white or yellowish-white. Their surface temperatures range from 6,000 K to 7,500 K. Their mass is from 1.2 to 1.6 times that of the Sun. An example of an F-type star is Canopus, which is part of the constellation Carina, the second-brightest star in the sky.

G-type stars look yellowish. Their surface temperatures range from 5,000 K to 5,800 K. Their mass is from 0.8 to 1.1 times that of the Sun. Our Sun is a G-type star.

K-type stars look orange or reddish. Their surface temperatures range from 3,500 K to 5,000 K. Their mass is from 0.5 to 0.8 times that of the Sun. Tau-Ceti, located in the constellation Ceti, is a K-type star.

M-type stars look orange or reddish. Their surface temperatures are less than 3,500 K. Their mass is from 0.5 to 1.3 times that of the Sun. Proxima Centauri, the nearest star to the Sun, is an M-type star.

Type	Color	Temperature Range (in kelvins)	Mass (as factor of Sun's mass)	Example
O	bluish	28,000–50,000 K	20–100	Alnitak
B	bluish-white	10,000–28,000 K	3–20	Regulus
A	white	7,500–11,000 K	1.5–3	Altair
F	white or yellowish-white	6,000–7,500 K	1.2–1.6	Canopus
G	yellowish	5,000–5,800 K	0.8–1.1	Sun
K	orange or reddish	3,500–5,000 K	0.5–0.8	Tau-Ceti
M	orange or reddish	< 3,500 K	0.5–1.3	Proxima Centauri

Application Read the essay below. As you are reading, think about possible categories for your table. Then use the information to make a table that shows the different kinds of reactions and what kinds of reactions each combination produced. Use the blank table on page 15.

Scientific Lab Solutions

In science lab today, we looked at several chemical reactions. Some were exothermic—they gave off heat. Others were endothermic—they attracted heat from the outside. Some had no heat transfer. Those without heat transfer showed the chemical reaction by a change in color, giving off a gas, or a precipitation of material at the bottom of the container.

First, we took a flask of supersaturated sodium acetate solution and put in a sodium acetate crystal. Immediately, the whole solution started turning into white crystals. We touched the outside of the flask; it was distinctly warmer.

Next, we took barium hydroxide and ammonium nitrate in a 2:1 ratio and mixed them in a small beaker. Almost instantly, the solution got very, very cold. When we took the temperature, it was -20°C ! The mixture did not change color. We did not see any precipitate.

Our next experiment was to take a solution of acetic acid and water, then add a tiny amount of phenolphthalein. The solution turned bright pink. Then we added a small amount of ammonia and water, and the color vanished. We did not notice any precipitate or any temperature change.

Our class was still not over. We combined acetic acid and sodium bicarbonate, and we observed gas rising from the solution as bubbles. This was a gas reaction; we learned that the gas was carbon dioxide. There was a slight warming of the solution, a difference of about 3°C . No precipitate appeared, and no color change occurred.

Finally, we added ten drops of aqueous lead nitrate solution to 100 mL of ammonia. We watched as the small pieces of lead precipitated out of the solution after it foamed up into a white, creamy soaplike gas. There was a slight cooling of the solution—less than a degree. In appearance, it changed from colorless to white.

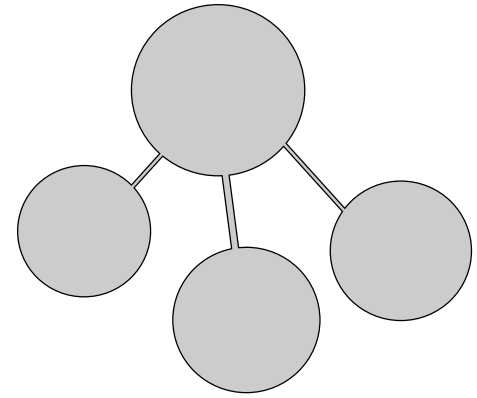


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Table Use the information in the article on page 14 to fill in the table below. Add or delete rows or columns as needed.

Chemicals Combined	Exothermic or Endothermic?	Gave off Gas?	Changed Color?	Precipitated?

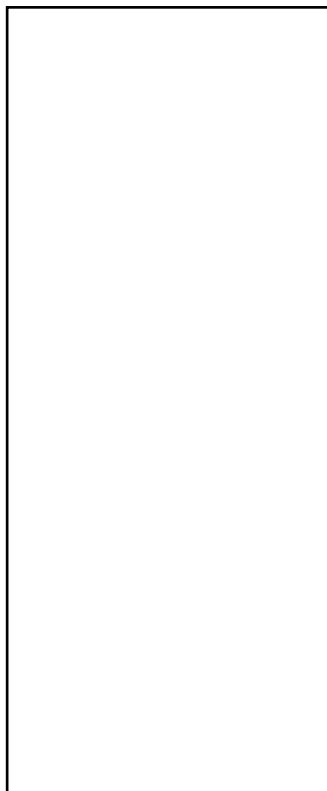
Problem and Solution Charts

We have looked at two types of organizers in this section, but there are many other ways to organize information. Here is another organizer you could use to brainstorm problems and solutions. Experiment with different ways to set up graphic organizers to find the ones that work best for you.

Write the problem in the horizontal box at the top. Write possible solutions in the vertical boxes. Once you have investigated the possible solutions, write the most successful one in the horizontal box at the bottom.



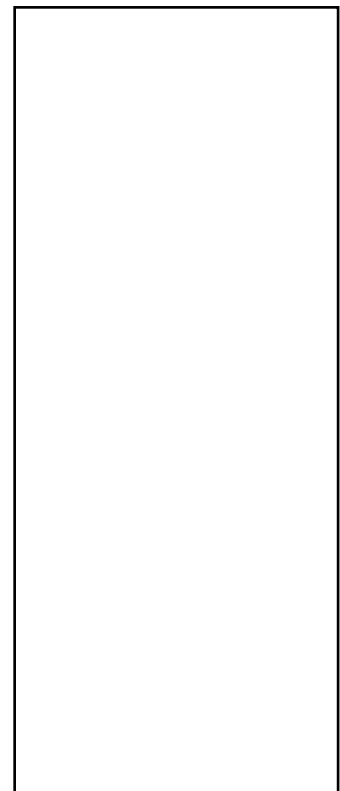
Problem



Possible Solution 1



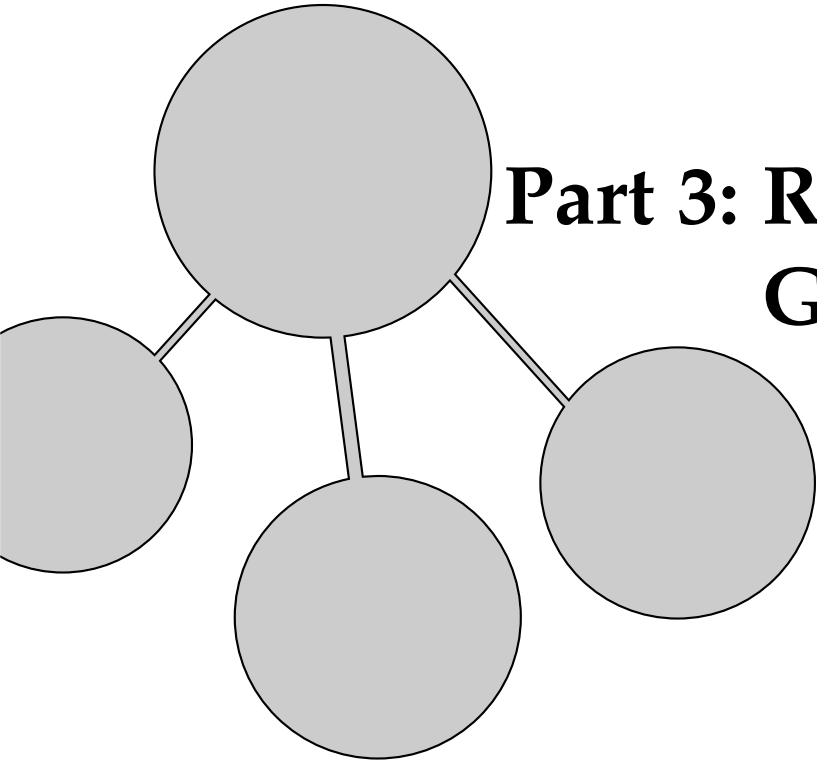
Possible Solution 2



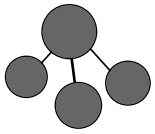
Possible Solution 3



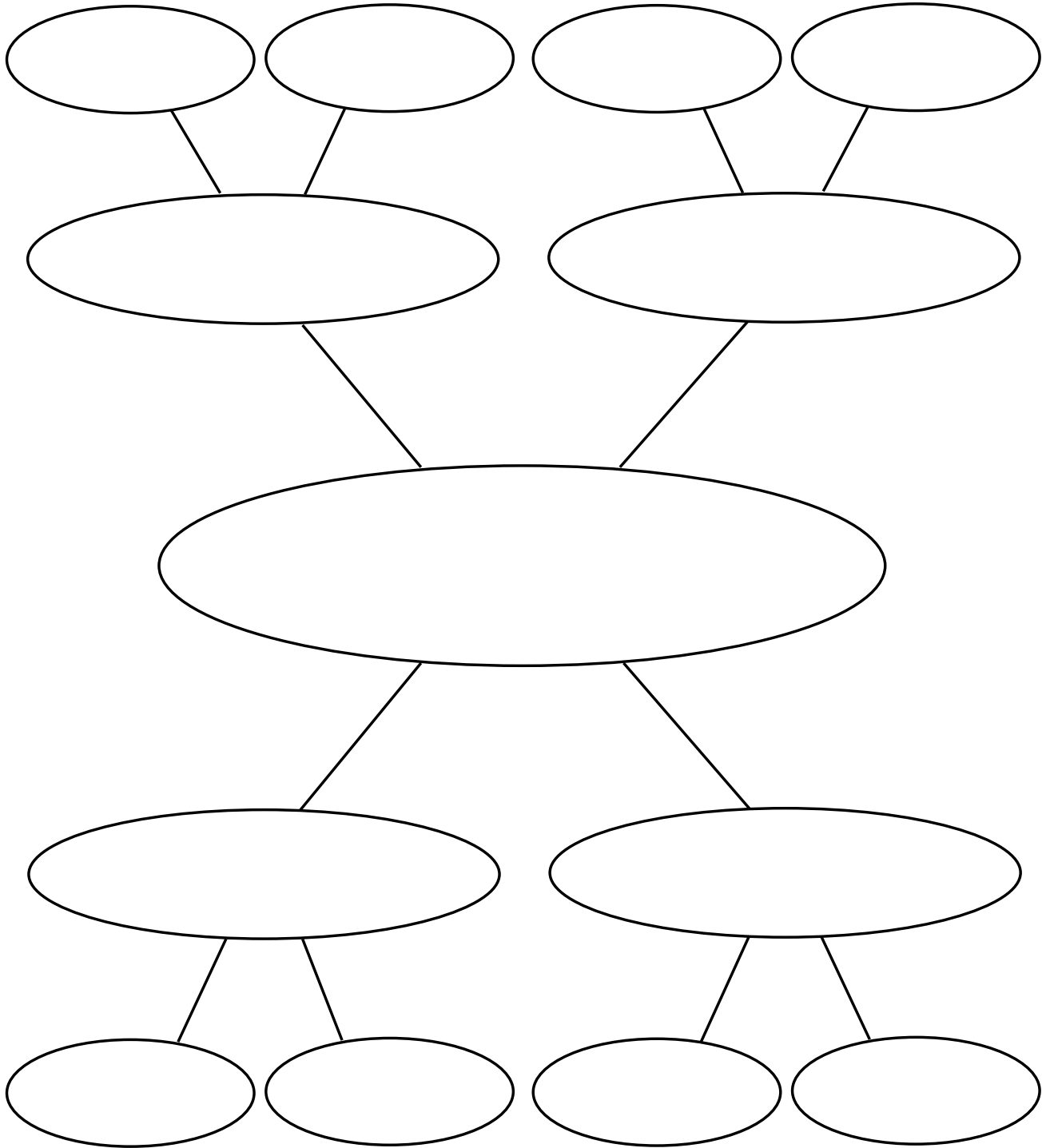
Best Solution

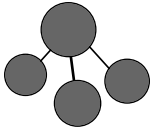


Part 3: Reproducible Graphic Organizers



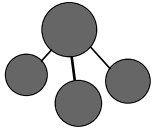
Write the main idea in the center oval. Write the information about the topic in the other ovals.
Add or delete lines and ovals as needed.





Table

Write the items being listed at the start of each row. Write the categories of information at the top of each column. Add or delete rows and columns as needed.



Problem and Solution Chart

Write the problem in the horizontal box at the top. Write possible solutions in the vertical boxes. Once you have investigated the possible solutions, write the most successful one in the horizontal box at the bottom.

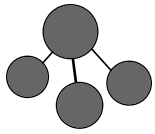
Problem

Possible Solution 1

Possible Solution 2

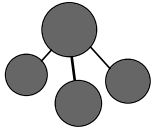
Possible Solution 3

Best Solution



Comparison Matrix

Write the characteristics to be compared across the top. Write the items to be compared at the beginning of each row. Add or delete rows and columns as needed. Then put check marks in the boxes where rows and columns meet to show that an item has a certain characteristic.



Venn Diagram

Write the names of the items to be compared in the circles. Write shared attributes in the overlapping area. Write unique attributes in the areas that do not overlap.

