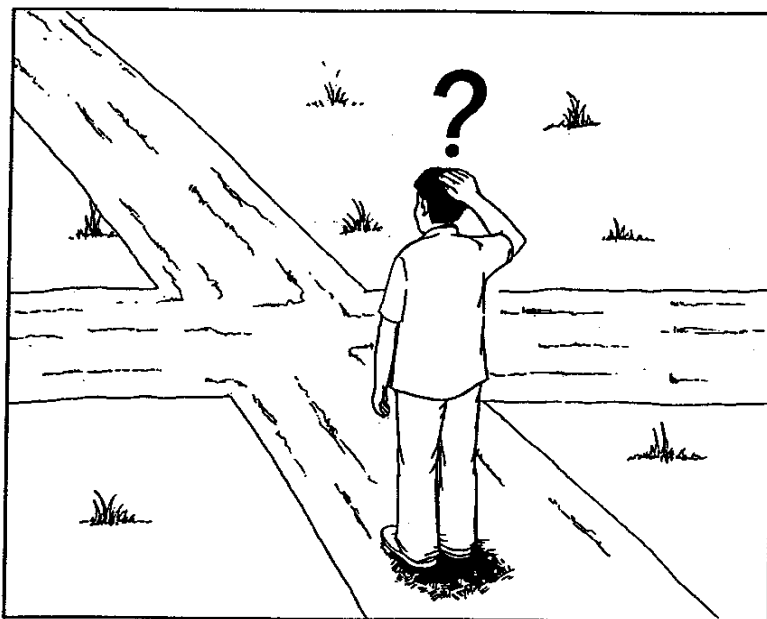




What Is This Module About?

Imagine yourself in an unfamiliar place. It is hot and you suddenly feel hungry. You want to rest under the shade of a tree and eat. But there are no trees and you have nothing to eat. The road seems to go on and on. But you continued walking until you reach a crossroad. You are suddenly faced with three choices, and you need to move on.



What are you going to do? Would you go left, right or straight ahead? What factors should you consider in making your choice?

In life, making decisions is very important. You may not be aware of it but you make decisions every day. You decide what to wear, where to go and how to get there. So, how do you come up with the best decisions?

This module will tell you all about this and more. You will be taught the process of scientific thinking. You will learn about the scientific method and how you can apply it in solving daily-life problems. You will also plan and carry out a simple investigation on some existing problems within your community. This way you may be able to help your community out.

This module is made up of three lessons:

- ◆ Lesson 1 — *The Scientific Method*
- ◆ Lesson 2 — *Applying the Scientific Method in Daily Life*
- ◆ Lesson 3 — *Applying the Scientific Method in the Community*



What Will You Learn From This Module?

After studying this module, you should be able to:

- ◆ identify the steps in the scientific method of problem solving;
- ◆ apply the scientific method in solving simple problems in daily life; and
- ◆ design/plan a simple study or investigation on an existing problem in your community.



Let's See What You Already Know

This module will tell you all about the scientific method of problem solving and how it is applied. Before you proceed, let's find out what you already know about the topic. Answer the following questions briefly.

Name the five steps in the scientific method.

1. _____
2. _____
3. _____
4. _____
5. _____

Give three advantages of using the scientific method.

6. _____
7. _____
8. _____

Give two problems that can be solved more easily using the scientific method.

9. _____
10. _____

Well, how was it? Do you think you fared well? Compare your answers with those in the *Answer Key* on page 26 to find out.

If all your answers are correct, very good! This shows that you already know much about the topic. You may still study the module to review what you already know. Who knows, you might learn a few more new things as well.

If you got a low score, don't feel bad. This means that this module is for you. It will help you understand important concepts that you can apply in your daily life. If you study this module carefully, you will learn the answers to all the items in the test and a lot more! Are you ready?

You may go now to the next page to begin Lesson 1.

The Scientific Method

We make decisions every single day. We may not be aware of it but we spend a lot of time thinking about whether to do one thing or another. The decisions we make are very important because they determine what will happen next. This is why we all want to come up with the best decision.

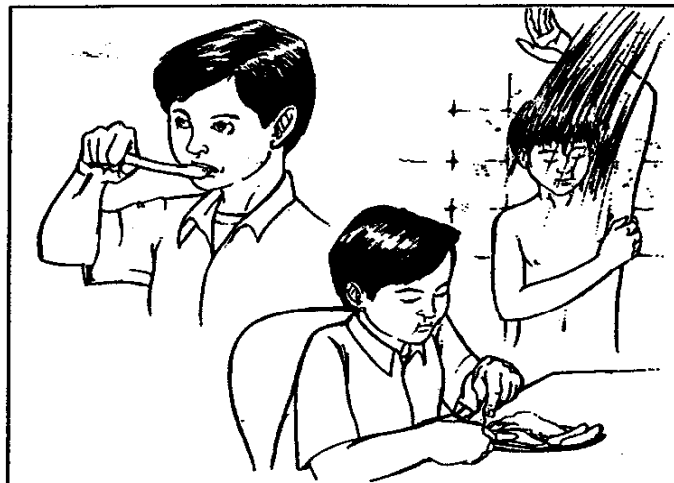
Making decisions is not as easy as it seems. Every problem needs careful study. We should first analyze the steps to be taken and assess all possible outcomes. We must always have a method of doing things.



Let's Try This

To find out whether you have a method of doing things, get a pen and a sheet of paper. Think of what you did this week to prepare for your learning session. List down in order the things you did from the moment you woke up to the time you get to the learning center. Do the same activities you did for the activity you did last week. Compare the two lists. Are there any similarities between them?

A **method** is a way of doing things. It is also called a **process** because it involves several steps that have to be followed before you can reach your goal. In the previous activity, chances are, you discovered that you have a method or process of preparing for the learning session. You brush your teeth, take a bath, have breakfast and prepare your bag almost every day, whether it is this week or last week. This is your method of doing things.



Of course, people have different ways of doing things. They may have different methods in preparing for school, work or the learning session. Ask your co-learners to make their own lists. What things do they do that you don't? You will discover that individuals differ from one another. Some of you may not eat breakfast before going to the learning session because that's how it is at home. Others may not even take a bath!

Notice that you often follow the same steps in doing something. This is because they have proven most effective for you. They have become habits.

This lesson will tell you all about the scientific method. At the end of this lesson, you will realize that the scientific method is a very effective tool in coming up with decisions. It often gives the best results and is very simple to follow.



Let's Think About This

Have you ever heard of the term "scientific method" before? What do you remember about it? What do you think being scientific implies? Reflect on this before proceeding to the next part of the lesson.



Let's Learn

The **scientific method** is an approach to problem solving by following a series of steps.

The term **scientific** means referring or relating to, or used in science. To understand this term, recall the definition of the word "science". **Science** refers to the systematic observation and classification of natural phenomena in order to learn about them and bring them under general principles and laws.



Let's Think About This

If somebody tells you that your Instructional Manager (IM) is absent because somebody told him, would you believe him immediately? Would you go home right away because you have no IM? Or would you first make sure that your IM is absent?



Would you still go home if another co-learner told you that she saw your IM earlier? Which one would you believe more —the one who heard it from someone else or the one who actually saw your IM?

Being scientific means relying only on observable facts. The scientific method, therefore, refers to a series of steps taken to solve a problem using observable information. The next part of this lesson will discuss the steps in the scientific method.



Let's Learn

Steps in the Scientific Method

1. Identify the problem
2. Formulate a hypothesis
3. Gather data
4. Analyze the data
5. Formulate conclusions and recommendations

Identify the Problem

Knowing that you have a problem is important. But knowing what the problem is, is even more crucial. Identifying your problem gives you a goal and in many ways, determines the steps that you should take to solve it.

But what if you have a lot of problems at one time. You then have to learn to prioritize. Setting priorities means determining which problems to address first. This way, you will not be overwhelmed.



Let's Try This

What are some of the problems you are facing at present? Pause for a while to think of the many things you need to accomplish before the day ends. Then, list them all down. Afterwards, prioritize! Determine which problem needs to be addressed first. Look at the example below.

Things to do today

- 1 — Do homework
- 2 — Talk with classmates regarding project
- 3 — Buy a gift for Ana
- 4 — Greet Ana, it's her birthday tomorrow
- 5 — Meet a friend for lunch

In setting priorities, several factors have to be considered. But how important these factors are depend on how you view them.



Let's Learn

Factors to Consider in Prioritizing

Urgency

Top priority should be given to things that need to be done immediately. Set aside those that can be done later.

Rewards and Punishments

In the example given, doing your homework must be prioritized because your teacher might reprimand you if you fail to submit it on time. In other words, you considered doing your homework a priority because you want to avoid punishment. However, there may be cases when avoiding punishment may not be the main consideration for setting priorities. If your mother is sick in the hospital and you need to stay with her, perhaps you will decide to stay with her rather than do your homework. After all, attending to your sick mother would be more important than avoiding punishment for not doing your homework.



Doing homework

Staying with sick mother

Relative Ease

All other problems being equal, you can prioritize those that can be more easily accomplished. Calling a friend to greet her a happy birthday does not take up a lot of time. You can do this before doing your homework. Doing the easier tasks first may make your problem list shorter.

Formulate a Hypothesis

A **hypothesis** is a statement proposition assumed to be true for the sake of argument. Using the given example, you will be able to formulate the following hypothesis:

1. that your teacher will reprimand you if you do not do your homework;
2. that your classmates are all at home so you will be able to talk to them;
3. that you already have an idea as to what gift to give Ana;
4. that Ana will just stay at home so you will be able to greet her; and
5. that you will have no more important business to attend to.



Let's Try This

Imagine that you and your friend agreed to meet in the school canteen at 10 A.M. It is already 11 A.M. but he still hasn't arrived. List down on a separate sheet of paper five hypotheses to explain why he has not showed up yet.



Let's Learn

Gathering Data

Gathering data involves testing your hypothesis. This means that you should consider what can happen if you do or don't do what you are supposed to. In some cases though, it may also involve actually trying it out. This step can either prove or disprove your hypothesis depending on the data you will come up with.

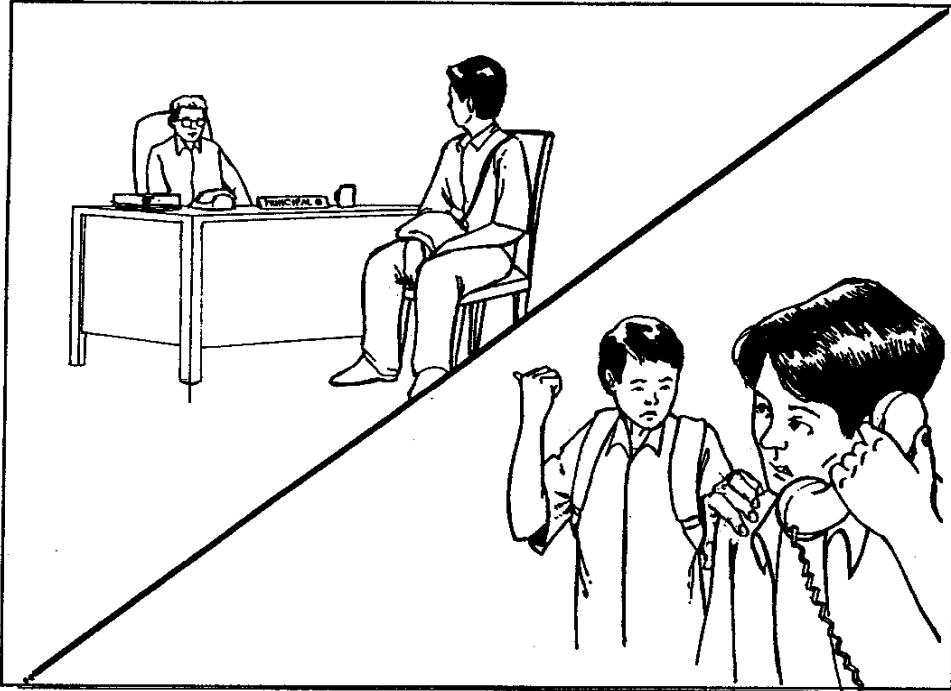
In the activity above, you can infer that something very important came up which could be the reason why your friend was not able to make it on time. He may be sick or have had to attend to an emergency. You can test this by calling him up at home or on his cellular phone, if he isn't at home or doesn't have a cellular phone, you can just wait for him and ask why he is late. If he doesn't arrive at all, you can find out the reason as soon as you get a chance to talk to him.

But one piece of evidence is not enough to prove your hypothesis. In fact, the more data you gather, the better. As in the case of a court hearing, the more evidence you have, the more solid your case will be. Gathering as much data as you can, before making an analysis or a decision, for that matter, can ensure the best possible solution to whatever dilemma you may be facing.



Analyze the Data

After gathering data, you need to study them and determine their reliability. If you called your friend's house, for example, and he is not there, what are the chances that he is indeed sick? What if another person who knows your friend dropped by the canteen and told you that he saw your friend at the principal's office, what would you do?



Make Conclusions and Recommendations

The last step in the scientific method is making conclusions and recommendations. A **conclusion** is a reasoned judgement. It summarizes your findings and suggests possible solutions to your problem based on the data you gathered.



Using the same example, based on the data you gathered, what would your conclusion be? So, since your friend was not at home when you called, you can conclude that he isn't sick. Besides, someone else saw him in school earlier. If he was seen going to the principal's office, you can infer that this may be the reason why he wasn't able to meet you.

Notice that the conclusion can either ACCEPT or REJECT your hypothesis. After formulating conclusions, you can then make recommendations. A *recommendation* is a suggestion on what to do next. In the given example, you can look for and talk to your friend to know what really happened. He may have a problem you can help him with which may forward another hypothesis to be tested. Hence, the scientific method goes round and round like a cycle as long as there are problems to solve.



Let's Try This

Use the scientific method to solve the following problem: you lost your wallet. What steps are you going to take to solve this problem?

Fill up the following experiment paper.

Problem:	_____

Hypothesis:	_____

Observations:	
	1. _____
	2. _____
	3. _____
	4. _____
	5. _____
Analysis:	_____

Conclusion:	_____

Recommendation:	_____



Let's Think About This

You may not notice it but you use the scientific method every day to solve problems and make good decisions. Now that you learned how the scientific method is carried out, you can start using it in your daily life. Imagine what life would be like without the scientific method.



Let's See What You Have Learned

Read the statements below. Determine which step in the scientific method applies to each.

1. Calling up a friend to find out if he is at home

2. Looking at the school records of your brother

3. Deciding that your brother should stop going to school

4. Saying that your brother is often absent from school because he stays at his friend's house

5. Finding out that one's school records have conflicting information

6. Failing in school

7. Saying that your brother has a stomachache from eating too much chocolate

8. Deciding to eat vegetables instead of meat

9. Asking for a raise in your allowance

10. Asking cousins in college what course you should take

Compare your answers with those found in the *Answer Key* on page 26. Did you get a perfect score? If you did, that's very good. If you didn't, that's okay, too. Just review parts of the lesson you did not understand very well before going to the next lesson.



Let's Remember

- ◆ The scientific method is an approach to problem solving by following a series of steps.
- ◆ The following are the steps in the scientific method:
 - a. identify the problem;
 - b. formulate a hypothesis;
 - c. gather data;
 - d. analyze the data; and
 - e. formulate conclusions and recommendations.
- ◆ Prioritization is important. The following factors should be considered when setting priorities: *urgency, rewards and punishments* and *relative ease*.
- ◆ The scientific method can be used over and over as long as there are problems to solve.

Applying the Scientific Method in Daily Life

In Lesson 1, you learned what the scientific method is. The scientific method is a wonderful process that helps you come up with very good solutions for your problems. But can it be actively applied to simple life situations?

In this lesson, you will learn how to apply the scientific method to simple life situations. Are you ready to learn more?



Let's Try This

A very common problem for most people is how to avoid being late. Apply the scientific method in solving this particular problem. Follow the format given in a preceding activity.

Problem: I am always late for appointments.

Hypothesis: I do not allot enough time for all the things I have to do before leaving the house.

Observatons:

1. It takes me 30 minutes to take a bath.
2. It takes me 15 minutes to dress up and prepare my things.
3. It takes me another 15 minutes to eat breakfast.
4. It takes me five minutes to brush my teeth.
5. My travelling time will depend on where I'm going.

Analysis: I should allot at least two hours to prepare myself for an appointment. That is, one hour and five minutes preparation time and around an hour for travelling time.

Conclusion: I do not allot enough time for all the things I have to do before leaving the house.

Recommendation: I will therefore wake up earlier than usual whenever I have appointments so I can do all my rituals and still avoid being late.

From the sample experiment paper given, you can see how the scientific method can be used in solving daily life problems. You can see that the step-by-step method can really solve problems like time management which can, in the end, do a lot of good for you.



Let's See What You Have Learned

Think of a problem you are facing at present. Apply the scientific method in solving it. Follow the given format.



Let's Remember

- ◆ The scientific method can be used to solve even very simple problems in daily life.

Applying the Scientific Method in the Community

In the previous lesson, you applied the scientific method in solving a simple problem. You followed the steps to come up with the best results.

This time, you will learn how to apply the scientific method in solving community problems. This lesson will guide you on designing and conducting a simple study or investigation on an existing problem affecting your community.



Let's Try This

Go around your neighborhood. Take note of problems you see around. Keep your notes for use later.



Let's Study and Analyze This

As you were walking around your neighborhood, you came upon some health-and-environment-related problems. You then decided to conduct a study on this. Follow the steps given below.

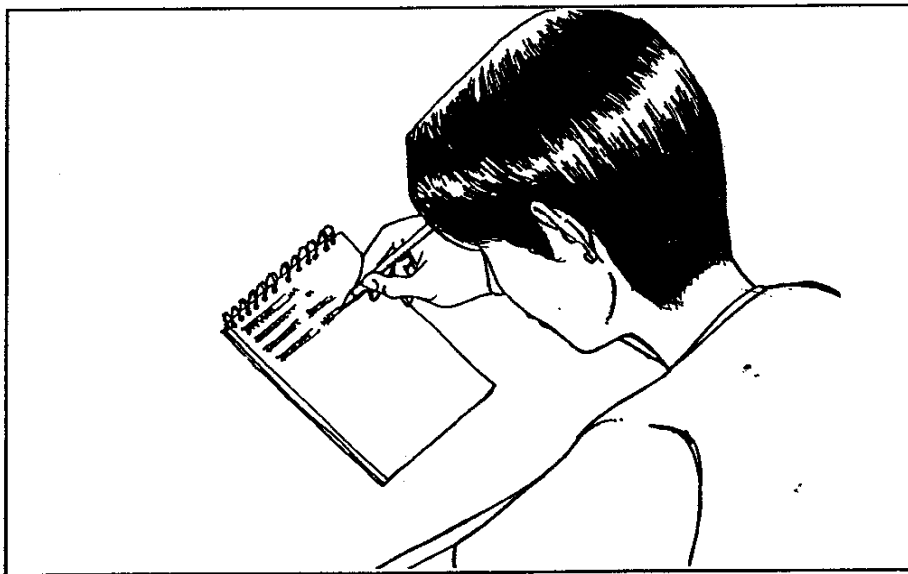
You noticed that a lot of children looked sickly and that the surroundings were not clean. You noticed that the manholes are not properly covered and that there are piles of garbage on the sidewalks.



Noting all of these, you decided to list down all the problems you came across with.



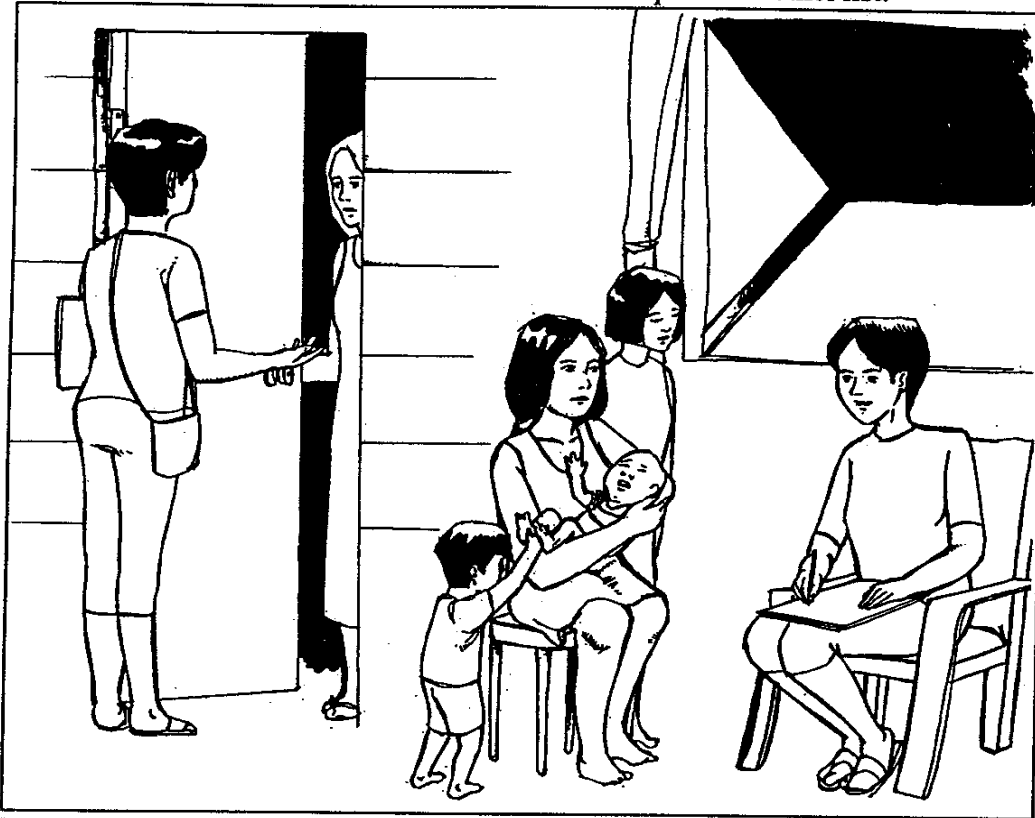
You came up with a list similar to the one below.



Community Problems

1. Improper garbage disposal.
2. Thin and sick-looking children.
3. Improperly covered manholes.

After listing down these problems, you came up with the following hypothesis: Many people in your community are becoming sick. To support your hypothesis you went from house to house. You asked what common illnesses affected the household members. You then came up with another list.



Identified Illnesses per Household

Household 1

- a. diarrhea
- b. fever
- c. cough and colds
- d. malnutrition
- e. intestinal worms

Household 2

- a. diarrhea
- b. infected wounds
- c. cough and colds

Household 3

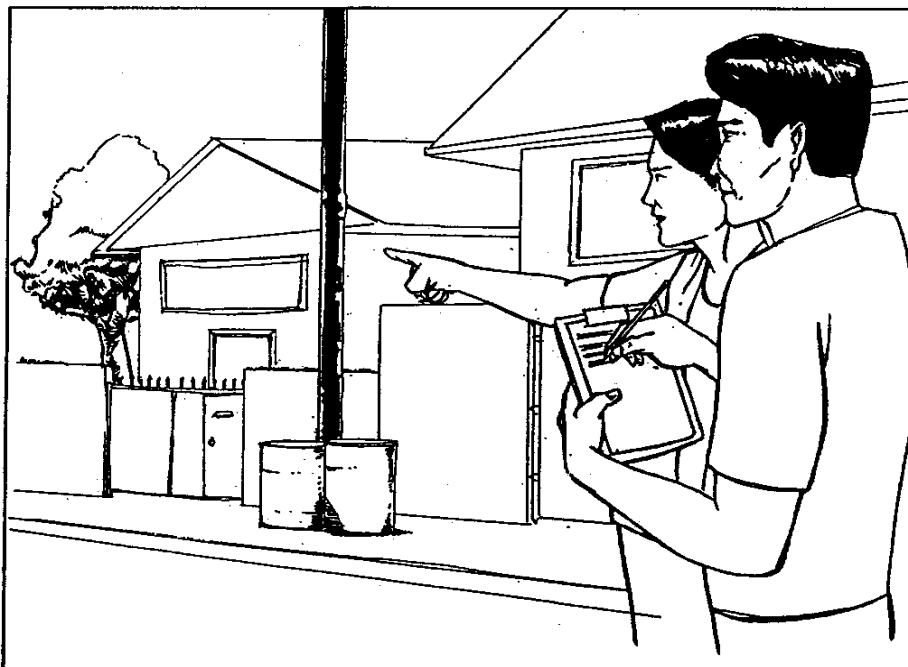
- a. fever
- b. diarrhea
- c. cough and colds

Of course your list can be longer. You should have interviewed a total of 30 households in your community. You can decide how many and choose which households to include in your survey in two ways: limiting and random sampling.

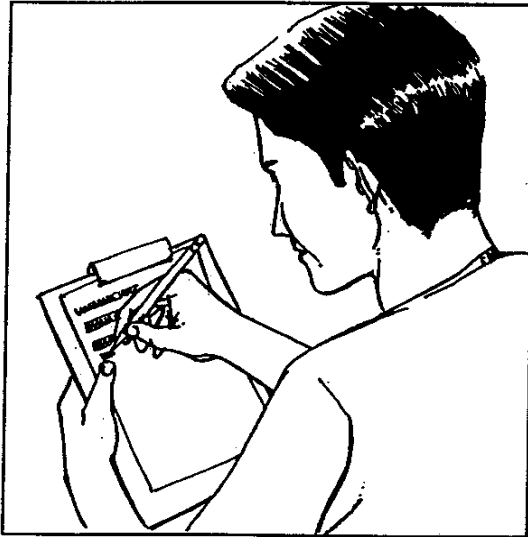
If you belong to a rather large community, you can apply **limiting** by including only those households within a certain area. You can conduct interviews only within, say two blocks away from your home.

Another method is called **random sampling** which means randomly selecting households by chance. This is also effective for big communities. Through this, each household has an equal chance of being included in the survey. The data that you come up with would then be an adequate representation of the community's responses. The following are the steps to follow in random sampling.

1. Seek the help of your community officials. Ask for a list of all the community members.



2. Write the numbers 1 to 5 on separate sheets of paper. Fold these and place in a jar. Pick one. For example, you picked the number "3."



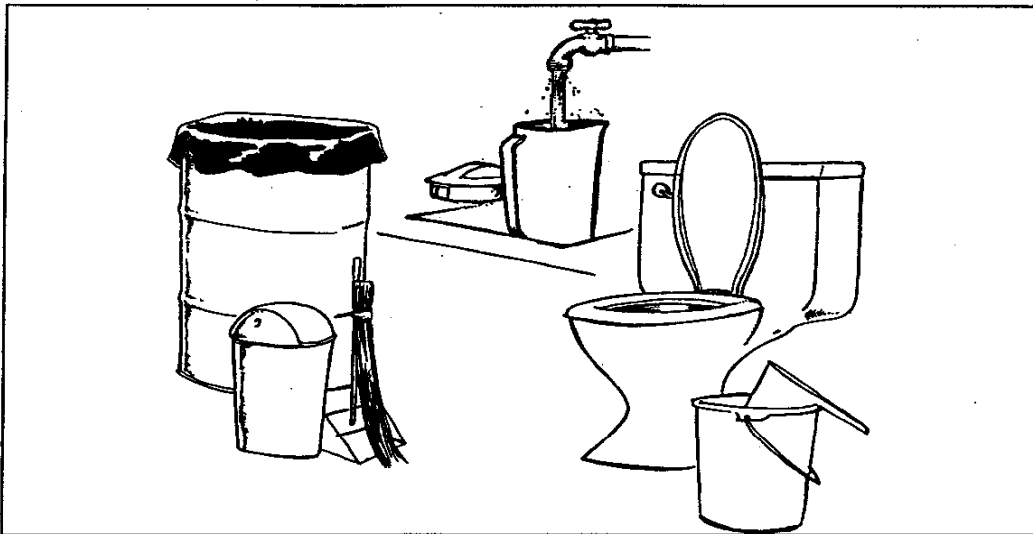
3. Using the list you obtained, pick every third household until you complete your list of people to interview. In this case, until you have listed 30 names.



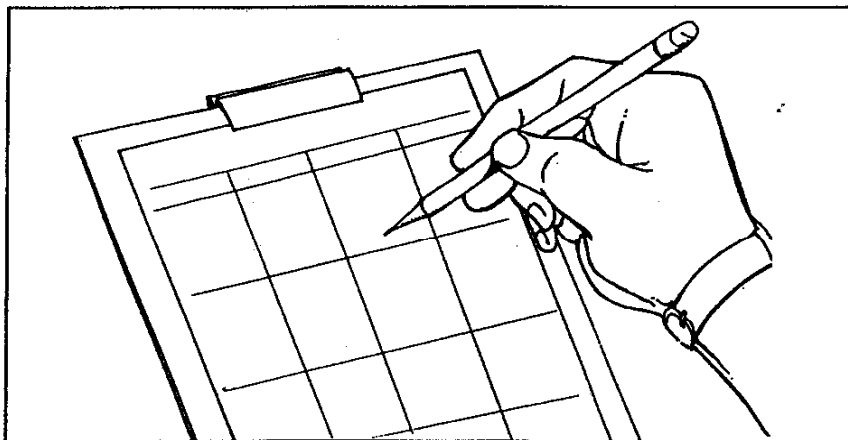
When you already have a list, start gathering data. Go from house to house and conduct interviews. Make sure you have the following materials for your interviews: a pen, sheets of paper for notes and an interview guide. Be sure to ask questions politely and tell the people you will interview the purpose of the interview. Record all your observations.



Take note of the cleanliness of your interviewee's homes too.



After completing the interviews, tabulate your findings.



You can classify your data as to:

1. Diseases from the most common to the least common.
2. Causes of diseases
3. Possible cures

Diseases	Causes	Cures
Diarrhea	Lack of potable water, etc.	
Fever	Infections, etc.	
Cough and Colds	Exposure to extreme temperatures, etc.	
Malnutrition	Lack of food, etc.	
Intestinal Worms	Dirty surroundings, etc.	
Infected wounds	Dirty Water (when there are floods), etc.	

Analyze the data you gathered. Determine which of the diseases you listed have something to do with your hypothesis. In this case, highlight the following: diarrhea, fever, intestinal worms and infected wounds. Identify the cures for these diseases and list them down in the table. The data in the table will help you formulate your conclusion and think of possible solutions or recommendations.

Afterwards, decide whether the data you were able to gather support or do not support your hypothesis. State your conclusion. Since you were able to identify diseases that are related to your problem, you can conclude that your observations indeed support your hypothesis. Then list down recommendations on what you and your fellow community members can do to prevent such diseases from spreading in the future. You can take note of these to complete your study.

Why don't you try doing this on your own? I'm pretty sure you can do it.

1. _____
2. _____
3. _____

Compare your answers with mine.

The following are some possible solutions to the given problem:

1. clean surroundings, dispose of garbage properly;
2. seek the help of your community leaders in covering open manholes;
3. make your own compost bin to lessen the garbage; etc. A compost bin is a sealed container, wherein you mix soil with manure and decayed plants for fertilizer.



Let's Remember

The scientific method can be used in solving not only personal problems but community problems as well.

Well, this is the end of the module! Congratulations for finishing it. Did you like it? Did you learn anything useful from it? A summary of its main points is given below to help you remember them better.



Let's Sum Up

This module tells us that:

- ◆ The scientific method is an approach to problem solving by following a series of steps.
- ◆ The following are the steps in the scientific method:
 - a. identify the problem;
 - b. formulate a hypothesis;
 - c. gather data;
 - d. analyze the data; and
 - e. formulate conclusions and recommendations.
- ◆ The scientific method can be used in solving not only personal problems but community problems as well.



What Have You Learned?

Apply what you have learned to the following situation.

Jose is concerned with the current state of his community. One day he noticed that there were a lot of dead fishes in a lake near his home.



Jose decided to investigate on this. He asked the people living nearby if this was a normal occurrence. They said it wasn't.

Jose took a sample of the water and had it analyzed in the laboratory where his father works. The results showed that the water contained high levels of harmful chemicals. Jose did further investigation and discovered that some factories were dumping chemical wastes directly into the lake. If you were in his place, what would your conclusion be? What are your recommendations? Write them in the space provided.





What Have You Learned?

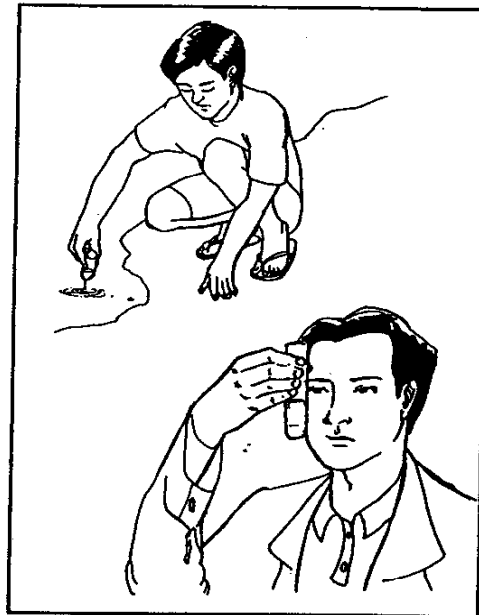
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Jose took a sample of the water and had it analyzed in the laboratory where his father works. The results showed that the water contained high levels of harmful chemicals. Jose did further investigation and discovered that some factories were dumping chemical wastes directly into the lake. If you were in his place, what would your conclusion be? What are your recommendations? Write them in the space provided.



Conclusion

Recommendations

Compare your answers with those in the *Answer Key* on page 27.



Answer Key

A. Let's See What You Already Know (page 2)

1. Identify the problem
2. Formulate a hypothesis
3. Gather data
4. Analyze the data
5. Formulate conclusions and recommendations
6. can save time and effort
7. is the most logical approach to solving problems
8. the best solutions can be arrived at
9. personal problems, such as deciding what course to take up in college
10. community problems such as health-related ones

The answers to numbers 6 to 10 may vary. If you are not sure if you got them right you may consult your Instructional Manager or Facilitator.

B. Lesson 1

Let's See What You Have Learned (page 12)

1. gather data
2. gather data
3. formulate a conclusion and a recommendation
4. formulate a conclusion and a recommendation
5. analyze the data
6. identify the problem
7. formulate a hypothesis
8. formulate a conclusion and a recommendation
9. identify the problem
10. gather data

C. What Have You Learned? (pages 24 – 25)

The following are some possible answers.

Conclusions:

1. The fishes in the lake died because of the harmful chemicals.
2. The pollutants came from the factories near the lake.

Recommendations:

1. Let the community officials know about the problem.
2. Organize community action against the erring factories



Glossary

Conclusion	A statement of decision
Data	Information
Experimentation	Used in Science, is the process of gathering and analyzing data
Hypothesis	A tentative or provisional solution
Method	A way of doing things
Prioritizing	Assigning relative importance to a set of problems
Science	A systematized body of knowledge based on facts
Scientific	A process used in Science
Scientific Method	A series of steps taken to solve a problem using information that are observable and based on facts
Systematic	Orderly
Urgency	The need to accomplish something in the soonest time



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Oram, R. et.al. Biology – Living Systems. 3rd edition. Charles E. Merrill Publishing Co., USA. 1979