Doctors Unlimited
A Summer in Colombia

Theory Examination

Student Information Document

Doctors Unlimited is an international relief organization that provides medical help to people in different countries.

You are a volunteer with *Doctors Unlimited,* assisting in a rural health clinic in Colombia, South America.

In your first week, you are introduced to people who work in the clinic and they tell you about their situation.

"We do the best that we can here, but we have limited resources. Just last week, for example, we did not have enough blood in the blood banks for an injured farmer who needed a transfusion," explains Dr. Juanita Davalos.

Dr. Davalos tells you about some of her tasks at the health clinic, which include seeing patients and advising the Ministry of Health.

"I spend most of my time dealing with Chagas disease, a common disease in this area. Chagas disease can cause serious heart and stomach illnesses."

You will be helping Dr. Davalos with her various projects during your time in Colombia.

You have four tasks to complete. For each task, analyze the background information provided and answer the questions in your answer booklet.

Task 1: Preventing Chagas Disease

Dr. Davalos has reported an increase in the number of cases of Chagas disease in the area. As a result, the Ministry of Health is ordering that the local houses be sprayed with pesticide. Spraying will reduce the population of the "Kissing Bugs" that carry the disease.

The pesticides are applied using a hand compression sprayer. Dr. Davalos will need your help to train some of the locals on how to use the pesticide sprayers effectively.

Your task is to analyze the background information about the hand compression sprayer and then to use scientific principles to explain how the sprayer works.

Task 2: Troubleshooting

You found 2 sprayers stored in the back of the clinic. Dr. Davalos has asked you to make sure that the sprayers are working properly. When you test the sprayers, you discover that neither of the sprayers is working properly.

For each sprayer, your task is to analyze the information about the problems with the sprayer and then to decide which part(s) of the sprayer need to be checked.

Task 3: Fernando's fatigue

Fernando is a 15-year-old boy with Chagas disease. He is complaining that he feels tired all of the time.

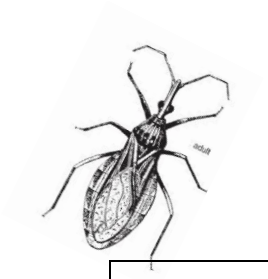
People with Chagas disease can develop **cardiomyopathy**, an inflammation and thickening of the heart muscle. The heart muscle may also become more rigid. You suspect that the reason Fernando is feeling so tired is because he has developed cardiomyopathy.

Your task is to describe the functions of the circulatory and respiratory systems to Fernando. Then, explain to him how the cardiomyopathy may be affecting these systems and making him feel so tired.

Task 4: Fernando's Abdominal Pain

Fernando has an enlarged and painful abdomen that is caused by an inflammation of the large intestine (colon). The inflamed large intestine is a complication of Chagas disease.

Your task is to explain to Fernando how food is normally digested and absorbed within the digestive tract. Then, explain how an inflamed large intestine (colon) could interfere with digestion.



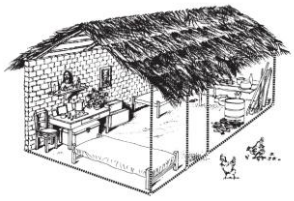
Chagas Disease Fact Sheet

What is Chagas Disease?

- A disease that occurs when humans are infected with the parasite *Trypanosoma cruzi*
- A disease spread by contact with an infected bug known as the "Kissing bug"
- A disease that can cause serious heart and stomach illness
- A disease that has killed more people than any other parasitic disease in the Americas

Who can get Chagas disease?

- Anyone can, but there is a greater risk for people living in rural areas of Mexico and Central or South America
- People living in houses with a thatched roof or walls that have cracks or crevices where the Kissing Bug can hide



How does someone get Chagas disease?

- Usually by being bitten by a Kissing Bug that is infected with the parasite that causes Chagas Disease
- The disease can also be spread through:
  - Mother to baby
  - Blood transfusion
  - Organ transplant

What are the Symptoms?

- A few weeks or months after people get bitten, they may have mild symptoms such as:
  - Fever and body aches
  - Swelling at the bite mark, which is usually the eye

- After this first stage of the illness, most people have no symptoms and many never get sick.
- Some people do get sick later, and they may have:
  - An enlarged heart and irregular heart beats
  - Problems with digestion and bowel movements
  - An increased chance of having a stroke

What tests can be done to diagnose Chagas disease?

- A blood smear can be examined under the microscope to check for the presence of the Chagas- causing parasite in the blood.

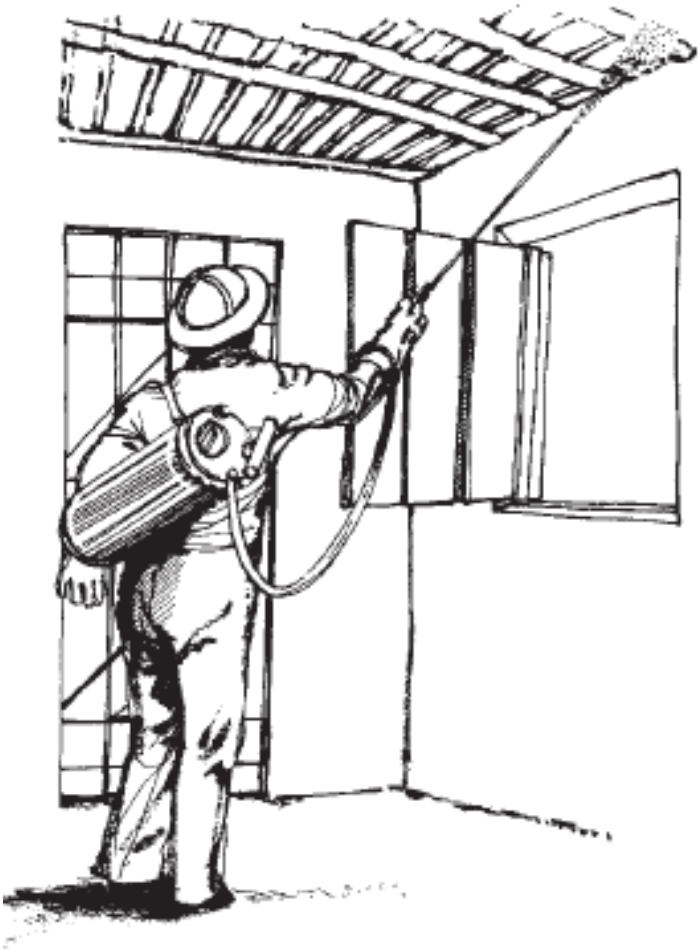
View of *Trypanosoma cruzi* parasites in the blood

- The blood serum can be tested for the presence of antibodies that are formed in response to the Chagas-causing parasite.

Tasks 1 and 2

Hand Compression Sprayer

A hand compression sprayer is used to apply pesticides to walls and roofs.



Components of Hand Compression Sprayer

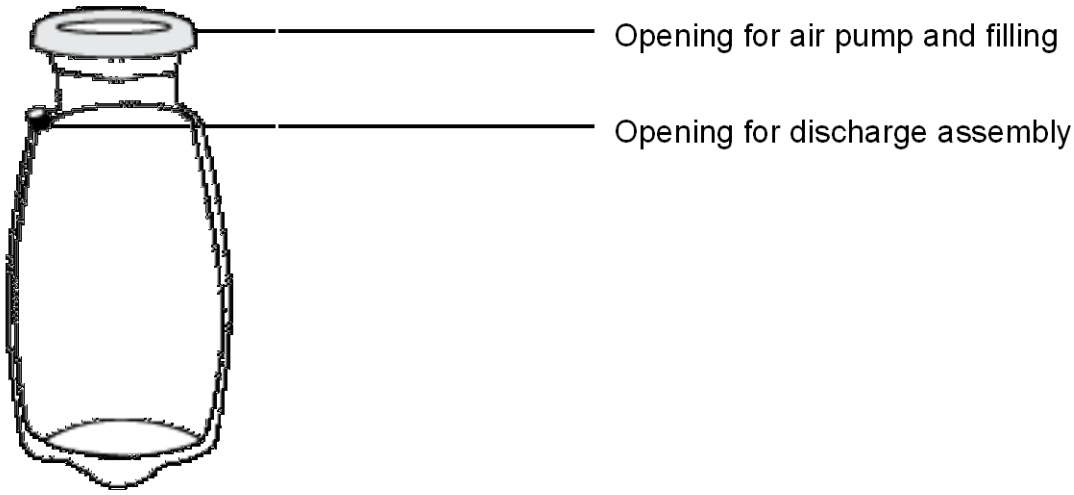
The main components of the pesticide sprayer are the tank assembly, the air pump assembly, and the discharge assembly.

Tank Assembly

The tank is filled with the pesticide for the spraying.

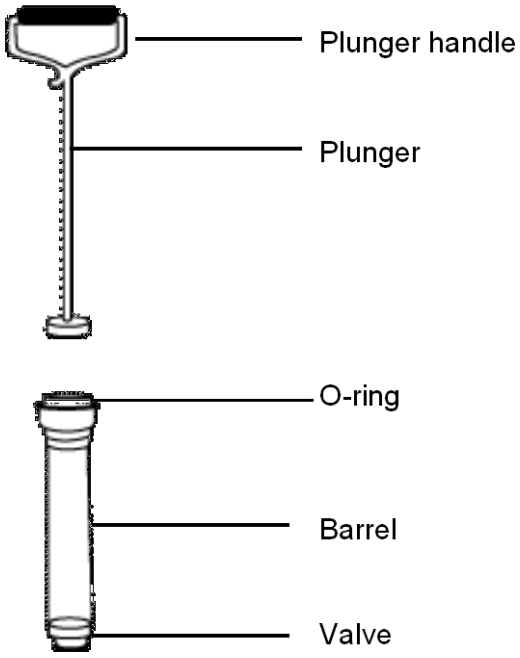
There are two openings in the tank assembly:

- A large opening for the air pump assembly and for filling the tank
- A small opening for the discharge assembly

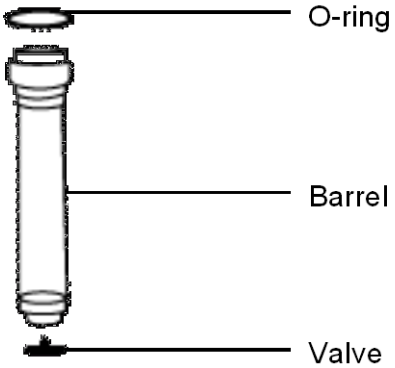


Air Pump Assembly

The air pump is used to force air into the tank. The air pump consists of a plunger that operates inside a cylinder. The plunger forces air through a valve at the base of the cylinder.



Exploded View of Air Pump Barrel



The **O-ring** is made of rubber and is used to seal the opening between the air pump assembly and the tank assembly.

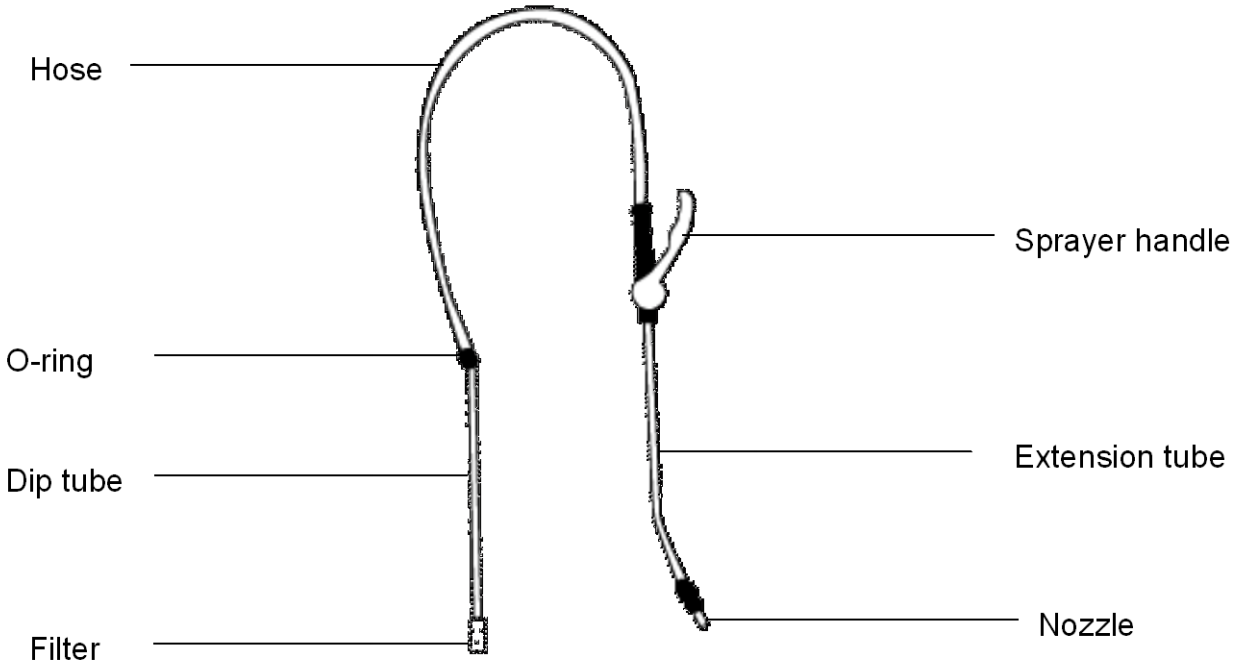
The **valve** is made of rubber and allows air to exit the pump barrel when the sprayer is pumped, but does not allow the pesticide or air to enter the barrel.

Discharge Assembly

The pesticide is forced out of the sprayer through the discharge assembly.

The main parts of the discharge assembly are:

- A **dip tube** that dips into the pesticide and is mounted in the tank with an O-ring
- A **filter** on the end of the dip tube that filters out particles too large to pass through the nozzle opening
- A flexible **hose**
- A **sprayer handle** that opens the cut-off valve when it is pressed down, allowing the pesticide to exit the sprayer (The cut-off valve is located inside the sprayer handle.)
- An **extension tube**
- A **nozzle** that can be adjusted to vary the rate and shape of the spray

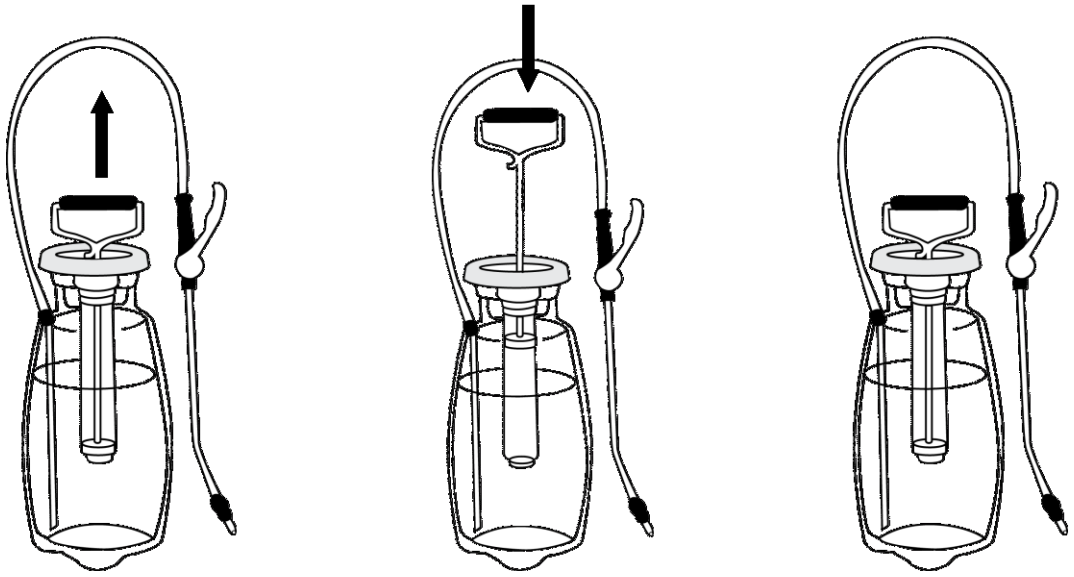


Sprayer Function:

1. Pressurizing the tank

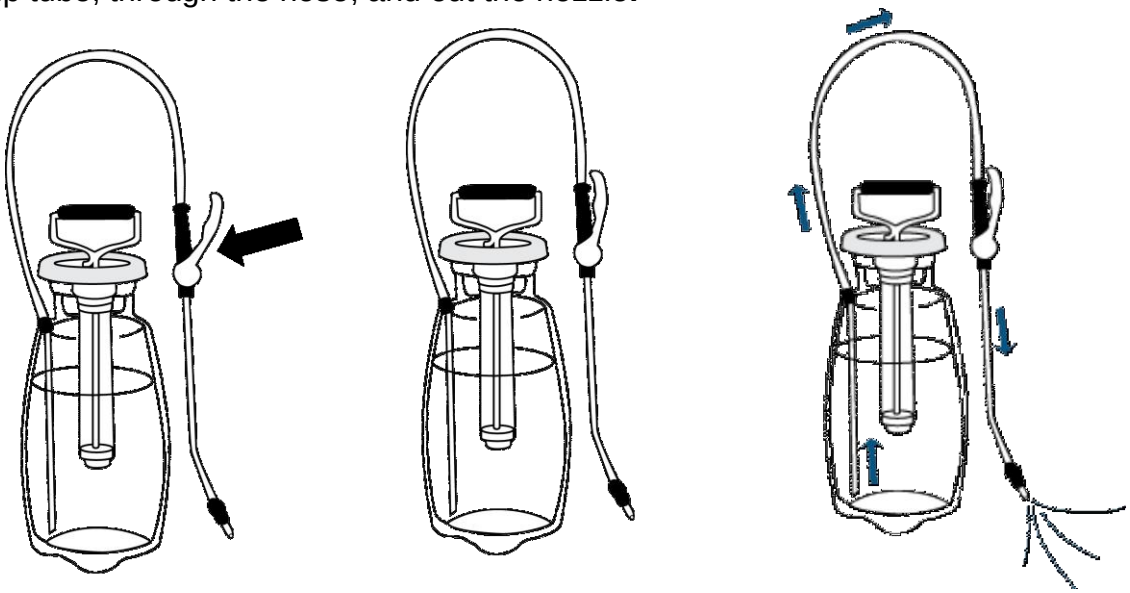
The tank is filled part way with the liquid pesticide and the air pump is used to force air into the tank.

The pump handle is pulled up and then pushed back down several times until resistance is felt.



2. Spraying the Pesticide

The sprayer handle is pressed down it opens a valve in the hose, and the pesticide is forced up the dip tube, through the hose, and out the nozzle**.**

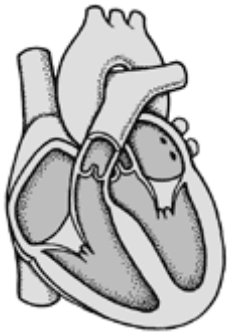


Task 3: Fernando's Fatigue

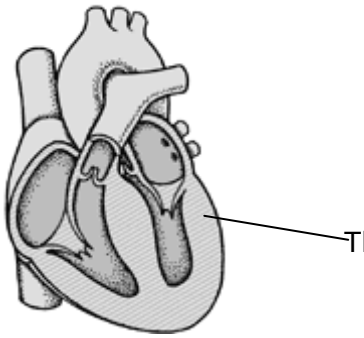
Cardiomyopathy

Cardiomyopathy is an inflammation and thickening of the heart muscle. The heart muscle may also become more rigid.

Normal Heart

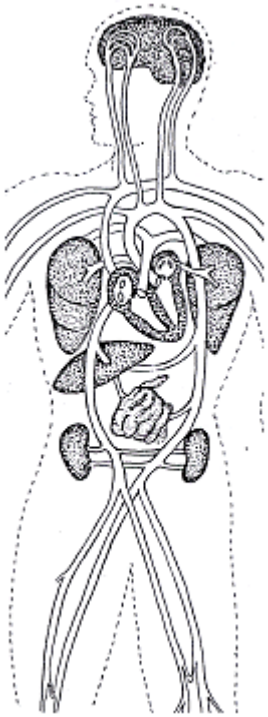


Cardiomyopathy



http://www.daviddarling.info/images/cardiomyopathy.gif

Circulatory System



Respiratory System

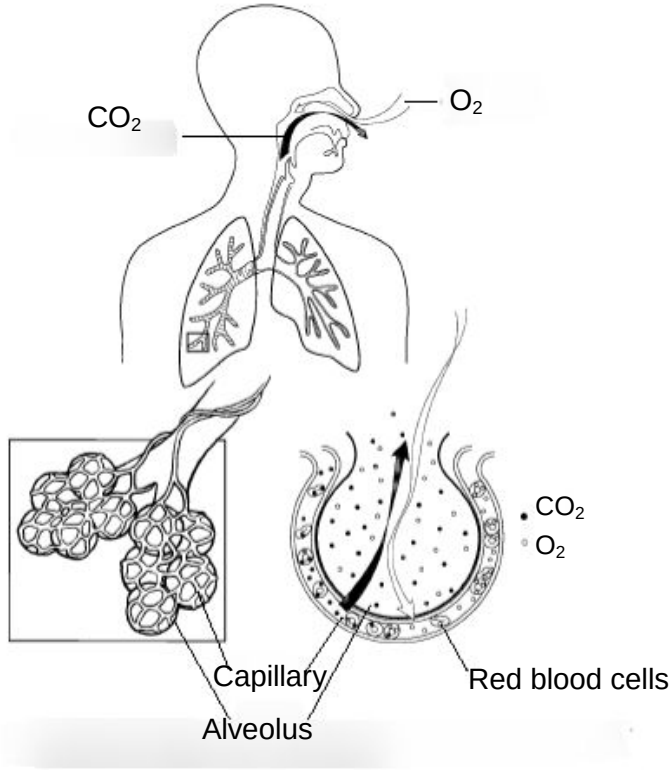
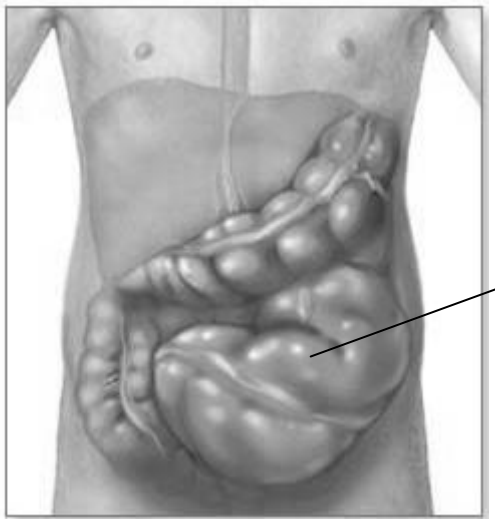


Diagram courtesy of National Heart, Lung, and Blood Institute

Task 4: Fernando's Abdominal Pain

An enlarged large intestine is a complication of Chagas disease.



- The enlarged colon is caused by a loss of the normal smooth muscle tone of the wall of the large intestine.

Competency 2
Makes the most of his/her knowledge of science & technology
Non-descriptive Scale

Evaluation Criteria	Observable Elements	Scale 5 4 3 2 1
Criterion 2 **Appropriate use of scientific concepts, laws, models and theories**	• Makes use of concepts related to tasks to be performed	
Criterion 3 **Relevant explanations or solutions**	• Provides appropriate explanations, related to the tasks to be performed, by using the concepts, models, laws, and theories of science and technology. • Identifies the defective parts of the application.	
Criterion 4 **Suitable justification of explanations, solutions or actions**	• Provides justification for solution based on the background information and scientific or technological principles.	
	Overall Evaluation	

Legend:
5. Advanced 4. Thorough 3. Acceptable 2. Partial 1. Minimal

Competency 3: Communicates in the Languages Used in Science and Technology
Non-descriptive Scale

Evaluation Criteria	Observable Elements	Scale 5 4 3 2 1
Criterion 1 **Accurate interpretation of scientific and technological messages**	• Selects and interprets the elements needed for the task	
Criterion 2 **Appropriate production or sharing of scientific and technological messages**	• Organizes the elements of his/her message and • Adapts message to target audience	
Criterion 3 **Use of appropriate scientific and technological terminology, rules and conventions**	• Uses scientific and technological terminology	
	Overall Evaluation	

Legend:
5. Advanced 4. Thorough 3. Acceptable 2. Partial 1. Minimal

Note: Criterion 1 is not evaluated in this situation.

Competency 2: Makes the most of his/her knowledge of science & technology

Observable Elements --- Evaluation Criteria	. Advanced 5	Thorough 4	Acceptable 3	Partial 2	Minimal 1
Criterion 2 **Appropriate use of scientific concepts, laws, models and theories**	❑ Makes judicious use of concepts, which sometimes go beyond the requirements of the tasks to be performed	❑ Makes appropriate use of the main concepts related to tasks to be performed	❑ Makes use of some of the concepts that are related to the tasks to be performed.	❑ Makes use of concepts that are partially related to the tasks to be performed.	❑ Makes use of concepts that are entirely inappropriate to the tasks to be performed
Criterion 3 **Relevant explanations or solutions**	❑ Provides clear and detailed explanations related to the tasks to be performed, using the concepts, models, laws, and theories of science and technology. ❑ Identifies all possible defective parts of the application.	❑ Provides appropriate explanations, related to the tasks to be performed, by using concepts, models, laws, and theories of science and technology. ❑ Identifies most of the possible defective parts of the application.	❑ Provides limited explanations related to the tasks to be performed by using concepts, models, laws, and theories of science and technology. ❑ Identifies the obvious defective parts of the application.	❑ Provides explanations that are sometimes incorrect or not very appropriate to the tasks to be performed ❑ Identifies parts that are partly related to the problem as defective.	❑ Provides incoherent explanations that are unrelated to the task to be performed or does not provide explanations. ❑ Identifies parts unrelated to the problem as defective.
Criterion 4 **Suitable justification of explanations, solutions, or actions**	❑ Justifies solutions clearly by going beyond the background information and the scientific or technological principles involved	❑ Justifies solutions based on the background information and scientific or technological principles.	❑ Justifies solutions based in part on the background information and scientific or technological principles.	❑ Proposes solutions related to the task, but justification is not related to the background information.	❑ Proposes incoherent solutions that do not take the background information into account.

Competency 3: Communicates in the Languages Used in Science and Technology

Observable Elements --- Evaluation Criteria	**Advanced 5**	**Through 4**	**Acceptable 3**	**Partial 2**	**Minimal 1**
Criterion 1 **Accurate interpretation of scientific and technological messages**	❑ Rigorously selects and interprets all of the elements needed for the task, the selected elements are described in detail	❑ Selects and interprets the main elements needed for the task	❑ Selects and interprets some of the elements needed for the task	❑ Selects elements that are not very useful for the task	❑ Selects elements that are irrelevant to the task
Criterion 2 **Appropriate production or sharing of scientific and technological messages**	❑ Rigorously and coherently organizes the elements of his/her message ❑ Adapts message to target audience and clearly communicates it	❑ Correctly organizes the elements of his/her message ❑ Adapts message to target audience	❑ Organizes some of the elements of his/her message ❑ Partially adapts his/her message to target audience	❑ Lists the elements of the message without organizing them ❑ Does not adapt his/her message to target audience	❑ Lists an insufficient number of seemingly unrelated elements ❑ Does not adapt his/her message to target audience
Criterion 3 **Use of appropriate scientific and technological terminology, rules and conventions**	❑ Makes judicious and rigorous use of scientific and technological terminology, rules and conventions	❑ Uses appropriate scientific and technological terminology for all the concepts involved	❑ Uses scientific and technological terminology for the simplest concepts	❑ Uses basic terminology	❑ Uses inappropriate terminology

Note: Criterion 1 is not evaluated in this situation.