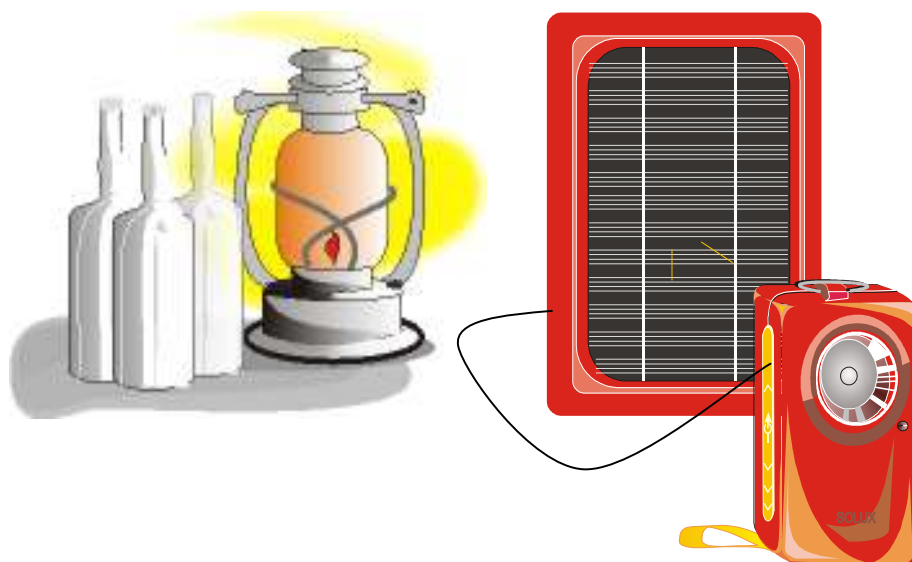


INSTRUCTIONAL MANUAL

Preoperational material for the introduction of solar lanterns to school children and their parents.



One Child One Solarlight



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INSTRUCTIONAL MANUAL

PROJECT 'ONE CHILD ONE SOLARLIGHT'

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ANNEX

1. INTRODUCTION

1.1 GENERAL OBJECTIVES

This manual aims at helping you to guide your pupils to identify the advantages of using the solar lantern, so that they, in turn, will encourage their families to acquire and use the solar products. We hope that this brochure will enable you to give at least a one-hour lesson on this subject. There is no doubt that creating awareness for the use of sustainable energy is an important aim for the education of children.

1.2 SPECIFIC OBJECTIVES:

By the end of the lesson, your pupils will be able to:

- i. Discuss solar energy
- ii. Other energy sources
- iii. The advantages of solar energy over other sources of energy

The manual will discuss:

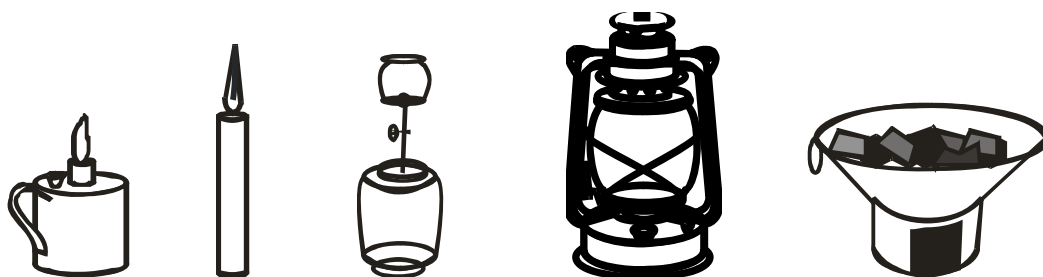
- a. Energy and sources of energy
 - i. Solar energy
 - ii. Fossil fuel
- b. Energy as a source of light
 - i. Kinds of lighting
 - ii. When we use the various kinds of light
- c. Advantages of solar energy over other sources of energy
- d. The solar lantern
- e. The advantages of the solar lantern over the kerosene lantern
- f. Acquiring the solar lantern

2. ENERGY

Energy is power. When we eat food, the food gives us energy. This energy is the power, strength, or ability to walk, talk, sing, run, and do other things that require physical strength.

Energy is also the power from coal, the atom, the wind and the sun, etc. These primary energy sources enable power plants and other energy devices as wind mills and photovoltaic solar modules to produce electricity which may be used to run machines and give us light when it is dark.

In the rural areas in Ghana, for example, we use firewood and charcoal to cook. We also use kerosene in lanterns to give us light in the night. The firewood, the charcoal and the kerosene are sources of energy. All human beings use one source of energy or another in their work or play.



DISCUSSION TOPIC 1

What are some of the sources of energy available to us in Ghana?

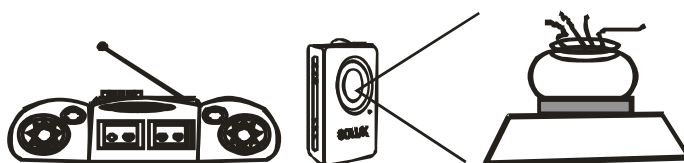


2.1 SOLAR ENERGY

2.1.1 What is Solar Energy?

Solar energy is power derived from the sun. This source of energy can be tapped to give cheap and environmentally friendly energy.

2.1.2 What can we use Solar Energy for?



Here are some uses of solar energy:

- Electricity to power radio & TV sets, mp3 music players, small fridges, recharge mobile phones, etc.
- Lighting our homes and streets, etc.
- Heating water, ovens for baking, etc.
- Drying things such as cocoa beans, freshly harvested maize, fish, etc.

2.1.3 Abundant Sunlight

We have so much sunlight in Ghana. In fact, in most parts of Ghana, the sun shines brightly for between nine and ten hours every day.

DISCUSSION TOPIC 2

What do we use sunlight for in Ghana?

What do you think will be the benefits if we could use the power of the sun in Ghana? If we could use the power of the sun to just light up our homes alone, we shall save much money. We can then use the money saved on equally important things such as paying our school fees and taking care of our health needs.

2.1.4 Do we use Solar Energy in Ghana now?

Yes. We use solar energy on a small scale, especially for lighting.

- A few homes in Ghana use solar panels to light up the homes at night.
- Until recently, the street lights on the campus, and in front of the University of Ghana campus used solar energy.

2.2 OTHER SOURCES OF ENERGY USED IN GHANA

2.2.1 Hydro-electric Power

Hydro-electric power is the energy that comes from water. A dam is usually built on a river to produce hydro-electric power. The Akosombo Dam and the Kpong Dam are two hydro-electric dams in Ghana. Most of us in the rural areas do not have access to the power from these dams to work our machines or to light up our homes at night. Also, people have to pay high bills when they use hydro-electric power.

2.2.2 Fossil Fuel (Petrol & Kerosene)

Another source of energy used in the rural areas is kerosene. The kerosene that we use in our lanterns in the rural areas comes from petroleum oil. Petrol and diesel for cars, and the gas some of us use in cooking our meals all come from petroleum. Petroleum oil is fossil fuel. Fossil fuel is formed from the decayed remains of plants and animals. When plants and animals die they get buried in the soil. After several thousands of years the remains of the plants and animals rot away, and the rotten remains turn into the raw material from which we get petroleum oil. Thus, petroleum oil is dug from beneath the surface of the earth, or the sea bed.

EXERCISE 1

1. Which of the following is not a source of energy? [Cross it out]
 - a. The food we eat
 - b. Electricity from the Akosombo Dam
 - c. Petrol
 - d. Diesel
 - e. Sunlight
 - f. Television sets
2. Write two sentences to say why we need energy.
3. From where do we get petroleum?
4. From what do we get solar energy?

2.3 THE ENERGY CRISIS

2.3.1 What is it?

There seems never to be enough energy for the world to use to work our machines, light our homes, cook our food, etc. One reason is that we rely too much on petroleum oil. The population of the world has also increased very much over the last 100 years. For example, before independence, some 50 years ago, Ghana's population was just about twelve million. Now we are over twenty million people. Because we do not have enough of it, the price of petroleum oil rises very often. The frequent rises in the price of fuel disturbs the smaller nations, especially those that do not mine petroleum oil.

One of the reasons why the prices of petroleum products rise often is that it is very costly to dig up petroleum oil. Also, very few countries in the world have natural reserves of petroleum. In addition, instability as a result of wars and other disturbances especially in countries that produce petroleum oil causes the price of petroleum products to increase.

We note that a rise in the price of petroleum products leads to an increase in the price of almost everything we buy. And the prices of petroleum products are not likely to go down in the foreseeable future. On the contrary, it is predicted that the prices will continue to go up. Why?

There are more and bigger cars, trucks, buses and machines in the world now. The petroleum reserves in the world are not infinite. Some of the countries that dig up petroleum oil now may not have any left to dig up in the next ten or twenty years. This means that there will be fewer nations digging oil for sale, but more people and machines needing the oil. So you see, the problem is not an easy one to solve.

Remember that we in the rural areas suffer much more from the rises in the price of petroleum products because we do not have much money.

2.3.2 Environmental Degradation

2.3.3 Pollution

Another problem caused by our reliance on petroleum oil is environmental pollution. Firstly, the cars and other machines that use petroleum oil emit fumes. The fumes from the cars and other machines contribute to global warming. Your parents will tell you that the weather is much much warmer now than it used to be when they were young. Also, the seasons are not as predictable as they used to be. These are some of the effects of global warming. Secondly, there is the effect on our health. The pollution from the fumes from the cars and other machines make us ill. We suffer from diseases such as cancers.

2.3.4 Deforestation

A second form of environmental degradation is caused by us, in the rural areas. We cut down the trees in the environment for firewood and charcoal. Cutting down too many trees without planting any trees to replace the ones we cut also contributes to global warming. Because we are cutting down the trees, the rains do not come when the season for the rains comes. These days, you have to go farther and farther away from the village to get some pieces of wood for your firewood or charcoal. Thus, the destruction we have caused to the forests and the use of petroleum oil have contributed to the change in the weather.

DISCUSSION TOPIC 3

Is there a way out for us? Can we help stop environmental degradation?

3 LIGHT AS A BASIC NEED

3.1 WHAT DO WE USE LIGHT FOR?

To start this discussion, you may create artificial darkness in the classroom by shutting all windows and doors. Then ask pupils to perform simple activities such read a word on the chalkboard, lift an object (for example, a pencil) and asking another pupil to name the object lifted up, etc. Then ask pupils to say why they had difficulty performing the activities.

EXERCISE 2

1. Put pupils into groups of between 3 and 5 pupils.
2. Have pupils discuss within the groups what they use different kinds of light for.
3. Have pupils read out their list.
4. Write the list on the chalkboard and discuss the items on the list as a class.

Here are some of the answers to expect:

- i. Reading/writing
- ii. Playing games; for example, ampe or oware in the night
- iii. Working; for example, sewing, washing dishes in the evening
- iv. Traffic lights; to direct traffic/warn pedestrians
- v. Traffic indicator lights of cars; to give signals to other drivers and pedestrians
- vi. Red lights to give signals

EXPERIMENTS WITH SUNSHINE

- a. Using a lens to light a fire
- b. Measuring the electrical output of a solar module
- c. Heat up stones and water as energy storage
- d. Using a solar lantern

3.2 FROM WHAT DO WE GET LIGHT?

3.2.1 Electricity

In Ghana, people in the cities and the large towns use power mostly from the Akosombo hydro-electric dam to provide light in the night. They pay a bill periodically, usually monthly. Electricity is not easy to pay for, even for those in the cities. They often complain of how much they have to spend on electricity alone.

3.2.2 Portable Generating Plants

Some rich people in towns and villages (also companies and hospitals) use portable generating plants (generators). These generators use petrol or diesel. Prices of petroleum products rise often, as we have said earlier on, thus, only those who have much money can use them.

3.2.3 Batteries



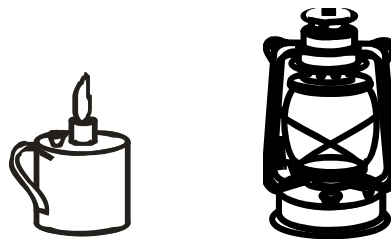
Another source of lighting in the small towns and villages is batteries. There are the **rechargeable batteries** and normal batteries which are thrown away after they are used.

- Some people use **car batteries** to light up their rooms. Car batteries have to be recharged periodically. This can be done by solar energy.
- Many people also use **dry-cell batteries** in torches, CD players etc. when they move from place to place. Dry-cell batteries have to be replaced often as they wear out quite quickly after a number of uses. Used dry cell batteries are often thrown away. They pollute the environment and poison the ground. Any way you should use rechargeable batteries.



3.2.4 Candles

We also use candles to light up our homes. We know the dangers involved in using the candle to light up the home. There is the danger of fire outbreaks. When the candle falls down while the user is asleep, there will be fire. Also, when the candle burns out in the night while the user is asleep, there could be a fire outbreak. Property and lives get lost when there is such a fire outbreak.

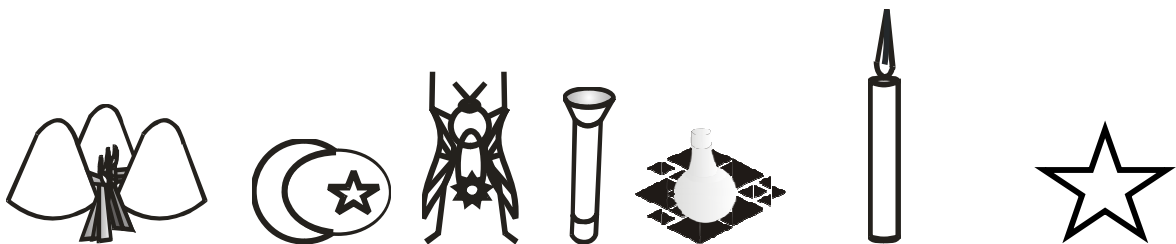


3.2.5 Kerosene Lanterns

Most of the people in the rural areas use kerosene lanterns. These are lamps that depend on kerosene to give light in the night.

EXERCISE 3

1. Put pupils into groups of between 3 and 5.
2. Have pupils brainstorm of sources of light, and write out these sources.
3. After five minutes, have pupils read out the sources to you. Write them out on the chalkboard and orally discuss them.



Here are some of the sources:

- i. Open fire
- ii. Moonlight
- iii. The firefly
- iv. Torch
- v. Electricity
- vi. Oil lamp
- vii. Candle
- viii. The stars
- ix. The headlamps of cars

Have pupils say what energy source powers these sources of lighting.

4 THE SOLAR LANTERN

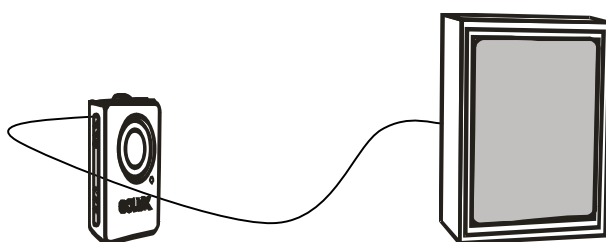
4.1 What is the solar lantern?

These are lanterns that use solar energy. The power of the sun provides the 'fuel' for these lanterns.

4.2 How does the solar lantern work?

The solar lantern comes with a solar module which produces electricity (drawn from the energy of the sun), which is saved in a rechargeable battery. This is the power the solar lantern uses.

Fig 1. Components of the solar lantern



4.3 HOW IS THE LANTERN USED?

The solar lantern is easy to use. The lantern comes with a solar module. You will have to recharge the lantern every day. All you need to do is to plug in the charger lead and place the solar module out in the sun. The lantern itself should be in the shade. You can carry your lantern and module to the farm (remember it is very light), and recharge it there.

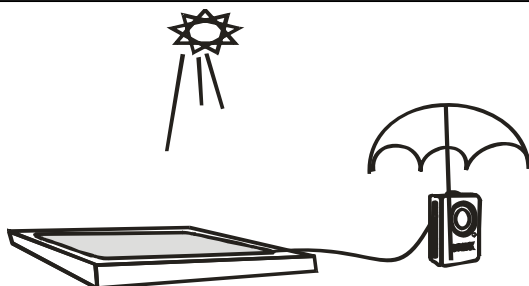
DEMONSTRATION

Demonstrate how the solar lantern works:

- a. how it is charged
- b. how it is switched on/off
- c. how it can be positioned: hung up, stood on a table, etc.

EXERCISE 4

1. Put pupils in groups of between 3 and 5.
2. Have each pupil within the group instruct the others on how to use the solar lantern.
3. Have a few pupils demonstrate how the solar lantern operates to the class.



4.4 Why should I use the solar lantern instead of the kerosene lantern?

The solar lantern is made especially for you in the rural areas where there is no supply of electricity. Here are 10 reasons why you should use one.

1. The solar lantern saves you money. You do not have to buy any kind of fuel for it. You do not pay any bill to any company either. Once you buy the lantern, you only have to recharge it regularly using the module. The sunlight that you use to recharge it is plentiful and free.
2. The solar lantern gives powerful light. It gives a much brighter light than 4 – 6 kerosene lanterns put together.
3. The solar lantern is very portable. It is very easy to carry around. In fact, for the SOLUX-LED-50, both the lantern and module together weigh only 360g. [A tin of Milo beverage weighs 400g; 40g more than the solar lantern and the module put together]
4. The solar lantern is strong. It is built using ABS plastic; a very tough kind of plastic. It does not crack or break when dropped.
5. The solar lantern is almost maintenance- free. It does not have a glass globe (chimney) which may break when it is dropped. Remember, breaking the globe means going without light until the globe is replaced. Also, you do not have to worry about cleaning up the globe because of the soot from the burning wick.
6. The solar lantern is easy to use. You do not have to look for matches to light it up. You simply reach out, flick a knob and the light is on.
7. The solar lantern is good for your health. The solar lantern does not give out the CO₂ in the smoke that the kerosene lantern gives. It does not give out any smoke at all. The smoke from the kerosene lantern affects your health and that of your family.
8. The solar lantern is accident-free. We all know about accidents caused by the use of the kerosene lantern. When the lighted kerosene lantern falls it may result in a fire outbreak in which property and lives may be lost. Some children accidentally drink kerosene. As a result, they may die or become ill for a long time. The use of the solar lantern will prevent such accidents.
9. The solar lantern is long lasting. The lantern is strong. You use it for a long time, without worrying about fuel, cleaning or rust.
10. The solar lantern is your sure bet to good education. Using the lantern ensures that you and your siblings have an equal opportunity to study and get the education you need to make a good progress in life.

ASSIGNMENT

Have pupils make a list of things that they see the solar lantern can do that the kerosene lantern cannot do. (Let them discuss the uses of the solar lantern with their parents, and have their parents make their inputs into what the solar lantern can do that the kerosene lantern cannot do)

5 CAN I BUY THE SOLAR LANTERN?

Here are some of the ways you can plan for and acquire the lantern:

1. You can start saving now. Save just GH¢6. 00 a month for 7 months and you buy it.
2. Ask your relative abroad or in the city to send you the money for it.

3. Join a SUSU group to make regular savings (just GH¢6. 00 a month for 7 months) and buy it.
4. Arrange with the Assemblyman/Assemblywoman to arrange micro credit facilities for you and other families in your community.
5. Take a loan from someone; you can easily pay it back using the money you would have used in buying kerosene.

Table 1: Comparing the cost of kerosene with the cost of a solar lantern

	KEROSENE (PRICE PER BOTTLE GH¢1.50)	SOLAR LANTERN (LANTERN & MODULE GH¢40.00)
1ST MONTH	GH¢6. 00	GH¢6. 00
2ND MONTH	GH¢6. 00	GH¢6. 00
3RD MONTH	GH¢6. 00	GH¢6. 00
4TH MONTH	GH¢6. 00	GH¢6. 00
5TH MONTH	GH¢6. 00	GH¢6. 00
6TH MONTH	GH¢6. 00	GH¢6. 00
7TH MONTH	GH¢6. 00	GH¢6. 00
TOTALS	GH¢42. 00	GH¢42. 00

NOTE: After 7 months, paying **¢6. 00**, just as much as you pay now for kerosene every month, you will have finished paying for the lantern. Remember, the price of kerosene may go up any day. You will not have to worry about buying kerosene after that. The price of the Module & Lantern does include VAT but no additional costs for financing

EXERCISE 5

1. Ask your pupils some basic questions to their kerosene consumption and make a summary report for each class. See annex!
2. How many months will you need to pay for the Solar lantern & Module if the price of kerosene increases to GH¢1. 80?
3. Maame Foriwa's family has finished paying for the solar lantern. At the current price of 1. 50 per bottle, how much will Maame Foriwa's family save after one year (52 weeks)?

5.1 MICRO CREDIT

Micro credit is a loan facility which works in places where the people, are unemployed, have very low income or have no collateral that the normal banks demand when they give loans. Small loans are given to these people when they come together in small identifiable groups in their communities. For example, tomato farmers can come together and get small loans to cultivate their crops. They are able to pay back such loans when they harvest the crops.

In Ghana, the District Assemblies are encouraged to facilitate such loans. You need to come together in a group. Your leaders will approach the Assemblyman / Assemblywoman, who will make a case for you. The rural / community banks facilitate the loans. You will be asked to save with the nearest rural bank and then you can apply for and receive a loan.

6 FREQUENTLY ASKED QUESTIONS ABOUT THE SOLAR LANTERN (FAQ)

Here are some frequently asked questions about the solar lantern.

1. **Is there any risk to use a solar lantern?**
No, there is no risk using this light. But you should avoid direct eye contact with the beam of the LED, this could hurt your retina, just as looking straight forward into the bright sun does.
2. **Why should I replace the kerosene lantern with a solar lantern?**
The solar lantern gives far more light (3-6 times more), there is no risk of fire, no risk to the health and after half a year you save the money you would have spent on kerosene. Solar energy is an environment friendly solution which is highly sustainable.
3. **How long will the Led50 give light in the evening?**
The LED-50 will give 4 to 5 hours bright light. Afterwards the light will decrease slowly for many hours. At the reduced level you will have 6 to 8 hours of light, decreasing further afterwards.
4. **May I use the lantern with dimmed light for the whole night?**
Yes you can switch the LED-50 (version 2.0) to dim light with 15% light output, which is sufficient for basic orientation at night. At this level the light will last far more than one night.
5. **Do we need batteries?**
There is a rechargeable NiMH battery – pack in the lantern which is recharged with the solar module. You must not buy batteries to use the lantern.
6. **How long must I charge it with the module?**
At full sunshine 4-5 hours are sufficient to have 4 to 5 hours light in the evening. To get the batteries completely full you may charge it for 8 hours.
7. **Does the module charge the lantern on a cloudy day?**
Yes, even on cloudy days the module will produce electricity, but not as fast as on a sunny day. If the light level is low in the evening please use the lantern at a reduced level.
8. **May I charge the lantern with a plug charger?**
Yes, usually the supplier does offer a suitable plug charger to be used with the normal electricity grid. Ask our local agent for the right plug charger. Do not use other plug chargers that could damage your batteries.
9. **Do I need a new bulb after some years?**
Good LEDs are designed for a life span of more the ten years. Under normal conditions you never will have to change it.
10. **What is the difference between the lantern and a torch?**
A torch is designed as spot light with batteries, which must be renewed after a short time, but a good solar lantern is designed as room light to be charged with a solar module without changing the batteries periodically.
11. **How can I know that the lantern is charging?**
When you connect the module to the lantern, the red LED comes on if the module is exposed to the bright sun. That is an indication that electricity is being produced.
12. **How can I know that the lantern is completely charged?**
There is no direct indication that the batteries are fully charged. Normally the batteries will be fully charged after two days of charging. The brightness of the LED light is an indication of how fully the batteries are charged.
13. **May I expose the module to rain?**
Yes, the module may be exposed to rain, but not the lantern. Protect the lantern against heavy water ingress.
14. **Does the module operate in the shade?**
No, the module must be positioned in the bright sun to produce electricity.

15. How does it differ from cheap camping lanterns?

Camping lanterns are designed to operate for a few hours during one year. They use cheap lead acid batteries which must be renewed often. Many camping lantern may only be charged with a car adapter or plug charger.

16. When must I replace the rechargeable batteries?

Under normal conditions the rechargeable batteries should last for several years. Afterwards you have to buy new ones from your supplier.

17. Who will repair the lantern when there is a fault?

Please take the lantern to your supplier. They are prepared for maintenance and repair work.

18. My kerosene lantern costs me only a few cedis while your Solar lantern costs GH¢ 40. Why should I pay so much money?

For a kerosene lantern you need GH¢1.50 for kerosene each week while the solar lantern does not produce any costs after it is bought. During half a year you will have paid GH¢45 for kerosene, GH¢5 more than what is sufficient to buy a solar lantern.

19. What is a micro credit?

A micro credit is a small loan which is given to a group of people who have decided to repay this loan in small portions as a reliable group. By this way the investment in solar lanterns are affordable to people with low income

20. Where can I get a micro credit?

There are several micro credit organisations in Ghana. Please ask your local representative of the *One Child One Solarlight* project.

21. What is *One Child One Solarlight*?

One Child One Solarlight is a Ghanaian project to introduce solar lanterns as a replacement of kerosene lanterns to school children and their families. The project will have local representatives in the rural areas.

7 RESUME

The whole world still faces an energy crisis and environmental pollution as a result of our dependence on petroleum oil for our energy needs. In the rural areas, we suffer more because we do not have much money and resources. In parts of the world where there is abundant sunlight, solar energy is the solution. Solar energy is clean, safe, environmentally friendly, and abundant. Thanks to modern LED technology, we can use solar energy to light up our homes. The solar lantern works on solar energy—free power from the abundant sunlight. The solar lantern is cost effective, gives powerful brightness, is portable, easy to use and easy to pay for. Embracing it means contributing to solving the world's energy crisis, making the world a healthier place, and giving our children a brighter opportunity to study and get well educated for our advancement as people of the world.

8 TO THE TEACHER**8.1 PROPOSAL FROM TEACHER TO IMPROVE THIS MANUAL**

We would like you to tell us if you found this manual helpful in helping your pupils understand the materials in it. Have you been able to guide your pupils to a better understanding why the solar lantern is a cheaper and more efficient means of lighting our homes?

We are highly interested to improve this manual. If you have any idea how to improve it, please send us your proposal including documentation, drawings and photos. Please get in contact with us.

One Child One Solarlight

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Annex A: Questionnaire to kerosene consumption for kerosene lanterns.

Please fill in the required data into this form. The data are only for **statistical purpose** and will help to introduce solar lanterns to rural areas.

1.	How many kerosene lanterns do you light in your household every evening?	0 1 2 3 more
2.	How long does the lantern burn every evening? (In hours)	2 4 6 8
3.	Do you run a lantern in your room when you sleep?	YES NO
4.	What do you pay for kerosene during one week? (in New Cedi)	Weekly:..... 0,00 to 0,50 0,51 to 1,00 1,00 to 1,50 1,51 to 2,00 more than 2,00
5.	What is the price for one litre of kerosene in your village? (in New Cedi)	less then 0,80 0,81 to 1,20 1,21 to 1,60 1,60 to 2,00
Date:..... School:..... Class:.....		