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ABSTRACT

The sample first-draft materials, produced by participants at a UNESCO regional workshop on population and family life, are designed as a reference tool to be used by curriculum developers. Divided into two major parts -- in biological science and in mathematics -- the teaching guide is for secondary level students. The first part, consisting of five lessons, focuses on problems ranging from under-nutrition to human fertility. Other topics included emphasize causes of under-nutrition, protein intake related to family size, population biology, and safety at childbirth. Population elements incorporated into teaching of mathematics are covered in the second part of the guide, which consists of eight lessons. Pupils compare the number of their mother's live births and the number of children they themselves expect to have as adults, collect and analyze data on the local population, construct age/sex pyramids, compute dependency ratios, and the rate of natural increase of the population of the country. See ED 059 586 for the social studies materials. (SJM)

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SCIENCE / MATHE

Unesco Regional Office for Education in Asia
Bangkok, 1971

POPULATION
AND FAMILY EDUCATION

DRAFT SAMPLE INSTRUCTIONAL MATERIALS

SCIENCE / MATHEMATICS

The curve on the cover is a representation of world population growth over a period of about ten thousand years, into the 21st Century.

Regional Workshop on Population and
Family Education, Bangkok,
7 September - 7 October 1970
Draft sample instructional materials.
Bangkok, Unesco Regional Office for Education
in Asia, 1971.
60 p.

1. FAMILY PLANNING - ASIA.
2. POPULATION EDUCATION - ASIA.

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REGIONAL WORKSHOP ON POPULATION AND FAMILY EDUCATION

7 September - 7 October 1970

DRAFT SAMPLE INSTRUCTIONAL MATERIALS

UNESCO REGIONAL OFFICE FOR EDUCATION IN ASIA
BANGKOK
1971

Published by the Unesco Regional Office for Education in Asia
Bangkok, Thailand, 1971

Preface

1. The sample instructional materials in this volume were produced by participants at the Unesco Regional Workshop on Population and Family Education held in Bangkok, Thailand, from 7 September to 7 October 1970

2. They have not been pupil-tested or elaborately revised, and should be considered *sample first-draft material* usable for reference purposes by groups responsible for designing curricula in individual countries.

3. *The multi-dimensional relationships between population growth, its possible consequences are so complex, and in many cases so little understood, that for particular countries some of the relationships indicated in the instructional materials may be non-existant or even the opposite of those indicated. Great care will have to be taken in utilizing these draft materials in the production of specific instructional materials for individual countries.*

4. The concepts for which these sample draft instructional materials were written were selected by the participants themselves from the larger body of concepts they had developed during the preceding phases of the Workshop. (See Final Report of the Workshop).

DRAFT SAMPLE INSTRUCTIONAL MATERIALS

IN

BIOLOGICAL SCIENCE

Type of instructional material: Teachers' Guide

Subject: Home Economics (Unit: Nutrition)

Age group/level: Secondary (Lower)

Under-nutrition is an important problem in Thailand

Objectives: To help pupils to comprehend that many people in Thailand are *under-nourished;* that one cause of under-nutrition is inadequate *production* of food; that rapid *population* growth may worsen the problem of under-nutrition.

Previous learnings: The concept of calorie requirements in nutrition.

Main topic	Content	Suggested activities	Reference
1. Nutritional condition.	Nutritional condition of persons. 1.1 A *satisfactory* nutritional condition implies the consumption of a balanced diet (with adequate amounts of calories, protein, vitamins and minerals). 1.2 One cause of *unsatisfactory* nutrition is an inadequate intake of calories, protein, vitamin and minerals. (Another cause is excessive loss of these from the body). 1.3 An unsatisfactory nutritional state may give rise to *signs* (changes) in the body.	Help the pupils to recall these concepts by asking questions about them.	1. Nutrition text, by the sub-committee of Nutrition Education in the National Nutrition Committee, second edition 2. *Fourth In-Service Training Material on Foods and Nutrition*, Supervisory Unit, Secondary Dept.

Main topic	Content	Suggested activities	Reference
	1.4 *Undernourishment* is due to an inadequate intake of calories (or to an excessive loss of calories). One sign of undernourishment is found in bodyweight.		
2. Undernourishment	Many people in Thailand are *undernourished.* 2.1 Methods used in assessing the nutritional condition of the people. - Clinical survey and dental survey. - Dietary survey. - Biochemical examination. - Helminthologic survey. 2.2 Nutrition surveys show that there are many undernourished persons in Thailand, especially in the Northeast region.	1. Data which can serve as a basis for discussion are found in Table 10, pages 137-138 of the Nutrition Text. (A summary on nutritional symptoms and signs is given in Table 11, pages 152-153 in the Nutrition Text.) Divide pupils into groups of two. Ask each pair to study Table 10 for about 30 minutes. You may have to give frequent personal attention to the pupils during this study period. Finally, discuss the data with the class as a whole to bring out the point that there are many undernourished persons in Thailand, especially in the Northeast. 2. Invite a doctor or nutritionist to give a lecture on nutrition problems and surveys in Thailand.	1. Nutrition Text.

Main topic	Content	Suggested activities	Reference
3. Under-nutrition, causes of.	There are many causes of under-nutrition. 3.1 *Shortage of food* - inadequate food production. - insufficient money. 3.2 *Lack of knowledge on nutrition* - failure to choose nourishing foods. - failure to preserve the nutritional value of the purchased foodstuffs. 3.3 *Unhealthy living conditions* - handicapped conditions. - disease. - poor personal hygiene. - lack of sanitation.	1. Have the pupils think about possible causes of the nutrition problem and list these causes into 3 categories as shown in column 2, section 3.1, 3.2, 3.3. 2. Ask the pupils whether any of these categories are connected with the growth of population.	1. *Collected lectures on Family Planning* Family Health Project, Ministry of Health, July 2513 (1970). 2. *The Journal of Social Sciences* Faculty of Political Science, Chulalongkorn University, Vol. VI, No. 4, October 1969.
4. Under-nutrition and population.	Food shortage is connected with the problem of population growth. 4.1 Thailand has one of the highest population growth rates in the world.	1. Further discussion on - How is the size of the population connected with the shortage of foods? The answer could be: Because there are so many people to share the food, so the food production can become inadequate.	

Main topic	Content	Suggested activities	Reference
		2. Have the pupils guess the total population at the present, the past and the future, then show the tabulated data placed on a chart and exposed row by row after each guess of the students.	
		Estimated and projected total population of Thailand 1947-1976	3. *Kasetsart Economic Report* No. 31, March 1969, page 4.
		Years / Total population (thousands): 1947 17,683; 1950 19,461; 1955 22,981; 1960 27,133; 1965 32,007; 1970 37,504; 1971 38,695; 1972 39,926; 1973 41,175; 1974 42,501; 1975 43,858; 1976 45,234	
		3. Further question could be: - As the population grows, what do we need more and more of, for maintaining the health of the people? The answer should include 'food'.	

Main topic	Content	Suggested activities	Referenc

4. Further discussion should go along the idea that foods transfer to energy and we can measure energy requirement in terms of calorie requirement. There is a study on calorie requirement which shows that the estimated total annual calorie requirements for the Thai population would grow considerably as shown in the following data.

Estimated total annual calorie requirements for the Thai population 1957-1976

Years	Calorie requirements (Billions of cal.)	Estimated population
1957	17,354.0	24,562
1960	19,136.4	27,133
1962	20,466.9	29,016
1966	23,373.9	33,047
1970	26,585.6	37,504
1971	27,447.0	38,695
1976	32,088.5	45,234

4. *Kasetsar Economic Report* No. 30, March 19 page 20

5. The teacher should ask some questions to elicit answer from the pupils that rapid population growth might worsen the problems of undernutrition, e.g.:-

- As we already know, many people in Thailand are undernourished at the present time. Do you think this problem might become worse in the future if the population grows rapidly?
- What should we do to solve such problem? The answer should lead to the point that something may have to be done to slow down the population growth rate. The Government of Thailand has recognized this. A National Policy on family planning came into effect from March 17, 2513 (1970).

uation: 1. Is the following saying true? "In the water, there is fish. In the field, there is rice, and we will never starve."

Answer: It may have been true in the old days, because there were not so many people to feed. Now, it's not always true, because there are so many people to share the fish and the rice. There may be practically no fish in polluted rivers.

2. Do you think that there is plenty of food in Thailand and no shortage of food? Why do you think so?

Answer: No, there is shortage of effectively distributed food in Thailand. Studies have shown that Thailand has a problem with undernutrition, one cause of which may be a shortage of food or failure to distribute food effectively among all sections of the population.

3. If there is a problem of inadequate production of food, what do you think might worsen the problem? Why do you think so?

Answer: The rapid population growth might worsen the problem of inadequate production of foods. Even now we are facing this problem. If the population grows faster than the growth of food production, the problem may worsen.

4. From the following data,

Year	Estimated calorie requirement (Billions of calories)	Estimated population (thousands)
1970	26,585.6	37,504
1971	27,447.0	38,695

(a) What is the percentage increase in the estimated calorie requirement for 1971 over the estimated calorie requirement for 1970?

(b) Which rate is higher - the rate of population growth or the rate of increase in calorie requirement?
Why is there a difference?

Answer:

(a) The increase in estimated calorie requirement in per cent,

$$= \frac{(27,447.0 - 26,585.6) \times 100}{26,585.6} = 3.24\%$$

(b) Population growth rate in per cent

$$= (38,695 - 37,504) \times 100 = 3.17\%$$

The rate of calorie requirement is higher, because the increase in calorie requirement must serve at least two purposes, namely:

(1) Supply calories to the new mouths that have to be fed.

(2) Supply calories to try to correct existing undernutrition.

Type of instructional material: Teachers' Guide

Subject: Family Life Education (Unit: Food and nutrition)

Age group/level: Secondary (Middle)

In Central Java the protein intake is inadequate; other things being equal, a small family has a better chance of getting an adequate intake of protein than has a large family

Objectives: To help pupils to relate protein intake to family size; to give practice to the pupils in tabulating data; to give practice to the pupils in calculating protein intake using foodtable to give practice to the pupils in thinking out lines of evidence in support of a hypothesis.

Previous learnings: The required protein for an adult is about 1g. per kg total body weight; calculation of calorie content of foodstuffs.

Procedures: (The italicised sections represent the kinds of motivating and stimulating questions, problem or situations which the teacher may generate in class during discussions).

1. Tabulate on the blackboard with the students' participation, the data for a typical Central Javenese diet, include a column for "estimated protein intake", and see that the pupil themselves fill up the column by calculating the values from foodtables.

Data and foodstuffs may be obtained from the following:

- Soekamto, S. *Ilmu Gizi*, Djakarta, 1956.
- Directorate of Nutrition, Ministry of Health, Indonesia *Food Tables for Indonesia*, Djakarta, Ministry of Health, 1968.

Common dietary pattern in Central Java

Grams of food per 50 kg. adult per day

(1) Menu	(2) Foodstuff	(3) Intake of foodstuff (g)	(4)* Estimated protein intake from the foodstuff (g)
I Breakfast			
1. Coffee (sweet)	Water	200	-
	coffee	10	-
	sugar	12	-
2. Boiled sweet potato	sweet potato	100	-
II + III Noon and evening meals			
1. Boiled or steamed rice mixed with cessave	rice	200	14
	cessave	300	2
2. Fried dried fish	salted dried fish	20	13 (animal protein)
	coconut oil	10	-
3. Vegetable soup with coconut milk	unripe jackfruit	200	4
	coconut milk	200	6
4. Sambal terasi (chilli paste with fermented shrimp)	red pepper chilli	20	1
	terasi	5	1 (animal protein)
		Total	41

* Figures obtained from the foodtable from the Department of Nutrition of the Ministry of Health in nd.

What is the estimated typical protein intake of an adult in Central Java?
(The pupils should add up the figures in column 4 of the table to get the answer to this question. The answer is 41 g. including 14 g. animal protein).

What do you consider to be the protein requirement of an adult man with 50 kg. body weight?
(The pupils should recall from previous study that the protein requirement is about 1 g. per kg. actual body weight. On this basis, the protein requirement is about 50 g./day for a 50-kg. adult man).

Is the estimated protein intake of the 50-kg, adult man in Central Java adequate?
(No. It falls short of the requirement by about 9 g./day).

Is there any other way of judging whether protein intake is adequate in Central Java?
(The pupils will probably think of illness due to protein deficiency. They might use vague terms to describe signs of protein deficiency).

Protein deficiency is widespread in many parts of the world, particularly in the tropics. Kwashiorhor, a form of protein malnutrition commonly occurring in infants and young children who have been fed on diet low in protein and composed mainly of foods rich in carbohydrates, has been recognized in many parts of the world, particularly in Africa, India, Indonesia. The main characteristics are: retarded growth and development, apathy and anorexia (no appetite), oedema, pellagroid skin lesions, alterations in skin and hair pigmentation, fatty liver and diarrhoea.

Treatment of patients suffering from protein malnutrition is essentially dietetic. The protein-rich diet may consist of a mixture of skim milk and suitable forms of carbohydrate such as ripe bananas. As soon as the digestive functions will permit, return should be made to a well-balanced normal diet, suitable for the child's age.

(Illustrate with pictures of patients suffering from protein deficiency)

Why do doctors think that kwashiorkor and hypoproteinoemie oedema are due to protein deficiency?
(Help the pupils to think of lines of evidence such as the following: the *nutritional history* of these patients supports the idea that they are deficient in protein; examination of the *blood serum* shows a low level of serum protein; feeding up these patients with a high protein diet is of curative value.

2. Other things being equal, a small family has a better chance of getting an adequate protein intake than has a large family adult.

Does the kind of protein, whether animal or vegetable, affect its nutritional value?
(Animal protein is, generally speaking, of higher nutritive value than vegetable protein, as shown by studi of their amino acid composition or of their effects on the growth of animals fed on different proteins).

What proportion of the dietary protein should be animal protein?
(Help the pupils to recall that it is recommended that at least 30% of the dietary protein intake, i.e. at least 15 g./day/adult, should be in the form of animal protein and the remainder in the form of vegetable protein).

Protein is relatively expensive. Let us work out some figures for the cost of protein.

Let us take meat as our source of animal protein. What is the amount of meat we should eat to get about 20 g. of animal protein?
(100 g. of fresh weight of meat. Meat contains about 80% water + 20% protein).

What is the cost of this?
(The market price is about 30 rupiah per 100 g. meat).

Let us take tempe and rice as our sources of vegetable protein. What is the amount of these foodstuffs that we should eat to get about 30 g. of vegetable protein?
(If the amount of rice a man eats daily is 300 g. this would give him about 3 x 7 g. protein and 21 g. of vegetable protein. The cost of 300 g. rice is Rp. 12. The amount of tempe protein must be 30 g. - 21 g. = 9 g. As 100 g. of tempe contains approximately 40% vegetable protein so the amount of tempe we will eat is $\frac{9}{40}$ x 100 g. = 22.5 g.)

What is the cost of this?
(The cost of 22.5 of tempe is about 5 rupiah).

What is the total cost of eating enough protein?
(The total cost is about 30 + 12 + 5 = 47 rupiah per adult per day, on the above calculation, or about 1410 rupiah per adult per month).

If the family size is large - suppose it is equivalent to 5 adults - what would be the cost of eating enough protein?
(5 x 1410 rupiah = 7050 rupiah for the family per month).

Is this a lot of money?
(The income of an average family is about 3000 rupiah. This income has to be used to pay not only for protein intake but also for the rest of the food, and for all the other family needs such as housing, clothing, medical bills, school fee, etc.).

Other things being equal would it be easier for a small family or a large family to get an adequate intake of protein?
(Obviously a small family).

Before you come back tomorrow to class, find out what foods were eaten today at home, and how much in quantity and price. Find out how much protein was taken and how much it cost.

(Note: The following question may possibly hurt the susceptibilities of some students. Do not ask the question if you feel that this is the case).

How many members are there in the family? Put down on the blackboard: compare the size of the family, the protein intake and the cost of the protein.
(Conclusion - note: The expected conclusion is that large families usually fare worse than small families in protein intake).

Have you enough evidence to come to this conclusion?
(Probably not because only one day's meals per family have been investigated - the sampling is too narrow).

How can we improve the sampling?
(We have to sample over many days, because one day's food may be different from the food eaten on other days).

Make an investigation for one week, one month, for many months. Is it better to do this investigation for one week, one month or many months?
(A record may be maintained in the class. The conclusions could now be related to family size, for a week's data collection. The advantage of prolonged study is that the data becomes more reliable for calculating averages etc. On the other hand the disadvantage of prolonged study is the labour involved collecting the data).

Assignment/Evaluation:

1. Why is it considered that the protein intake of the adult in Central Java inadequate?

2. Which areas of Central Java are known to have many cases of illness from protein deficiency?

3. Using the foodtables calculate the protein content of:
   200 g. meat; 75 g. shrimps; 250 g. Chinese cabbage;
   300 g. fresh fish; 100 g. coconut; 400 g. dry soya beans.

4. Give some examples of foodstuffs which are rich in animal protein and those which are rich in vegetable protein.

5. Calculate the daily food budget for the protein alone, for 4 students, living in one apartment and eating adequately so that their protein intake meets the recommended amounts; the average bodyweight of the students is 60 kg.

Put a circle around your choice of a, b, c, or d.

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6. The requirement of protein for an adult male is usually taken to be:

0,5g. per kg. bodyweight	a
1,0g. " " "	b
1,3g. " " "	c
1,2g. " " "	d

7. Which of the following would you consider to be the just adequate intake of protein per day for a healthy adult of 60 kg. bodyweight?

30 g.	a
40 g.	b
50 g.	c
60 g.	d

8. What minimum percentage of the total protein intake for an adult should be animal protein?

15	a
30	b
40	c

Answers to the questions:

1. The total protein intake is only 41 g.
   A 50 kg. adult male should have +50 g. protein.

2. Gunung Kidul, Wonogiri, Kebumen.

3. 200 g. meat contents 2 x 22 g. = 44 g. protein
   300 g. fresh fish contents 3 x 17 g. = 51 g. "
   75 g. small shrimps contents $\frac{75}{100}$ x 12g. = 10 g. "
   100 g. coconut contents 1 x 3 g. = 3.5 g. "
   200 g. Chinese cabbage cont. 2.5 x 1.8 = 4.5 g. "
   400 g. soya beans contents 4 x 34.1 =136.4g. "

4. Meat, fish, shrimps, egg, are rich in animal protein. Dried soya beans, salted water melon seeds, roasted peanuts, are rich in vegetable protein.

5. If the choice of the students is meat, the answer will be:

   4 x 1 x 60 g. 240 g. protein is needed for one day meal for the students.

   100 g. meat contents 22 g. protein

   the four students need $\frac{240}{22}$ x 100 g. meat is 1090 g. meat

   which is round 1.1 kg.
   The cost of 1.1 kg. in Indonesia is about 1.14 rp.
   300 = Rp. 330.

6. b

7. d

8. c

Type of instructional materials: Teachers' Guide

Subject: Biology (Unit: Fertility)

Age group/level: Secondary (Grade X)

Average size of family can change rapidly

Objectives: To teach the above idea which is part of the larger idea that family size can be controlled. Subsidiary objectives are: to provide practice in using the statistical concepts of sampling and of the arithmetical mean; to provide practice in asking for relevant data before answering questions; to provide practice in noticing trends in data.

Previous learnings: Reproductive phase of a woman's life, lasting about 30 years from the age of about 15 years to the age of about 45 years; the statistical concepts of sampling and of the arithmetical mean.

Procedure: *What is the size of the family in Ceylon?*
(The question is imprecise. Encourage pupils to ask you what is meant by "family size" and whether it is "actual family size" or "ideal family size" that you are after, and also whether you wish to have an average figure or the range of variation. Say that "family size" in the present context denotes the average number of children born to mothers who have come to the end of the reproductive phase of their lives, that is, mothers who are about 45 years old. Allow the pupils to make some guesses if they wish, e.g. an average family size of 4 children, 6 children, etc.).

How can we find out the answer to the question - What is the average family size in Ceylon?
(Help the pupils to recognize that a *survey* would have to be made, by questionnaire or by interview. Point out that a country's *census* is an example of such a process of nation-wide data collection).

I'm going to provide you with some data from a survey. This survey was extensive, but not as extensive as in a census. Only a sample of households was visited.

What do I mean by "sample"

(Help the pupils to recognize that a "sample" is a selected number of households out of the total number of households in the country. Help them to recall that they have been doing "sampling" each time they did an experiment - e.g. sampling of leaves in the exercise on photo-synthesis, sampling of saliva in the exercise on amylase action. In the study from which some data are to be cited in this lesson, a very complex process of stratified random sampling of households was done. The procedure, which need not be discussed with the pupils, is described in a chapter on methodology in Part 2 of the study, Abhayaratne, D.E.R. and Jayewardene, C.H.S. *Fertility trends in Ceylon*, Colombo, 1967).

Here now are the data

(Put the data down on the blackboard in tabular form as follows:

Table. Average family size in the South West Coast of Ceylon, 1940-1964

Five-year period	Average number of children born to mothers who reached the age of 45 years during the stated period
1940-44	6.2
1945-49	5.7
1950-54	5.3
1955-59	5.1
1960-64	5.2

(The data are from:- Abhayaratne and Jayewardene, *loc. cit*, page 225. Say that you have deliberately selected the South West Coast rather than other areas, in order to show that family size seems to be changing in the other areas, the trend is not so clear. The South West Coast is an area of high population density - containing over 500 persons per square mile. Not all regions with high population density in Ceylon, however, show a reduction in family size during this period).

What is the trend in average family size in the South West Coast region over the fifteen year period?

(Elicit the recognition that average family size appears to have been more or less progressively decreasing over the 15-year period. Repeat that the trend in other regions is less clear).

What is the point that I intended making with the row of figures?

(Average family size is not a fixed quantity. It can change over a period of time - even over a relatively short period of time of a few years. The change can be in the direction of a progressive decrease)

Type of instructional material: Teachers' Guide

Subject: Biology (Unit: Ecology/Population Biology)

Age group/level: Secondary (Grade X)

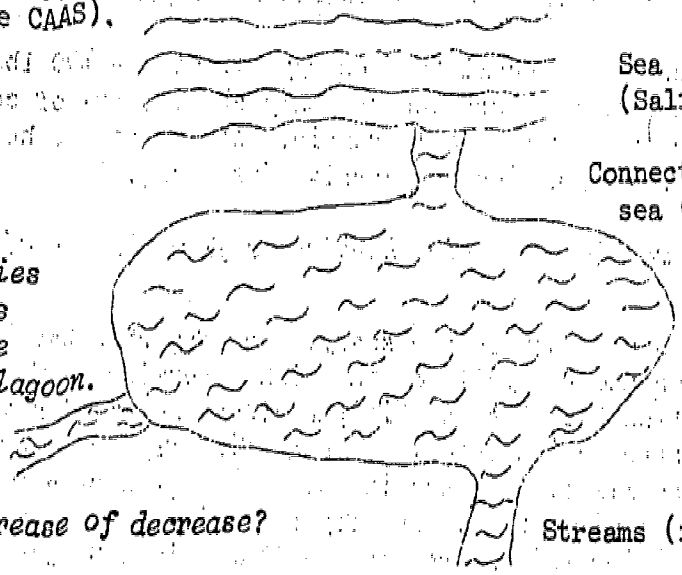
The italicised sections represent the kinds of motivating and stimulating questions, problems, or situations which the teacher may generate during discussions.

1. Population biology and fish farming

(The purpose of this teaching sequence is to give some indication of the relevance of *population biology* to a practical matter like fish farming).

(The material is derived from:- *Pillai, T.G. 1965. Brackish-water fishery resources of Ceylon.* Paper read at the 21st Annual Session of the CAAS).

(Draw a figure on the board to represent a coastal lagoon).



There is a mixed population of fish in the lagoon. Some of them belong to species which are characteristic of lagoons. Others have come in from the sea, and the rest have come along the streams which open into the lagoon.

How might the population of fish increase of decrease?

(Elicit that the population may increase from births and immigration or introduction by man, and decrease from deaths and emigration or capture).

Sand bars are frequently formed at the mouths of lagoons by wave action. The sand bars block the mouth of the lagoon. What might their effect be on the fish population in the lagoon?

(Recall that the lagoon fish consists of a resident population and immigrants from the sea and strean Sand bars stop immigration from the sea. They therefore tend to decrease the lagoon population, unless the immigrants are predatory species which prey upon the residents. Generally speaking, the fish population increase when sand bars are removed and the connection between lagoon and sea widened. Some types of fishing traps and kraals also hinder immigration of fish from the sea into the lagoon. Prohibition of these would tend to increase the fish population).

Clearing sand bars and other obstructions between sea and lagoon would allow immigration of fish from sea to lagoon. If the block is permanent, we can still grow sea fish in the lagoon if we do some artificial "immigration" by putting suitable sea fish fry into the lagoon. Would you choose first order consumers (herbivores) or higher order consumers (carnivores) for introduction into the lagoon?

(Help the pupils to recall the "energy pyramid" - 100 lbs. producers e.g. algae support about 10 lbs. of herbivorous fish which in turn support only about 1 lb. of carnivorous fish. If there were no carnivorous fish, the 10 lbs. of herbivores would remain. It is assumed here that the acceptability of herbivorous fish as human food is the same as that of carnivorous fish).

But how can we find out which herbivores from the sea will grow well when introduced into brackish water?

(An experimental study is necessary. The fry will have to be introduced into an experimental brackish water farm or lagoon and the yeild of the fish determined. The results of experiments done at the Experimental & Demonstration Fish Farm at Pitipane (near Negombo) have indicated that herbivorous sea fish which are suitable for introduction into lagoons as fish fry and fingerlings include milkfish *(Chanos)* and grey mullet *(Mugil)*. The milkfish breeds in the Gulf of Mannar and the fry can be collected in large numbers from side pools during certain months. The fry potential at Mannar has been estimated at 400,000,000 per year. Grey mullet fry and fingerlings are also available in abundance).

(Some other biological factors in fish farming include: improving the food supply for the fish by the addition of chemical and organic fertilizers; minizing predation by carnivorous species of fishes and other animals; prevention of over-fishing).

2. Population balance in hookworms in the intestine of man

The purpose of this teaching sequence is to serve as a review exercise on *population balance.* It also gives good practice in interpreting data and formulating hypotheses.

(The material is drawn from:- Sweet, W.C. 1925. Hookworm re-infection. *Ceylon J. Sci* (D), *1*, 129 - 140).

What happens to the hookworms when a hookworm patient is given worm treatment?

(The hookworms are killed, and they pass out in the faeces of the patient. The dead worms can be recovered from the faeces. Proper treatment of the patient kills practically 100% of the worms. Hence it is possible to estimate rather precisely the hookworm population that existed in the patient's intestine).

Suppose that we have made egg-counts in the faeces of the patient before he was treated.

In making an egg-count, a gram of faeces is weighed out, treated with a known volume of salt solutio in order to extract the eggs which are then counted under the microscope. The egg-count is expressed as the number of eggs per gram of faeces).

Suppose that the egg-count was 952 hookworm eggs per gram of faeces, and that 76 hookworms were passed out after hookworm treatment. How many eggs came from each hookworm?

(On the average, it will be 952/76 or 12.5 eggs from each hookworm to each gram of faeces).

Studies on these lines have enabled biologists to estimate the size of the population of hookworms in the gut from egg-counts alone.

(The errors that may arise from variations in the consistency of faeces, etc., need not be discussed here).

What will be the size of the hookworm population in the gut a few days after proper hookworm treatment?

(Practically zero).

A biologist did egg-counts 15 days after treatment and found that the average population size was about 6 worms in the intestine.

(These few worms have apparently survived the treatment. The population size before treatment was, unfortunately, not estimated, but some indirect evidence suggests that it was about 75 worms per intestine).

The biologist estimated the size of the hookworm population in the gut in different groups of people who had last received hookworm treatment one year ago, two years ago, and so on. His results were as follow

Average of 6 hookworms in the gut, 15 days after treatment.
" " 26 " " " " 1 year " "
" " 43 " " " " 3 years " "
" " 53 " " " " 4 " " "
" " 54 " " " " 5 " " "
" " 45 " " " " 6 " " "
" " 56 " " " " 7 " " "
" " 73 " " " " 8 " " "

(Each of these 8 groups contained 67-186 persons. Plot the results in a graph on the blackboard in order to show the plateau in the population number from about 3-7 years).

Comment on the shape of the graph. - What is the size of the hookworm population as the years pass b

(The hookworm population in the gut is practically nil immediately after treatment. It then increase rather rapidly in the first 3 years after treatment, and then remains fairly steady from about 3-7 years, after which it appears to increase again).

Consider the initial rise in population numbers in the first 3 years after treatment. What could it be due to?

(Direct the discussion so that the following possibilities are considered: the few worms which survive the treatment have multiplied within the gut. Discard this possibility by stating that worms are not known to multiply within the gut. New worms have come into the gut by re-infection. Confirm the likelihood of this possibility. If the treated persons continue their old way of life - living amidst polluted soil and walking bare-footed on these soils - re-infection is inevitable. Refer to the new worms as fresh *immigrants*.

Call another possibility, which need not be discussed in the class, is that the increase in worm population is a chance phenomenon, since the groups of persons who were studied were different - different

in locality, age, etc. The majority of the egg-counts were made on tea estates and in towns and villages between Kandy and Nuwara Eliya. The difference in worm population size may be related to differences in locality, etc., rather than to the number of years which have elapsed since treatment. This possibility cannot be ruled out, on the available data, and it indeed points to an imperfection in the study. However, the shape of the graph is too orderly - a rise and a plateau - to be explicable on the basis of chance, locality, etc. The best explanation for the orderly shape of the curve is that there seems to be a definit relationship (and not a chance relationship) between the size of the hookworm population in the gut and the period that has elapsed after treatment).

So we think that the best explanation for the rising phase of the hookworm population is that it is due to immigration of new worms, arising from re-infection of the persons.

Now consider the plateau. The hookworm population seems to remain fairly steady in size. What could the plateau be due to?

(Consider the following possibilities: immigration of new worms has stopped. This is unlikely. There is no evidence that re-infection stops; immigration continues but it is balanced by the death of old worms. Supposing the re-infection rate to be about 20 worms per year, there would be 20 worms at the end of 1 year, 40 at 2 years and 60 at 3 years. If the life span of the hookworm is also 3 years, the 20 worms that came in the 1st year would die at 3 years, and the total population of live worms at 3 years will be 40. At 4 years, the 20 new immigrants would be balanced by the death of 20 worms that came in the 2nd year, and the population therefore remains at 40.

The plateau therefore gives us indirect evidence that the duration of life of the adult hookworm is about 3 years.

(Sweet's own judgement was as follows: "from the nature of the curves of re-infection, it would seem probable that the average length of life of the adult hookworm is between 2 and 5 years. This theoretical estimate requires confirmation, of course, but the data here presented indicate that the period of 10 years usually given for the length of life of the adult hookworm is considerably too long).

What happens to the worm population curve after 7 years?

(The data are scanty, but the curve seems to rise).

If this later increase in worm population is a real one, what could it be due to?

(Consider two possibilities: old worms live longer. This does not sound plausible. Re-infection (immigration) rate increases. Perhaps soil pollution slowly builds up, so that re-infection increases. This will presumably go on until the old balance which was present before treatment - 75 worms per person - is once again reached).

(The following remarks by Sweet on population balance are meant here to be background material for the teacher:

"On theoretical grounds one would expect, in the untreated population of a non-sanitated district that the various factors concerned in the production of hookworm infection intensity rates would tend to equalize and that the average intensity rate would consequently maintain a level. Some of the factors concerned in maintaining this level would be the amount of faecal material deposited on the soil, the number of hookworm eggs in such faeces, the number of eggs which hatch and develop into adult larvae, the hatits of the people in regard to shoes, work, etc., and the length of life of the adult hookworm. These factors would tend to equalize and produce a level of infection intensity which would he maintained. If this were not true the infection intensity would become so great that the people would ultimately die off. Any influence which disturbed the relations of these factors would produce a new level in the course of time. Examples of such influences would be the provision, and use, of sanitary latrines, or mass treatment of a part or all of the population.

The treatment of such a population would suddenly enormously reduce the number of eggs in the faecal material reaching the soil and so disturb the equilibrium. The sudden drop in the number of worms capable of producing eggs to infect the soil would so re-arrange the proportions between the factors maintaining the level of infection that a new level would be created. This new level would seem to be maintained for about seven years after the date of treatment. The over-coming of this level would be gradual and the end result would be a new level, lower than the old untreated level, to which both the untreated and treated would slowly conform.")

Type of instructional material: Teachers' Guide

Subject: Biology (Unit: Reproductive system)

Age group: Secondary (Upper)

Safety at childbirth

Main objectives: To help pupils know that the risk of death at childbirth is greater to a mother who alread has several children as compared with the risk of death at childbirth to a mother who has only 1 or 2 children. To help the pupils know that the safest age for children from the point of view of maternal mortality is the age of 20-24 years.

Subsidiary objectives: To help pupils recognize that data are required before some questions can be answered; to help pupils develop skills in interpreting tabulated data.

Procedures: The italicised sections represent the kinds of motivating and stimulating questions, problems and situations which the teacher may generate in class during discussions.

1. Relation between maternal mortality rate and order of childbirth.

What is meant by maternal mortality?

(This is a recall question. Maternal mortality means the death of mother associated with childbirth).

What is meant by maternal mortality rate?

(The pupils should recall that the maternal mortality rate is the number of mothers who died at childbirth during a given year for every 1000 mothers who were at childbirth during the same year).

Do you think that maternal mortality rate is related to the number of children which a mother has had earlier?

(Help the pupils to recognize that this question cannot be answered without looking at the relevant data).

I have here some data bearing on this question.

(Data from Medical College, National Taiwan University, 1958-67).

Put the following table on the blackboard:

Maternal mortality rate by order of childbirth

Order of childbirth	Maternal mortality rate
1	1.84
2	1.52
3	3.47
4	4.41
5	7.69
6	8.08
7-9	10.56
Over 10	51.38

When is the maternal mortality rate the lowest as related to number of childbirth?
(The data suggest that the 2nd childbirth is the one that is associated with lowest maternal mortalit
ate).

Do you notice any trend in the maternal mortality rate in relation to the order of childbirth from he above data?
(The trend is that the maternal mortality rate increases progressively after the 2nd childbirth. At he 4th childbirth the maternal mortality rate is almost 3 times as high as the maternal mortality rate at he 2nd childbirth).

2. Relation between maternal mortality rate and mother's age.

Is maternal mortality related to the mother's age at the time of childbirth?
(Have the pupils recognize that without data it can be only guess work).

Here are some data from the same source as before.

Maternal mortality rate by age group

Mother's age group in years	Maternal mortality rate
20-24	2.28
25-29	2.85
30-34	4.31
35-39	9.36
40 and over	21.49

In which age group is the maternal mortality rate highest?
(In the age group of 40 years and over).

What is the relationship between mother's age and maternal mortality rate?
(The maternal mortality rate is lowest in the 20-24 year age group. In the older age groups maternal mortality rate rises progressively with age).

What is the maternal mortality rate of mothers under 20 years of age?
(The question cannot be answered from the above data. You may say however that other series of data have shown that the maternal mortality rate is higher for the under 20 year age group than it is for 20-24 year age group).

Summarize the main concepts by asking recall questions such as:

Which childbirth seems to be the safest from the point of view of maternal mortality? (The 2nd childbirth). *Which age seems to be safest for the mother to have her child from the point of view of maternal mortality?* (The 20-24 year age group).

Assignment/Evaluation:

They can be recall questions such as: What do you understand by the term "maternal mortality"? What is meant by the terms "maternal mortality rate"? What age group is the safest for childbirth from the point of view of maternal mortality?

Or comprehension questions such as: What is the relationship between the number of childbirth and maternal mortality rate? How much greater are the maternal mortality rate for 4th childbirth and over as compared with the maternal mortality rate at the 2nd childbirth? Compare the age group of 20-24 years with age group of 35-39 years and over, regarding maternal mortality rate?

Or more complex questions such as: Is it necessary to see more data on this subject? Give reasons for your answer.

Type of instructional material: Teachers' Guide

Subject: Biology (Unit: Human fertility)

Age group/level: Secondary (Upper)

The pattern of human fertility can change

Objective: To help pupils know that human fertility patterns can change, and to suggest to them that such changes can be voluntarily controlled.

Subsidiary aims include: giving pupils practice in the construction of a table of data, including the verbalization of a heading for the table; giving pupils practice in comparing data for groups containing different numbers of subjects, by expressing the data in terms of 'per 100 subjects'; giving pupils practice in interpreting tabulated data.

Previous learnings: The reproductive period of a woman's life is confined to about 30 years, from about age 15 to about age 45; 'Fertility' is distinct from 'fecundity'.

(The italicised sections represent the kinds of motivating and stimulating questions, problems, or situations which the teacher may generate in class during discussions).

In today's exercise, suppose that we have completed a survey. The purpose of the survey was to study the fertility pattern of a certain region in Ceylon - the South West Coast.

What is meant by the term 'fertility'?

('Fertility' denotes the actual number of children a woman bears during a given period of time. 'Fecundity' denotes the maximum number of children she could have borne during the same period of time. If we take the 30 years or so of the reproductive period of a woman's life, from the age of, say, 15 years to 45 years, and if we find that she has borne 3 children during this period, her fertility is 3 children, whereas her fecundity might have been, say, 15 children).

Suppose that we have visited many hundreds of households in the area and interviewed all the married women, say some 2,500 of them, in the area. We have asked them for their ages.

Let's put down a column for these ages by five-year age groups and a second column giving the number of women in each of these age-groups.

(With the pupils' co-operation, put down the columns on the blackboard. They should look like colum 1 and 2 in Table A. Try to get the pupils to verbalize the headings for the two columns. Don't put down any other columns yet! Say that you are excluding the data for the age groups below 25 years and over 80 years because they are not of immediate interest to you. TABLE A IS AT THE END OF THIS UNIT).

In reply to questions from us, the women have kindly told us how many children they bore and when each child was born.

Here are the figures we collected.

(Put up the rest of the column headings as shown in Table A. Then write in the figures 392, 355 and 329 as shown in column 3 of Table A, and ask -)

What's this 392 here?

(Elicit the understanding that the survey showed that the 327 mothers who were 25-29 years at the tim of the survey had given birth to 392 babies when the 327 mothers had been 20-24 years old).

What's the 355 and 329 here?

(The 284 mothers aged 30-34 years at the time of the survey had given birth to 355 babies when these 284 mothers had been 20-24 years old. The 286 mothers aged 35-39 years at the time of the survey had given birth to 329 babies when 286 mothers had been 20-24 years old).

Can we say that the women who are now 35-39 years old were less fertile than the women who are now 25-29 years old, when we compare their fertility figures for the 20-24 year period of their lives? It's 329 versus 392.

(Elicit the understanding that the numbers of women in the two groups are different, viz. 286 and 327 respectively. In order to compare the fertility of the groups, a correction should be made for this).

What correction shall we make?

(We may, for example, express the fertility as so much per 100 women).

Now, for the completed table.

(Give each pupil a copy of Table B. SEE THE END OF THIS UNIT).

The Table has no heading. A table should have a heading. Let's devise a heading.

(Allow several minutes for the pupils to devise a heading. Then choose the best of them. A suitabl heading might be: Fertility of women at different periods of their lives, mid-1960's, South West Coast of Ceylon).

Look horizontally along the rows of figures in columns 3 to 8. Do you notice a pattern?

(Generally speaking, the figures in each horizontal row increase to a peak in column 4 or 5 and then decrease progressively in columns 6 to 8).

What interpretation would you place on this pattern?

(Fer' ility was maximal when the women were 25-29 years old or 30-34 years old. After that, fertilit decreased markedly and was negligible after the age 45).

Why did fertility decline after age 35?

(Elicit the recognition that we cannot answer this question with the present data alone. We can onl make guesses. One possibility is that there is a true physiological decrease of fertility. Another possi- bility is that the women may be voluntarily avoiding conception).

Now look vertically up and down the columns. Look for a pattern, if any.

(Allow time for this. In columns 6, 7 and 8, the figures seem to decrease from below upwards. In column 3, the opposite is possibly the case. In columns 4 and 5, there is no clear trend).

How would you interpret the decreasing figures as you go up columns 8, 7 and 6?

(A reasonable interpretation is that it is becoming unfashionable, in recent years in the South West Coast of Ceylon, to have children after the age of 35 years. Another interpretation is that at the time of the survey, the older women supposed that they had their children at later ages than was actually the case. A far-fetched interpretation is that women over 35 years have recently been losing their fecundity).

Does this suggest that fertility can be controlled?

(Yes, if the interpretation is accepted that it is becoming unfashionable to have children after the age of 35 years).

We have left out of consideration several matters that could influence the reliability of the data. Can you mention some of them?

(For example: What was the sampling procedure that was used in selecting the households for the sur vey? What was the technique of interviewing? Did it minimize the chances of getting false answers? How reliable were the statements of age made by the women? How reliable were the memories of the women with re gard to the ages at which children were born to them?)

Assignment/Evaluation:

1. Summarise our conclusions in a sentence or two.

(For example: The data that have been presented show that the fertility of mothers in the 35-45 years age group has recently been decreasing in the South West Coast of Ceylon. The cause of the decrease is unknown, but one possibility is that it is becoming socially unfashionable for a mother to have children after the age of 35 years).

2. The table below gives data for the fertility rates of women of various age groups in Ceylon and i the Vavuniya District of Ceylon in 1960.

Age group of women (years)	Fertility rate of the stated age group (Number of births per 1,000 women in the stated age group)	
	Ceylon	Vavuniya District
15 and under 20	68	267
20 and under 25	227	381
25 and under 30	262	396
30 and under 35	257	387
35 and under 40	155	197
40 and under 45	44	49

(a) Give at least two reasons which might account for the relatively lower figure for the fertility of the age group '15 to under 20'.

(For example: The proportion of married women in this age group may be low; reproductive maturity, i.e. the ability to bear children, may not have been attained by all the women in this age-group; the women in this age-group may be practising contraception to a great extent).

(b) Which of these reasons do you consider to be the best?

(The proportion of married women in the age-group '15 and under 20 years' being low).

(c) Give at least two reasons which might account for the low figure for the fertility of the age-group '40 and under 45'.

(For example: A proportion of the women may have reached the age of physiological infertility; a high proportion of women in this age-group may be practising voluntary restriction of conception).

Table A

Present age of mothers (years) (1)	Number of mothers in the stated age group (2)	Number of children born to the mothers when these mothers were					
		20 - 24 years old (3)	25 - 29 years old (4)	30 - 34 years old (5)	35 - 39 years old (6)	40 -44 years old (7)	45 - 49 years old (8)
25 - 29	327	392					
30 - 34	284	355					
35 - 39	286	329					
40 - 44	182						
45 - 49	189						
50 - 54	160						
55 - 59	103						
60 - 64	75						
65 - 69	72						
70 - 74	43						
75 - 79	26						

Source: Abhayaratne, O.E.R., and Jayewardene, C.H.S., *Fertility trends in Ceylon*, page 227, Colombo, 1967

Table B

Present age of mothers (years)	Number of mothers in the stated age group	Number of children born to the mothers (per 100 mothers) when these mothers were:					
		20 - 24 years old	25 - 29 years old	30 -34 years old	35 - 39 years old	40 - 44 years old	45 - 49 years old
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
25 - 29	327	120					
30 - 34	284	125	140				
35 - 39	286	115	140	115			
40 - 44	182	125	160	120	75		
45 - 49	189	100	145	130	70	20	0
50 - 54	160	115	135	120	60	20	0
55 - 59	103	80	135	140	85	40	5
60 - 64	75	95	145	130	90	45	
65 - 69	72	105	140	150	125	60	15
70 - 74	43	85	135	140	120	60	15
75 - 79	26	50	135	125	110	70	10

Source: Abhayaratne, O.E.R., and Jayewardene, C.H.S., *Fertility trends in Ceylon*, page 227, Colombo, 1967.

DRAFT SAMPLE INSTRUCTIONAL MATERIALS

IN

MATHEMATICS

Type of instructional material: Teachers' Guide

Subject: Mathematics (Unit: Elementary Statistics)

Age group/level: Grade VIII

Introduction:

This unit is written with a view to incorporating some population elements into the teaching of m
matics. As data on population can very easily be put into tabular and graphic forms, it is hoped that i
this kind of data is included in the teaching of elementary concepts of statistics, mathematics instruct
would be more interesting and challenging to the pupils. Of course, this is not the only kind of data t
teacher could use in teaching about tables, graphs, arithmetical mean, and so on. The teacher might inc
data such as those obtained from dice throwing, counting the numbers of cars passing along a main road o
highway at specific intervals of time, counting specific colours of different dresses worn by a set of p
during a festival day. Still, population data, as it concerns the pupils themselves, might be a very in
ting source of material for the pupils to learn. Moreover, it lends itself to small group discussions o
portant problems concerning human beings. It can provide relevance and realism to classroom mathematics
teaching.

This unit is intended for the lower secondary, Grade VIII, level. If the skills of plotting grap
have already been acquired, additional time may be given to discussions on the population problems implic
n the data. If the elementary statistical concepts including graphs are to be taught at this level, thi
nit might be included along with other kinds of data.

The unit consists of eight lessons, starting, in Lesson 1, with the comparison of the number of
hildren born alive to their mothers and the number of children which the pupils themselves expect to hav
hen they are adults. Later, the pupils collect data on the population of the locality and analyse the d
mong the operations included are the construction of age/sex pyramids and the computation of dependency
hey will also compute the rate of natural increase of the population of the country from data provided b
he teacher.

In the teaching sequence the *italicised* sections represent the kinds of motivating and stimulating
uestions, problems or situations, which the teacher may generate in class during discussion.

Lesson 1

Objective: To help the pupils become familiar with the construction of a frequency table using data on family size.

Procedures:

1. *What determines the size of a family?*
(The students may answer births, marriage, permanent visitors, etc. The purpose of this question is to begin focussing on data on the number of live children in different families).

2. *What is the number of children born alive to your mother?*
(The students should also include any children who may have died since birth, in answering questio 1. Write the figures on the blackboard as the students answer. You will have a series of figures on the blackboard, such as 4, 5, 7, 3, 2, 9 .....).

3. *How many families are there that have 4 children each? 5 children each? 3 children each?*
(Let the students count 4's, 5's for a few minutes).

Is it easy to find this from the list that we wrote on the blackboard? Could you think of any oth way of setting out those figures so that it would be easier to find the number of families with one child, 2 children, 3 children, etc.?
(Give some time for the students to think. If the students could come out with a method, represen it on the board and discuss the method of recording the data. If not, ask further questions such as the on given below).

What is the biggest number of children born alive to a mother?
(Write the number at the top of blackboard).

What is the smallest number of children born alive to a mother?
(Write the figure at the bottom of blackboard. Discuss with pupils about putting the data in a tabular form. If necessary, suggest the following:

Table I

Number of children (n)	Tallying of families having the number of children stated in Column 1	Frequency (f)
9	1	1
8	1111	4
7	𝍸 11	7
6	𝍸 𝍸	10
5	𝍸 𝍸 1	11
4	𝍸 111	8
3	𝍸 11	7
2	1	1
1	1	1
		Σf50

(Introduce the idea of the "gate technique" of tallying in fives as shown in the table above, and the Σ sign which denotes the sum of all the figures in the column).

Does the table help us to tell quickly the numbers of families with different numbers of children?
(Tell the students that this kind of table is called a "frequency" table).

4. *How many children do you expect to have when you will yourselves be the parents?*
(Give the students enough time to think and write the figures on the blackboard. ave students copy these in their worksheet).

Assignment/Evaluation: Prepare a frequency table on the data you copied in the class.

Additional exercises of a similar kind may be given to the pupils. These and the frequency tables above may be utilized for the next lesson.

Lesson 2

Objectives: To help the pupils understand the *"mode"* and acquire the skill in computing the *arithmetical mean* from given data or from a frequency table.

Procedures:

1. (Write a pupil's frequency distribution, on the blackboard).

What is the most frequently occurring value in respect of the expected number of children?

What is the least frequently occurring value in respect of the expected number of children?

What can we say by looking at the most frequently occurring value?

(Many of you seem to have settled on having that number of children. Tell the pupils that the most frequently occurring value is called the "mode". When there is a range, say 4-6 children, the mid-point of the range, i.e. 5 is usually taken as the "mode". Circle the "mode" in the table. The occurrenc of one or a few extremely high (or low) values has no effect on the mode).

2. *How can we describe the characteristics of the group - here the class preference for a certain number of children?*

(Here, pupils need to be reminded that the *average* (arithmetical mean) value represents the central tendency" of the characteristics of the whole group. Elicit from pupils the method of calculating the average value.

How can we calculate the total number of children?

(Multiply the number of children by the frequency. As for instance, if there are four responses, i.e. f = 4, to the category of 8 children, the total number of children in that category will be 4 x 8 = 32 children).

What is the next step to get the average?

(Divide the total number of children by the total number of families. This gives the average. Complete the table with pupil participation, as shown below.

No. of children (X)	Tallying	f	Xf
9		1	9
8		4	32
7		7	49
6		10	60
5		11	55
4		8	32
3		7	21
2		1	2
1		1	1
		$\Sigma f = 50$	$\Sigma Xf = 261$

$$\text{Average } (\bar{X}) = \frac{\Sigma Xf}{\Sigma f}$$

$$= \frac{261}{50}$$

$$= 5.2$$

Tell the pupils what we call the *average, "Arithmetical Mean"*, or simply "Mean". Mean is written as $\bar{X}$. The Mean is a measure of the Central Tendency. It is representative of the measurement of a group as a whole with respect to certain traits. The Arithmetic Mean should be thought of as a computed value and not as a value which actually exists.

3. *How does "Mean" help us to describe the characteristics of the group?*

Assignment/Evaluation:

Mean and mode computation on the other frequency distributions. What does the mean indicate? Give possible reasons.

Additional exercises of a similar kind may be given to the pupils.

Lesson 3

Objective: To help pupils acquire the skill of constructing bar-graphs.

Procedures: Data relevant to the daily lives of the pupils may be put on the blackboard. For example, the profits made by a shopkeeper during the week:

Sunday	- Rs. 20	Thursday	- Rs. 35
Monday	- Rs. 10	Friday	- Rs. 45
Tuesday	- Rs. 15	Saturday	- Rs. 75
Wednesday	- Rs. 30		

How could we put the profits made by the shopkeeper in pictorial form?

(Let the pupils depict the data in any pictorial form of their choice. Discuss how accurately the picture portrays the data. Lead to a "bar picture" or Bar Graph with, in the example above, the profit in the vertical axis as well as in the horizontal axis).

Does the Bar Graph show how much profit the shopkeeper made before 12 noon on Sunday?

(Lead pupils to realize that the values in a given interval are being considered, and in the interval above the unit is one day and not half-a-day or groups of days.

What are the advantages of putting data in the form of a Bar Graph?

(Elicit the ease of visualising the numerical data, and of seeing trends. The question as to whether these trends will be repeated every week and what operations may be used to find out, may be discussed).

What would Bar Graphs for the data in Lessons 1, 2 look like?

(Assist the pupils to draw the Bar Graphs, such as with the number of children on the vertical axis and the frequency of a family having the stated number of children on the horizontal axis).

Assignment/Evaluation:

Other data with population significance such as the total population or the school going population in the country over 50 years against the census years, may be given, for pupils to depict in Bar Graph

Lesson 4

Objectives: To help pupils acquire the skill of constructing *line graphs*, using the same units of measurement, for the purpose of comparing different sets of data.

Procedures: *What would happen to the Bar Graph picture if the thickness of the bars was gradually reduced?* (Guide the pupils towards point representation, and function of axes (x, y). A brief explanation with illustrations, about dependent and independent variables would be useful).

How would the data used so far look like in line graph form?
(Some pupils could draw the first frequency distribution and some the second, with frequency a number of children as axes).

In the first two frequency tables considered in Lessons 1, 2, what were the variables?
(Lead to the possibility of drawing line graphs depicting both sets of data on the same paper, and with the same units on the axes).

What comparisons may be made from the two line graphs?
(Discuss various statements which may be made and supported by the graphs).

Assignment/Evaluation:

1. Other data relevant to population, such as the following may be used to draw line graphs:

Estimated population of the world since 1650

Year	Population (in millions)
1650	545
1750	728
1800	906
1850	1,171
1900	1,608
1950	2,517
1958	2,903
1964	3,220
1970	3,584
1980	4,318

2. A similar discussion may be generated regarding questions, such as when the population growth was most (least) rapid, and how the line graph supports the statements made by pupils.

Lesson 5

Objective: To help pupils develop skills in collecting data on the popula
say, 200 families.

Procedures:

1. *What is the population situation in the locality?*

(Here, of course, the pupils will have difficulty in answering
of the question, however, is to make an entry, with pupils' participatior

How can we find out about the population size of our locality?

(First, the boundary of the locality must be decided. Then to
go to each household in the locality, and collect the necessary data. Fo
groups of two or three, according to the size of the class. Assign a cer

2. *We have decided to go to different households to collect da*
to collect?

(As students express their views, list them on the blackboard.
such as: Who are the members of a family? Who are the members of a hous
number of persons in the household; male or female; ages; relationship to
Discuss how these various items may be placed in a tabular form. Settle
shown below. Finding the accurate age of persons may be a problem in the
question that might be asked when collecting data: for example, how o
was born? How old were you when the event..... took place? etc).

Assignment/Evaluation: Visit the households you are assigned to and c

Locality: Class:
House No. Name of the inves
Total No. of persons living in the house: Date:

List the person in serial order from the oldest to the youngest	Sex Male or female	Age (rounded to years)
Serial No. * (No name)		

* Don't mention temporary visitors in the list.

Lesson 5

develop skills in collecting data on the population of a locality consisting of,
es.

opulation situation in the locality?
e, the pupils will have difficulty in answering this vague question. The purpose
is to make an entry, with pupils' participation, into the subject of population).

out about the population size of our locality?
ndary of the locality must be decided. Then to answer the above question, we could
e locality, and collect the necessary data. For this, the pupils may work in
cording to the size of the class. Assign a certain number of households to each group).

ded to go to different households to collect data. What kind of data are we going

press their views, list them on the blackboard. If necessary, ask leading questions,
ers of a family? Who are the members of a household? Write on the blackboard -
ousehold; male or female; ages; relationship to the head of the household.
items may be placed in a tabular form. Settle on a format somewhat like that
accurate age of persons may be a problem in the villages. Discuss the kinds of
ed when collecting data: for example, how old were you when your first son
when the event..... took place? etc).

Visit the households you are assigned to and collect data.

Class:
Name of the investigating group:
sons living in the house: Date:

order ungest	Sex Male or female	Age (rounded to years)	Relationship to head of the household

visitors in the list.

Lesson 6

Objective: To help pupils construct a five year *age-group* table using the data collected in their own locality.

Procedures:

1. *We have collected some data on the population of our locality. We now wish to know how many persons there are in various age groups. Should we put the data using one year intervals of age?*

(Have pupils realize that setting out data in one year intervals, will be a lengthy task. Get them to express other age intervals, and discuss the merits and demerits. If necessary, suggest 5-year intervals and have the class consider it).

2. *How many five year intervals are there going to be?*

(Arrive at a format somewhat similar to the data analysis sheet shown below:)

Age group (years)		Tallying	Frequency	Percentage of the total population
70 & over	M			
	F			
65-69	M			
	F			
60-64	M			
	F			
55-59	M			
	F			
50-54	M			
	F			
45-49	M			
	F			
40-44	M			
	F			
35-39	M			
	F			
30-34	M			
	F			

Data analysis sheet (Cont'd)

Age group (years)		Tallying	Frequency	Percentage of the total population
25-29	M			
	F			
20-24	M			
	F			
15-19	M			
	F			
10-14	M			
	F			
5-9	M			
	F			
0-4	M			
	F			

Compiled by Group .....

M = male
F = female

(Have each group of pupils who participated in the survey as described in the previous lesson, work on compiling a table for their own data).

3. *Now, how can we put all the data together?*

(Have each group report the figures and add them. The teacher could put them on the blackboard. Let the pupils fill up a data sheet such as below).

Assignment/Evaluation:

1. Complete filling up the following data:

Age group		Tallying	Frequency	Percentage
70-80	M			
	F			
65-69	M			
	F			
60-64	M			
	F			
55-59	M			
	F			
50-54	M			
	F			
45-49	M			
	F			
40-44	M			
	F			
35-39	M			
	F			
30-34	M			
	F			
25-29	M			
	F			
20-24	M			
	F			
15-19	M			
	F			
10-14	M			
	F			
5-9	M			
	F			
0-4	M			
	F			

Add a suitable title to the above table.

2. What is the percentage of females in the total population in your locality?

3. What is the ratio of males to females?

4. What percentage of the people in your locality do you consider to be the productive population?

Lesson 7

Objectives: To help pupils construct an *age/sex pyramid*; to assist them to calculate the *dependency ratio*.

Procedures:

1. (Tell the pupils that we are going to construct an *age/sex pyramid*. It is a special kind of bar graph. The pyramid reorganises the bars by representing all men on one side and all women on the other side of the page. The format of the graph is given below:

Age group	Male	Female
70 & above		
65-69		
60-64		
55-59		
50-54		
45-49		
40-44		
35-39		
30-34		
25-29		
20-24		
15-19		
10-14		
5-9		
0-4		

10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10

percentage

(Have the students write all the age groups and percentages on the squared paper. Let them construct the pyramid individually).

What are advantages of setting out data in the form of a pyramid?
(It shows clearly the age and sex structure of a population).

2. *What is meant by "Productive" population?*

(People of working age group, i.e. generally 15-60 years). Refer to certain weaknesses of this definition. For example, children under 15 and old persons over 60 may be active in producing food, etc. while some persons in the 15-60 age group may be non-productive).

What is meant by the non-productive population?

(People under the age of 15 and above the age of 60. Introduce the term "Dependency Ratio". This is the ratio of non-productive population to the productive population. It is calculated by adding the percentages of population under the age of 15 and above the age of 60, dividing this sum by the percentage of population within the age range of 15-60, and then multiplying by 100. The higher the dependency ratio, the greater is the burden on the population of working age group to support the "non-productive" population).

What sorts of things do we need to calculate dependency ratio?

(The percentage of children under 15 years of age; the percentage of persons over 60 years of age; and the percentage of persons aged 15-60).

Could you put that in the form of a table?

(The table will look like:

Age groups in percentages			Dependency ratio
0-14	15-59	60 +	

Assignment/Evaluation:

1. Construct an age-sex pyramid using the data given below:

Age group (years)	Male	Percentage of total population	Age group (years)	Female	Percentage of total population
70 & above		.6	70 & above		.8
65-69		.7	65-69		.7
60-64		1.1	60-64		1.2
55-59		1.2	55-59		1.3
50-54		1.6	50-54		1.7
45-49		2.0	45-49		2.2
40-44		2.4	40-44		2.6
35-39		3.0	35-39		3.1
30-34		3.3	30-34		3.9
25-29		3.9	25-29		4.4
20-24		4.0	20-24		4.5
15-19		4.7	15-19		4.6
10-14		5.5	10-14		5.6
5-9		6.6	5-9		6.8
0-4		8.0	0-4		8.0

Source: *CBS*, His Majesty's Govt., Nepal, 1968.

Describe briefly the population structure as revealed by the age pyramid.

2. Compute the dependency ratio for the population represented in the following table:

Year	Age groups %			Dependency ratio
	0-14	54.4	60	
1961	40.5	54.4	5.1	
1966	40.4	54.4	5.2	
1971	39.4	55.1	5.5	
1976	38.8	55.5	5.7	
1981	38.8	55.3	5.9	

Source: *CBS*, Population projection for Nepal, 1968.

Does the dependency ratio indicate any trend?

Lesson 8

Objectives: To assist pupils to understand the meaning of certain demographic terms: the *birth-rate*, the *death-rate*, and the *rate of natural increase;* to help them acquire skills in computing the rate of population growth.

Procedures:

1. *How does the population grow?*
(Population grows as a result of *births* and *immigration*).

How is the population reduced?
(Population decreases due to *deaths* and *emigration*). Explain that the annual *birth-rate* is the number of births per one thousand persons in the population during the course of a year. The (annual) *death-rate* is the number of deaths per 1,000 persons in the population during the course of a year. The (annual) *immigration rate* is the number of persons coming into the country during the course of a year, and the (annual) *emigration rate* is the number of persons going outside the country during the course of a year

2. *When does the population grow?*
Could you state the rate of population growth in terms of birth-rate, death-rate and emigration rate and immigration rate?
(Help the pupils to realize that the population tends to increase when the birth-rate exceeds the death-rate. The *rate of natural increase* in birth-rate minus death-rate. Make it clear to pupils that at present the rates of immigration or emigration are negligible factors compared with the rapid natural increase of population so, the rate of natural increase becomes the rate of population growth in most of the developing countries. Present the data of an imaginary country X where the birth-rate is 55 per 1000 persons and the death-rate is 15 per 1000 persons. Assume that the rate of immigration or emigration is negligible).

What will be the growth rate of the population of the Country X?
(40 per 1,000 persons in the population).

3. (Present the following data to the class. The birth-rate in Nepal was 40 per 1000 persons and the death-rate is 18/1000 population in the year 1961. Immigration and emigrate rates were negligible).

What was the rate of population growth for Nepal in the year 1961? How many persons were added during that year to Nepal's population of eleven millions?

4. *Compare the population of two countries 'A' and 'B'*

'A'	'B'
BR = 65	BR = 45
DR = 44	DR = 17
IR or ER = 0	IR or ER = 0

Where BR means the birth-rate
DR " " death-rate
IR " " immigration rate, and
ER " " emigration rate.

In which country is the rate of population growth higher?

Is the rate of population growth for country 'B' the same as the rate of natural increase?
(Country B has the higher rate of population growth, 28 per 1000, as compared with 21 per 1000 for country A).

(The rate of population growth for country B is the same as the rate of natural increase of population, since the effect of immigration and emigration, is nil).

Assignment/Evaluation:

1. Compute the rate of population growth of the country 'D' for 1960 and 1970, and answer the questions given below.

Country 'D'

Year: 1960	Year: 1970
Total population = 9 millions	Total population = 11 millions
BR = 55	BR = 40
DR = 37	DR = 18
IR = 0	IR = 0

What is the rate of growth for the year 1960?

What is the rate of growth for the year 1970?

How many people (total population) would have been there in the year 1961?

How many people (total population) will there be in the year 1971?

How many more people are added to the total population of 1971 than to that of the year 1961?

What could you say about the trend of population growth in the country 'D'?

2. Fill in the missing information:

	Philippines	India	Laos	Nepal
Rate of population growth	-	-	24	22
Rate of natural increase				
Crude birth-rate			47	
Immigration rate			0	0
Crude death-rate				18

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