Basic malaria microscopy

PART II

Tutor’s Guide
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This training module on basic malaria microscopy is in two separately bound parts. Part I, the Learner’s Guide, contains all the technical information that will be needed by trainees in this field. Part II is the Tutor’s Guide, which gives extensive advice for those responsible for organizing, running and evaluating training programmes.

The module is one of two\(^1\) published by the World Health Organization concerned with different aspects of the control of malaria. It can stand alone as a medium for teaching malaria microscopy to public health and laboratory personnel, or can be used as an integral part of a longer and more comprehensive programme of training in malaria.

In 1988 WHO published *Bench aids for the diagnosis of malaria*, which comprise all the colour plates that appear in the Learner’s Guide and much of the core information. These bench aids are published in the form of separate laminated sheets, which are very robust and easy to use at the laboratory bench. While it is not essential to provide these for use during training courses, they are recommended for use by all health workers engaged in routine malaria microscopy.\(^2\)

The need for this module was identified by Member States in the Eastern Mediterranean, South-East Asia and Western Pacific Regions of the World Health Organization, and the project was conceived by Dr McWilson Warren, former Team Leader of WHO’s Interregional Secretariat for the Coordination of Malaria Training in Kuala Lumpur, Malaysia. Work on the module was one of the major activities of the Secretariat. The original text was written by Mr John Storey and the colour plates in Part I are taken from watercolour paintings meticulously prepared by Mr Yap Loy Fong.

The text, particularly that of Part II, has been reviewed by numerous individuals and revised by Dr P. F. Beales, Dr C. W. Hays, Dr D. Payne and Mr W. Rooney. Editing of the entire module was undertaken by Professor Michael Colbourne.

WHO wishes to acknowledge the collaboration and financial support provided by the United States Agency for International Development for this and other activities of the Interregional Secretariat for the Coordination of Malaria Training.

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\(^{1}\) Also available: *Entomological field techniques for malaria control* (1989) (see inside back cover)

\(^{2}\) A second edition of these bench aids was published in 2002 (see inside back cover)
Introduction

This Tutor's Guide is designed primarily to help those responsible for training health workers and laboratory personnel in malaria microscopy. Some parts of it should be useful even to the most experienced teachers. The style of writing has been kept simple, to avoid misunderstanding and to facilitate translation into any local language.

It is essential that you read the Learner's Guide (Part I of the training module) before planning your training programme, rather than reading only the Unit that relates to your next teaching session.

This Introduction will help you to understand the role of tutor and facilitator in this training system and explain why the Learner's Guide is designed the way it is.

For whom is this training module intended?

The module is intended for health workers who are responsible for diagnosing malaria by the microscopic examination of blood films to detect the presence of malaria parasites and to determine their species. It can be used equally well for basic training and for refresher training.

Educational level of learners

The appropriate educational or entry level of learners will depend upon a number of factors. Experience in many parts of the world has shown that health workers from a wide range of educational backgrounds can be accepted for training in this subject. However, if the entry level is relatively low, the period of training may need to be extended: it may well take longer to train someone with only 8 years of schooling than someone with 12 years. On average, it should be possible to teach the contents of this module in about 5 weeks.

Apart from education requirements, it is equally important that learners:
- are able to read, comprehend and write simple English (or the language into which the module is translated);
- can systematically follow a set of written instructions;
- have good hearing and eyesight;
- can tell the difference between, and name, the two colours red and blue;
- are sympathetic to the health problems of the community;
- indicate willingness, on completion of the course, to work with members of the community, especially those who are sick.

This list is not necessarily complete: for example, another requirement might be willingness to work for long periods in rural areas far from home.
Often, you and your colleagues will be unable to interview candidates directly. It then becomes particularly important, when writing to those who will select learners for the course, to indicate the most suitable type of person.

How is the training designed and what is its content?

The training module is intended to facilitate the teaching of all the individual tasks involved in basic malaria microscopy to health workers and laboratory personnel. The principal objectives of the training are listed in the Introduction to the Learner’s Guide. Please stop and read these now.

This training system differs from others in that it deals with each step of the diagnostic routine in the correct sequence. For example, learners are taught how to clean and wrap slides before learning how to make blood films on these slides. In other words, the learners acquire, step by step, all the knowledge and skills they need for the tasks involved in malaria microscopy.

This type of training may be referred to as performance-based or competency-based. When carried out properly, it is highly effective. It is also very economical: training is kept as short as possible, yet participants learn all they need to perform the required tasks competently. This saves time, money and resources.

At the beginning of each Learning Unit in the Learner’s Guide is a list of the learning objectives. Learning objectives summarize the knowledge, skills and attitudes that each learner should have acquired by the end of that Unit. You and your colleagues must satisfy yourselves that each learner has achieved the stated objectives before proceeding to the next Learning Unit. (Methods of evaluating progress are described later.)

While it is more convenient to have all the learners working together, or in small groups, on each Learning Unit, this programme allows the slower learners to work through each Unit at their own pace. However, careful planning is essential if the brighter participants are not to become bored.

Who runs the course?

You and your colleagues are responsible for organizing and running the course. The Learner’s and Tutor’s Guides will do much to help you, but the final results will depend upon your efforts. This may be the first time that you have organized and run such a course, or you may be an experienced teacher: in either case, the importance of using the Learner’s Guide and the Tutor’s Guide together as you proceed through the Learning Units is stressed.

Who helps you in the course?

Your job will be easier, and your teaching more effective, if you have one or more persons to help you. These assistants, who should have working experience of malaria microscopy, are called facilitators. You can then divide learners into small groups of perhaps two to four, and allocate one facilitator to each
group. The greater interaction this allows between the learners and the facilitators results in better learning and understanding.

As overall manager of the training programme, you will be responsible for designing the timetable, explaining the learning tasks to the learners and facilitators, and giving learners and facilitators whatever help they need. Do not worry if the facilitators are not trained as teachers; their task is to explain or demonstrate a particular activity and to watch learners perform it. They must also be able to admit to learners when there is something that they do not know and be prepared to refer the question or problem to you. Impress on your facilitators that no one person can be expected to know everything about a particular subject. There is no shame in saying “I do not know, but I will find out for you”.

Many problems can be avoided by giving your facilitators plenty of time to read the Learner’s Guide and discuss with you any part of it that may need clarification. It would be a good idea for you and the facilitators to go through the module together; you could then test their knowledge by asking them appropriate questions.

Remember, there are many methods of malaria microscopy. This training module describes, and attempts to standardize, well-tried methods that have been widely used in many parts of the world.

Why provide a Learner’s Guide?

Providing learners with a full set of notes ensures that:

- all learners have exactly the same set of notes, and thus avoid unnecessary note-taking during lessons;
- you and the facilitators can refer to any part of the Learner’s Guide knowing that all learners can find the right page quickly;
- learners can spend more time reading the notes, and therefore have a greater chance of understanding them, because there is no need to write up notes taken during class;
- there is no chance of learners making errors in note-taking;
- after the course, each learner can take home a set of notes that will be a helpful reference in his or her daily work.

How is the course run?

This subject is dealt with on pages 7–9 of the Learner’s Guide: please stop and read these now.

As stated in the Learner’s Guide, classroom presentations should be kept to a minimum. Demonstrations and role-play involving the learners, practical sessions, field visits and discussion groups are all much more effective ways of teaching.

Learners who are actively involved learn more and learn better than those who must simply sit and listen to a single person talking for long periods of time.
How will you know whether it was a good course?

Judging whether or not the course was a good one is difficult and involves answering the following questions:

- **How well did the group learn?**
  
  This may be determined by evaluating the learners' performance as they work through the Learning Units and again at the end of the training. A further evaluation of how well they have retained their knowledge, skills and competence may be necessary 10–12 months later.

- **How did the learners view the training?**
  
  Learners' answers to this question will yield valuable information on how useful they find this type of training, especially if they provide a short evaluation during the course and a longer one at the end. (A suitable questionnaire is provided in Annex 5.) Frankness can be encouraged by allowing learners to make their responses anonymously.

Feedback provided during the course allows you to assess how well your training is being received and to make any improvements that seem necessary. Feedback received at the end of the course will help you to improve future programmes. If you have prepared the course carefully, feedback is likely to be favourable, which is rewarding both for you and for the facilitators.

Whatever the government policy may be regarding the award of a certificate of competence, some record of attendance and level of competence reached by each learner should be kept so that details may be checked later.

Use of the Tutor's and Learner's Guides

The Tutor's and Learner's Guides may be used together (and with the suggested audiovisual aids) for basic group training and for in-service training. The Learner's Guide alone may be used for refresher training, or by individuals for reference.

The way in which you and your facilitators should make use of the Guides and the audiovisual aids will become apparent as you work through the training module.

Learners will follow the group training activities using the Learner's Guide plus whatever other materials you provide them with.

Training facilities

A number of basic facilities and equipment must be organized before training can begin. In some countries these are readily available but in others you may need to improvise or to modify existing equipment. Bear in mind that there may be long intervals between ordering supplies and getting them delivered, but do not delay training unnecessarily because you do not have the best equipment.
Ideally, two rooms should be available for training. One of these can be used for group discussions and for the overhead and slide projectors. Chairs and small tables or desks will be needed for this room.

The second room will be used as a laboratory. Ideally, the laboratory should be air-conditioned and well lit, and have ample cupboard and shelf space. There should be a reliable electricity supply with several outlets, running water and at least one sink, a firm bench or tables about 75 cm high, and a chair of adjustable height for each learner. Space on a wall should be available for a black- or white-board. In practice, you may have no running water, little if any electricity, few tables, and chairs or stools of fixed height. Whatever the conditions, do your best to ensure that the learners are as comfortable as is possible in the circumstances: you may be surprised how much you can achieve even with relatively few facilities.

Teaching equipment

For teaching sessions and group discussions, the following items should ideally be available:

- Overhead projector.
- Projector for 35 mm slides, preferably with automatic slide feeder.
- Screen for slide projection (a white sheet is an adequate substitute, but the white-board is unsuitable because it will reflect projected light).
- Flipcharts — one for each small group of learners — of the type shown in Annex 1. Supplies of “butcher’s paper” or “newsprint” are usually cheap and readily available.
- Large blackboard or white-board.
- Chalks for blackboard or marker pens for white-board, in a selection of colours.
- Acetate sheets for overhead projector (or used and washed X-ray plates).
- Coloured marker pens for acetate sheets (including some permanent markers for diagrams you may wish to keep).

If the room cannot be darkened for the projection of 35 mm slides you may need to construct a daylight viewing box with rear projection screen. Annex 2 gives directions for the construction of a suitable box. You may find that you can manage with only the overhead projector. Many trainers prefer the overhead projector to the black- or white-board, since they can continue to face their audience while illustrating what they are saying.

A white-board constructed with a metal sheet beneath the white surface allows the use of magnetic visual aids, such as illustrations of the erythrocytic cycle of the malaria parasite, during discussion sessions.

Glassware, chemicals and reagents

You probably have most, if not all, of what you need for the training course available to you in the laboratory where you do your own routine work. A full list of the minimum requirements is provided in Annex 3.

Learners’ equipment

The equipment listed below should be provided for each learner. Where supplies have to be ordered, this should be done well in advance of the course; many items are difficult to obtain at short notice.
- Copy of the Learner’s Guide.
- Microscope. Try to determine the type of microscope that trainees will use when they return to their places of work; there is little point in training them to use microscopes that use artificial light if they will later have to work with natural light. It may be possible for trainees to bring with them the microscopes that they will use in their work, but it is preferable to provide microscopes that can be used with both artificial and natural light.
- Notebook. This should be used only for occasional notes or instructions; as explained earlier, there should normally be no need for notes to be taken during training sessions.
- Ballpoint pen.
- Set of pencils (medium-hard graphite, plus red, blue, brown and black) for drawing diagrams of suspected parasites during practical sessions.
- Pencil sharpener
- Eraser.
- Ruler.
- Set of reference slides with Giemsa-stained thick and thin blood films, containing the species of malaria parasite each trainee is most likely to see in routine work. Normally, the species would be *Plasmodium falciparum*, *P. vivax* and *P. malariae*, although *P. ovale* is being seen increasingly, both in Africa and in the rest of the world. Unfortunately, good specimens of *P. malariae* and *P. ovale* are difficult to obtain. *(Note that, under normal tropical conditions, these reference slides will have a shelf-life of only about 6 months.)*
- Set (about 25–30) of Giemsa-stained thick and thin blood films for use in practice sessions. These should show the species of malaria parasite that are common in the area where trainees will be working, at different stages and in various densities. *(Collecting these slides will require a lot of time and effort, but is ultimately worth while; practical sessions will proceed much more smoothly if facilitators know exactly what each learner is examining.)*

### Syllabus and timetable

The syllabus

The contents list of the Learner’s Guide represents the syllabus — the list of subjects to be covered — for the training course. Planning the course is made easier by the division of each Learning Unit into a number of subunits or main topics. Go through each of the Learning Units in turn; for each subunit calculate how much time you will need to devote to it and decide what kind of learning activity would be most suitable for the topic. For example, you will find that Learning Unit 1 — Malaria, the disease — has six learning objectives and is divided into three main sections, dealing with different aspects of the disease. If you consider that one or more of the learning objectives could best be achieved through group discussion, with interaction between you, the facilitators and the learners, you should then decide what other materials you might need to reinforce the learning. It might be valuable to show a film or some slides of patients with malaria to illustrate the effects of the disease.

The following is a list of the various learning activities that you might consider using:

- **Group discussion**
  
  Once participants get used to group discussions, the two-way exchange of information between them and the facilitators makes this a very effective
learning activity. People share their knowledge and experiences with the rest of the group and stimulate each other’s thoughts on the subject in hand.

- **Practical work**
  Practical work usually takes place in the laboratory or other suitable location. Its purpose is to give learners the opportunity to practise the procedures involved in malaria microscopy. The more practice they have, the more competence they will acquire in making and interpreting slides.

- **Field work**
  Work performed in the field, in conditions as close as possible to those that trainees will meet later in their jobs, is a very effective learning activity.

- **Demonstrations, role-plays and films**
  These three activities are designed to reinforce the learning process. A film might be a good way to show learners what a particular place looks like without your having to take them there. Introducing learners to the appearance of a malaria parasite under the microscope might easily be achieved in a demonstration. Role-play can be used for training in various aspects of work, such as approaching patients for blood samples, with the learners acting the parts of those involved in the situation.

**Evaluation**

Evaluation is assessment of the level of skill, competence and knowledge that learners have achieved in a particular area. Methods of evaluation are discussed later. Evaluation of the course, and of you and the facilitators, by the learners is also important, and will provide feedback that will help you to improve the training course.

**The timetable**

Once you have calculated the amount of time that needs to be spent on each subunit, all the various learning activities must be fitted into the framework of the training programme. The duration of the programme may be something over which you have little control; for instance, you may be told to limit the programme to 5 weeks because of shortage of funds, even though you have calculated that it should ideally be spread over 6 weeks. You and the facilitators will then need to spend time reorganizing the timetable so that all the learning activities can be fitted into the time available.

Table 1 shows a simple method of allocating time to each of the Learning Units. However, it represents just one approach to the problem and is intended only as a guide that may be of help to you in organizing your training programme. It cannot take account of all the factors that may influence your planning, such as the length of your normal working week, the need for you to divide your time between the training course and your routine work, or the fact that there are public holidays during the course.

In planning the timetable, remember to allow time for evaluation both during and after the course, and for the “hidden” activities, such as tidying of the laboratory, completion of records, travel time for field work, etc.

A suggested timetable for a 5-week training course is shown in Table 2, but again is provided only as a guide. It is based on a 7-hour working day and
a 5-day week; this may not be suitable for your purposes and will have to be adapted appropriately. You will notice that a certain amount of time in Week 5 remains unallocated at this stage. As the course progresses you may feel that further discussion is necessary on some topics or that there are other films you would like to show; these activities can be fitted into the "free" periods.

Introduction to the course

Your very first session with the learners should take place in the meeting room, preferably with the seating in a semicircular arrangement as indicated in the diagram below. If the chairs do not have fixed supports for notebooks, it would be helpful to have small desks or tables available.

Introduce yourself first. Write your name on the board or flipchart and tell the learners a little about your background and your job. Then ask each of the facilitators to do the same thing.

The learners should introduce themselves next. It might be helpful to divide the learners into pairs and ask them to exchange names, information about jobs, home towns, etc. Each learner can then introduce his or her partner to the whole group. This method often has the effect of reducing tension, and a relaxed atmosphere is a good learning atmosphere.

The learners will have been given their copies of the Learner's Guide. Allow them 10 minutes or so to read through its Introduction and then briefly, but carefully, deal with the various topics covered. Explain, for instance, that working in small groups with facilitators should make learning easier, and that there should be little need to take notes during the course. Stress that the course will involve a great deal of practice, since this is the best way to acquire the necessary skills.

Go through the objectives of the various Learning Units so that the learners understand exactly what they should have achieved by the end of the course. Explain that the learners should keep these objectives in mind throughout the course and always ask for help if they feel uncertain of having achieved them. Each learner is likely to be more aware than the facilitators of how well he or
she has understood a particular topic or has mastered a particular skill; it is the job of the facilitators to make the learning process as effective as possible.

There may be other subjects you want to raise at this time, but try also to encourage the learners to discuss the training programme — what they expect of it, what aspects of it are worrying them, and so forth. Explain that you and the facilitators will welcome feedback throughout the course — constructive criticism from the learners may well help you to improve the training programme.

Finally, talk to the learners about evaluation. Explain that evaluation will be a continuous process throughout the training course. Stress that the weekly spot tests and multiple-choice quizzes should be enjoyed rather than feared; they are part of the learning experience. Their purpose is to allow you and facilitators to assess the learners’ progress, to correct mistakes and clarify misunderstandings. Emphasize the importance of the learners reading all the questions (and any supplementary instructions) very carefully. Explain that everyone will learn at different speeds and that you and the facilitators will make as much allowance for this as possible.
### Table 1. Allocation of time to learning activities

<table>
<thead>
<tr>
<th>Learning Units</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>B/D</th>
<th>A/B</th>
<th>A/D</th>
<th>A/E</th>
<th>B/C</th>
<th>Total</th>
</tr>
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<td>2</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>3/4</td>
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<td>1/2</td>
<td>2/3</td>
<td>1/2</td>
<td>5 1/4</td>
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<td>1</td>
<td>1</td>
<td>2</td>
<td>3/4</td>
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<td>1/2</td>
<td>1/2</td>
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<td>4 1/4</td>
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<tr>
<td>Cleaning and storing microscope slides</td>
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<td>6 1/4</td>
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<td>Keeping accurate records</td>
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<td>1</td>
<td>3</td>
<td>1/2</td>
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<td>1/2</td>
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<td>1/4</td>
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<td>1/4</td>
<td>7/4</td>
<td>7 1/4</td>
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<td>Examining blood films</td>
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<td>4</td>
<td>1</td>
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<td>1</td>
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<td>1</td>
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<td>1/2</td>
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<td>4 1/3</td>
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<td>Supervisory aspects of malaria microscopy</td>
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<td>1</td>
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<td>3 1/3</td>
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<td>7</td>
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<td>3</td>
<td>4</td>
<td>17</td>
<td>11</td>
<td>21</td>
<td>141</td>
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</table>

A = presentations (including brief lectures, group discussions, information exchange, feedback)
B = practical work in the laboratory
C = field work
D = film, demonstration, role-play, or a combination
E = evaluation of learners by multiple-choice questions before and after the course, evaluation of the course by lecturers, or both

**Note:** Each session lasts about 50 minutes, allowing for breaks between sessions, moving to another room, etc. Dividing 141 sessions by 7 hours = 30.1 days to complete the training. However, additional time should be allowed for registration, opening and closing ceremonies, issuing and receipt of equipment, travel, etc., which represents about another 3 working days. Thus 20 days + 3 days, divided by 5 working days in a week = 4 weeks and 3 days, say 5 weeks in all for this course.
Table 2. **Example of a timetable**

<table>
<thead>
<tr>
<th>Period</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
</table>
| 1      | Arrival and registration of participants | Cleaning and storing microscope slides | Record forms and how to use them | Collecting blood films (field trip)  
*Note*: You will need to leave early for the field | Weekly spot test |
| 08:00–08:50 | A/D | B | C | | |
| 2      | Opening ceremony | As Period 1 | Blood films (and how to make them) | As Period 1 | Weekly quiz (written or multiple-choice answers) |
| 09:00–09:50 | | B | A | C | | |
| 3      | General information and issue of supplies | As Period 1 | Making blood films | As Period 1 | Discussion of spot test results |
| 10:10–11:00 | | B | D/B | C | | |
| 4      | Introduction to the course and how it will function | As Period 1 | As Period 3 | As Period 1 | Discussion of weekly quiz results |
| 11:10–12:00 | A | B | B | C | | |
| 5      | Timed pre-test and feedback | As Period 1 | As Period 3 | As Period 1 | Film on malaria |
| 13:00–13:50 | A/E | B | B | C | | |
| 6      | Malaria, the disease | Record forms and how to use them | As Period 3 | As Period 1 (plus travel time back to training centre) | Group discussion on malaria film |
| 14:00–14:50 | A | A/D | B | C | | |
| 7      | As Period 6 | As Period 6 | Briefing and preparation for field work | Packing and storing collected films, and completing records | Learner assessment of week 1 and feedback |
| 15:00–16:00 | D | D/B | A | C | | |

*Note*: As for Table 1, A = presentations, B = practicals, C = field work, D = film, demonstration, role-play, E = evaluation.
<table>
<thead>
<tr>
<th>Period</th>
<th>From</th>
<th>To</th>
<th>Day 1</th>
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<tbody>
<tr>
<td>1</td>
<td>06.00–08.50</td>
<td></td>
<td>Staining blood films with Giemsa stain</td>
<td>The microscope</td>
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<td>Examining blood films for malaria parasites</td>
<td>Weekly spot test</td>
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<td>As Period 1</td>
<td>Discussion of spot test results</td>
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<td>Examining blood films for malaria parasites</td>
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<td>Learner review of week 2 programme and feedback to facilitator</td>
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<td>As Period 4</td>
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<td>Weekly record of work done</td>
<td>Meeting with facilitators to review training activities</td>
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<td>Weekly quiz (written or multiple-choice answers)</td>
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<td>Discussion of spot test results</td>
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<td>Artefacts in blood films</td>
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<td>Routine examination of blood films for malaria parasites</td>
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<td>The life cycle of the malaria parasite</td>
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<td>As Period 1</td>
<td>Supervisory aspects of malaria microscopy</td>
<td>Final weekly spot test</td>
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<td>1300–13:50</td>
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<td>As Period 5</td>
<td>Final weekly quiz (written or multiple-choice answers)</td>
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<td>1400–14:50</td>
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<tr>
<td>7</td>
<td>As Period 1 (plus daily record of work done)</td>
<td>As Period 1 (plus daily record of work done)</td>
<td>As Period 1 (plus daily record of work done)</td>
<td>Monthly records and supplies requests</td>
<td>Completion of weekly/monthly work record</td>
</tr>
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<td>15:10–16:00</td>
<td>B/C</td>
<td>B/C</td>
<td>B/C</td>
<td>A</td>
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<tr>
<td></td>
<td>Meeting with facilitators to review training activities</td>
<td>Meeting with facilitators to review training activities</td>
<td>Meeting with facilitators to review training activities</td>
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<tr>
<td>1</td>
<td>06:00-08:50</td>
<td>Discussion of spot test results</td>
<td>Time flexible to be filled as needed</td>
<td>Issue of supplies to take back to duty station</td>
<td>Free</td>
</tr>
<tr>
<td>2</td>
<td>09:00-09:50</td>
<td>Discussion of weekly quiz results</td>
<td>Time flexible to be filled as needed</td>
<td>Individual counselling before returning to duty station</td>
<td>Closing ceremony and presentation of proficiency certificates</td>
</tr>
<tr>
<td>3</td>
<td>10:10-11:00</td>
<td>Discussion of daily/weekly/monthly reports and supplies</td>
<td>A</td>
<td>As Period 2</td>
<td>As Period 2</td>
</tr>
<tr>
<td>4</td>
<td>11:10-12:00</td>
<td>As Period 3</td>
<td>A</td>
<td>As Period 2</td>
<td>As Period 2</td>
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<tr>
<td>5</td>
<td>13:00-13:50</td>
<td>Return of supplies and equipment</td>
<td>As Period 5</td>
<td>As Period 2</td>
<td>Final meeting of the facilitators to evaluate the course, decide on responsibilities for writing the report and discuss changes to be made to future courses</td>
</tr>
<tr>
<td>6</td>
<td>14:00-14:50</td>
<td>As Period 5</td>
<td>As Period 2</td>
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<td>7</td>
<td>15:00-16:00</td>
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<td>As Period 2</td>
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</table>
LEARNING UNIT 1

Malaria, the disease

As the learning objectives state, this Unit is intended to:
- emphasize that malaria is an important disease;
- outline the clinical signs and symptoms of malaria;
- explain briefly how the disease is caused;
- stress to the learners that they should be serious about their jobs at all times;
  *an incorrect diagnosis could result in the death of a patient.*

It would be a good idea to run this Unit as two discussion sessions, showing a film or slides at the start of one or both sessions; films and slides will often stimulate discussion. Moreover, your learners will almost definitely have seen cases of malaria in their home towns or villages and will be able to make useful contributions to the discussion. The group’s collective knowledge of malaria may be surprisingly extensive.

To emphasize the importance of malaria — and of training health personnel in diagnostic microscopy — it might be a good idea for these sessions to be conducted by someone known by the learners to be of senior status. Ensure that the person you choose for this task takes full account of the stated learning objectives in what he or she says and does. If you are unable to exercise this degree of control, you may have to organize a further session so that the subject is covered to your satisfaction.

Remind learners that they should take the time to read the Introduction and Learning Unit 1 of the Learner’s Guide, plus Learning Unit 2 in preparation for the next session.
LEARNING UNIT 2

Cleaning and storing microscope slides

This is probably the first time that the learners have worked in a laboratory situation; they will feel a little strange, curious, and perhaps nervous, and will need your encouragement.

The following are the most important purposes of this unit:

- Learners must understand that without good clean slides the quality of their work will be lowered and they might make a wrong diagnosis.
- Going through these exercises gives you the opportunity to prepare all the cleaned and wrapped slides needed for the blood films that will be made during the rest of the course.

Remind learners to read Learning Unit 3 before the next session.
Notes
LEARNING UNIT 3

Keeping accurate records

You will have about eight sessions to deal with this Unit, which concentrates on the importance of keeping good, clearly written and accurate records.

You will almost definitely have your own record forms for the following purposes:

- daily register of slide examinations, which probably has space for examination results and the daily total of slides examined;
- weekly slide examination record;
- monthly slide examination record;
- requisition of supplies.

Go through each of these forms in detail. Give the learners as much practice as possible in completing them; be particularly careful to explain any items that might be misunderstood, so that errors are eliminated from the outset.

Tell the learners to start using the record forms in their daily training activities from this point onwards.

Remind learners to read Learning Unit 4
before the next session
Notes
About 13 sessions should be devoted to this Unit, which could valuably be made up as follows:

1 discussion group
1 demonstration period
3 practice sessions in the laboratory
1 session preparing for field trip
6 sessions of field activity
1 tidying-up/debriefing session.

Where it is feasible, increase the amount of time given to field activities.

Emphasize from the very beginning the precautions that must be taken to avoid contamination when blood films are made. This will also give you the opportunity to discuss the diseases that can be transmitted by contamination with blood — malaria, hepatitis and acquired immunodeficiency syndrome (AIDS). Explain that these diseases can pass from an infected person to another patient if needles or lancets are contaminated with blood, or to the individual taking the blood sample through accidental contact with blood. Stress to the learners, however, that the chances of their transmitting or contracting a disease in this way are very small provided that they observe the following simple precautions, which are also outlined in the Learner’s Guide:

- Wear protective gloves whenever they are handling blood or taking blood samples.
- Avoid getting blood, including that from unstained slides, on their fingers or hands.
- Cover any cuts or abrasions on their hands with adhesive dressings.
- Take care not to prick themselves or others with any sharp instrument that has been in contact with blood.
- Never use disposable lancets more than once.
- Always wash their hands with soap and water after completing any task that involves the handling of blood.
- If blood does get on to the skin it should be wiped off quickly with cotton wool dampened with alcohol, and the affected area should be washed with soap and water as soon as possible.
- Any materials contaminated with blood, such as lancets, cotton swabs and discarded blood slides, should be boiled for 20 minutes, or soaked in a solution of bleach or sodium hypochlorite (available chlorine 10 000 parts per million), then disposed of safely by burial or incineration.

Thick and thin blood films

Spend time discussing with learners the differences between thick and thin blood films and explaining what each is used for. You can use Plate 2 of the Learner’s Guide to illustrate what you have to say. You will need to
demonstrate the correct way of making these blood films, then allow the learners as much time as possible to practise the techniques themselves.

The best approach is probably to divide the learners into groups of two or three who will work together. Get them to practise thin films first, making one per slide. When they have reached the standard you require, allow them to make a thin and a thick film on the same slide.

Quite a lot of blood will be needed if the learners are to have sufficient practice. In the past it was usual for learners to take blood from one another, but the discomfort involved in repeated sampling often made them reluctant to continue. A better alternative is to use out-dated blood from a blood bank or to acquire a small sample of non-infectious blood, treated with an anticoagulant, from a hospital laboratory.

In addition to their samples of anticoagulant-treated blood, each group of learners will require a Pasteur pipette fitted with a 5-ml rubber teat. Once each learner has shown you 10 slides with satisfactory thick and thin films, he or she should be allowed to proceed to making blood films from another member of the group. At this stage, insist that conditions are as similar as possible to what the learners will encounter in the field. All collection materials, including record forms, should be assembled before sampling begins, blood films should be correctly labelled and relevant details should be entered on the record forms.

A learner may be judged competent when he or she has prepared three or four satisfactory slides, correctly labelled and accurately recorded.

Before finishing work on the day that you practise making blood films, prepare all the equipment that will be needed for the following day’s field work, and allocate the jobs to be done by each learner.

**Blood collection in the field**

For many learners, this will be their first exposure to field work and is therefore likely to be a tense but exciting experience. It may also be their first opportunity for direct observation of people with malaria.

Exactly how the team will work will depend on the type of field work you have been able to organize. Whether it is a village survey, a collection at a school, or a regular collection at a dispensary or health centre, impress on the learners the need to deal gently and sympathetically with patients at all times.

**Flies, heat, dust, discomfort**

The learners will quickly become aware of the problems posed by working in the field; stress to them again the need to protect the slides from the effects of dust, flies, heat and intense sunlight. They will also probably find that working in the field can be hot, humid and uncomfortable, and start to realize that their routine work in rural areas is unlikely to be easy. You should have emphasized this point in the discussion at the start of the Unit and during your briefing for the field trip; do not be surprised if learners raise the subject again in later discussions.
Checking slide numbers against records

One of the commonest problems in malaria microscopy is that of incorrectly recorded slide numbers. In hot, tiring conditions, mistakes are easily made in writing the numbers on slides which link them with patients’ record forms. You will already have stressed the importance of accurate records in earlier discussions, but remember to check continually during this field trip.

Leaving the field

At the end of the field trip, everyone will be tired, and this is the time when mistakes can be made — record forms misplaced, slides poorly packed, etc. Impress on the learners the need to collect up all material (used and unused) and take it away with them; contaminated lancets and cotton wool, in particular, are possible sources of infection if they are left lying around. Ensure that all the slides are properly packed and protected from the heat, which can cause autofixation of blood films.

Feedback

Try to obtain as much feedback from the learners as possible concerning their experiences during the field trip. This is a valuable topic for discussion and learners will probably be keen to share their observations and impressions.

Weekly quiz and spot test

At about this time you should organize the first weekly quiz and spot test. Remember, the purpose of these is to allow you to:

- evaluate the skills each learner has developed;
- help learners to assess their own progress and identify areas where improvement is needed;
- help each learner, where necessary, to improve his or her own performance.

You may have to explain to the learners exactly what is involved; they may not have experienced multiple-choice questioning before, or may not understand what a spot test is.

The multiple-choice quiz is a valuable learning activity and should be as interesting as possible. Its design is not easy, however, and a “bank” of suggested questions has therefore been included in this Guide (see Annex 4) to help you. Remember that the questions should be concerned only with topics that the learners have already covered in the course.

Rapid feedback from the quizzes reinforces learning, and you will therefore want to mark the papers as quickly as possible. Use a blank sheet of paper (or an old, washed X-ray film) and cut holes in it, in positions that correspond to the correct answers. Placing this “template” over the learners’ answer papers will enable you to complete the marking in a very short time — probably while learners are working on the spot test.

The spot test can include any practical exercise in which you feel you should test the learners’ skills. At this stage of the course only a limited number of practical tasks have been learned; later there will be much greater scope, but for now you could ask learners to demonstrate the cleaning and wrapping of slides, making properly labelled blood films, or completing record forms.
A discussion and feedback session should follow immediately after the quiz and spot test. After giving learners their results, allow them time to discuss these with each other and with you. You may find that dividing the learners into groups for these discussions encourages their interest and promotes a team spirit. Feedback should be seen as a two-way exchange: opinions from the learners on how they found the quiz and spot test may help you to improve this aspect of the training.

Remember to record the learners’ scores as a means of charting their progress. As the course proceeds, this will help you to identify those learners whose progress is consistent and those who may be having trouble. For some learners it may be necessary to slow the pace of the course, or to allocate a facilitator to provide special or individual help.

Remind learners to read Learning Unit 5 before the next session

**Briefing session with facilitators**

Before finishing for the weekend you should hold a briefing session with your facilitators (you may already have held others earlier in the week). Your discussion should include the following topics, plus any others that you or the facilitators may wish to raise:

- which learners are doing well;
- which learners are working more slowly and may need special attention;
- which facilitator to assign to help the slower learners;
- how much of the week’s programme remains to be done;
- what improvements can be made to the training for the remaining Learning Units;
- results of the quiz.
LEARNING UNIT 5

Staining blood films with Giemsa stain

Before the learners are allowed to start staining the blood films, they should make up the necessary buffered water. If the balances you have available for the weighing process are very different from those suggested in the Learner's Guide, you should write notes on their use before starting on this Unit. This is time-consuming but worth while; all learners will have identical notes, which they can add to their Learner's Guides and take home with them at the end of the course. If learners are allowed to make their own notes while you explain the procedure, it is quite likely that they will make a number of errors.

If you routinely use buffer tablets to adjust the pH of the water, rather than weighing out the individual salts, there is no reason to change this system. The choice of method is yours. However, buffer tablets from old stock may stick to one another because of water in the container. This causes differential leaching out of the constituents and a resultant variability in the pH that will be produced. Water at the wrong pH will interfere with the quality of staining.

The time that you devote to this Learning Unit depends largely on the amount of equipment you have available. Each learner must become completely familiar with the weighing process and colour testing: the more equipment you have, the less time this will take.

Nearly all training activities from this point onwards will take place in the laboratory: if you have not already done so, now is the time to allocate specific bench space to each learner. With a small group of, say, four learners, position two of them on each side of the bench; this will make it easy for them to work together and for their facilitator to help them and to evaluate their progress continuously.

Remind learners to read Learning Unit 6 before the next session

33
Notes
The learners must be taught the importance of caring for their equipment, but should also learn that using the microscope can be enjoyable. The following exercise will encourage a sense of enjoyment.

Collect one or two jars of pond water about a week before the session in which you plan to discuss the microscope and its use. Add a few pieces of dried grass (about 8 cm long) and keep the water in sunlight until it is needed. Allow each learner, using a Pasteur pipette, to take one or two drops of pond water, transfer the water to a clean slide and cover it with a coverslip. The slide can then be examined, using the $\times 10$ and $\times 40$ objectives. The water should contain a number of free-living protozoa by this time, which the learners will be able to observe. While becoming familiar with the use of these objective lenses, the learners will also enjoy discovering that numerous organisms can live in water that to the naked eye appears to be clean.

When you or your facilitators decide that the learners have become sufficiently competent to start using the oil immersion objective, examination of normal blood films can begin. Learners generally find this much more interesting if they are allowed to examine their own blood.

Remind learners to read Learning Unit 7 before the next session
Examining blood films

Once you have reached this stage of the training programme, your job and that of the facilitators should become much easier, as learners are able to work more and more on their own.

After an introductory discussion on the subject of examining blood films, learners should start by examining films of normal blood. Complete familiarity with the components of normal blood is an essential foundation of malaria microscopy; it is important that learners understand that the same blood component can look different in size and shape in different blood films. (It should also be stressed to the learners that anything they see in their routine work which appears to be abnormal should be reported to their supervisors: the ability to recognize abnormalities other than malaria parasites adds to the versatility of the microscopist.)

The natural starting point for this practical work is the examination of thin blood films. Without spending an undue amount of time on this, the learners should be helped to recognize as many of the white blood cell types as possible. Cooperation within each small group of learners — or within the whole class if necessary — should ensure that everyone has the chance to see even the less common types.

Once you are satisfied that the learners can recognize all the blood components to be found in thin films, move on to examination of thick films. It is unlikely that all learners will achieve this at the same time, but this is not important. As each learner finishes working with thin films, he or she can be individually briefed by a facilitator. By the time you are ready to hold discussions on the appearance of blood components in thick films, several individuals will already be able to describe what they have seen. Further discussions can be held within the small groups of learners when they have made the necessary progress. (This same approach can be adopted when blood films are examined for malaria parasites.)

Remind learners to read Learning Unit 8 before the next session
Examining blood films for malaria parasites

It is generally found that the best approach to take to examination of blood films for malaria parasites is similar to that for examination of normal blood, i.e. to start with thin blood films. Allow the learners time to examine films that are malaria-positive without worrying, initially, about identification of stages and species of parasite. They will be able to achieve quite a lot on their own, just using the Learner’s Guide.

It is up to you to decide when to make use of the visual aids at your disposal. You may decide to use simply those that help with recognition of parasite stages until the learners are fully familiar with these; some learners may become confused if asked to start identifying species too soon. Base your decision on your assessment of learners’ abilities.

Once the learners have shown that they are able to recognize parasites, and identify the different stages and species, they should be allowed to move on to the examination of thick blood films. It is at this stage that the colour plates provided in the Learner’s Guide will be of particular value; encourage learners to make routine use of them when examining slides.

Quiz and spot test

At the end of the second week of the course you should organize another quiz and spot test. A lot of ground has been covered in this week and some learners may have become confused or forgotten some of the earlier work. Careful selection of multiple-choice questions from the “bank” in Annex 4 will enable you to judge whether learners are progressing as you have planned. You will probably find that many of the errors the learners make can be traced to failure to follow instructions or to read questions properly; emphasize the importance of this continually.

You now have plenty of material for the spot tests too, including parasite stages and species. Try to confine the spot tests to problems that the learners will encounter regularly in their jobs. It is the routine work that you are training them for, and presenting them with highly unusual equipment or diagnostic problems will only cause confusion.

You should find the results of these tests very interesting; they will reveal a lot about how much the learners have understood and retained. When you communicate results to the learners, provide plenty of positive feedback. Make it clear that you and the facilitators will provide whatever help is needed to correct mistakes. If you feel that it would be helpful to some of the learners to repeat part of the work they have done, you should allow them to do this.
At about this time it would be valuable to introduce a new facet of the learning process. Before the first session of the day, place a selection of slides next to each learner's microscope. These should be slides that are positive for malaria and that clearly show the diagnostic features required for identification. It is suggested that you provide each learner with between 10 and 20 of these “spots” and allow about 20 minutes at the start of each day for their identification; however, the number of slides and the time allowed must be your decision, based on availability of equipment, time and facilitators, and on the abilities of the learners.

After the period allowed for identification, it is usual to allow learners to mark their own work. Devote the rest of the session to discussion. If you have a particularly confident group of learners, you may like to ask each of them to choose one of his or her spot slides and explain the features that led to a particular diagnosis.

From now on, you should devote about 20 minutes each day to this type of spot test, which is a highly effective learning technique. Maintaining the “quiz” approach allows you further opportunity to assess progress without the learners feeling at all intimidated.

Remind learners to read Learning Unit 9 before the next session.
Artefacts in blood films

By the time you reach this Unit, learners will already have observed many artefacts in the blood films they have examined. This Unit therefore aims only to formalize what they have started to learn for themselves.

Learners now need to be taught to recognize specific artefacts — those shown in Plate 4 of the Learner's Guide, for example, plus any others that you and the facilitators may find. It is particularly important to remind learners that an object that appears to be an artefact to someone looking only for malaria parasites may actually be some other organism, such as the microfilaria illustrated on page 63 of the Learner's Guide. Impress on them that this kind of "artefact" must be reported to the supervisor at the earliest opportunity.

Remind learners to read Learning Unit 10 before the next session
Notes
LEARNING UNIT 10

Routine examination of blood films for malaria parasites

The Learner's Guide provides quite specific instructions for the routine examination of blood films, but you should be particularly careful that learners have understood the following:

- that routine examination is always of thick blood films, not thin films;
- that, for consistency, thick blood films should be examined in a standardized manner (for which instructions are given in the Learner's Guide);
- the importance of parasite densities in the assessment of a patient's response to treatment;
- the importance of careful and systematic estimation of parasite densities.

Check that learners are following all relevant instructions. If necessary, re-emphasize all the points made above and explain their significance.

During the rest of this Unit, you should also:

- ensure that daily, weekly and monthly records are up to date and accurate;
- provide assistance, if necessary, with completing stores request forms;
- discuss any problems of laboratory management that might concern the microscopist.

Remind learners to read Learning Unit 11 before the next session.
LEARNING UNIT 11

Life cycle of the malaria parasite

It might seem that this Learning Unit is in the wrong place in the training programme. However, performance-based learning aims to teach skills in the order in which they will be applied: learners have already observed the stages of the malaria parasite in Learning Unit 8, and practised identification of species. The purpose of this Unit is therefore simply to fill in any gaps that remain in their understanding of the malaria life cycle, notably the role of the female *Anopheles* mosquito as vector of the disease.

Remind learners to read Learning Unit 12 before the next session

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The Learner's Guide covers this subject adequately. It remains only to stress that a good supervisor is supportive of his or her colleagues and does all that is possible to help them solve their problems. Poor supervision only creates further problems.
At the end of the training course, all that remains to be done is to confirm that learners have achieved the necessary skills and competence — and then to award them their Certificates of Competence (if you have decided to do this).

You and the facilitators have kept records of the learner's progress and of their results in the spot tests and quizzes, and will therefore easily be able to judge their degree of success. You must be satisfied that each one will be capable of doing his or her job competently and reliably.

You may occasionally encounter a learner who is slow to master the necessary skills or who seems to be incapable of doing the work despite receiving considerable extra attention. You obviously cannot certify the competence of such an individual, and you have two alternative courses of action:

- Inform the learner that he or she has not succeeded in the course and that an alternative job should be found.
- Provide a certificate of attendance only, and explain to the learner (and the supervisor) that he or she is not yet competent to work on his or her own. With further practice, supervision and guidance, such an individual may eventually achieve the required standard.

The importance of an evaluation of the course by the learners has been stressed previously. An appropriate questionnaire may be found in Annex 5, but is intended only as a guide — you do not need to use it if you already have something equally suitable. Analyse the completed questionnaires and provide feedback to the learners.

Later you should discuss the learners' opinions of the course, of its content, how it was conducted and how it might be improved with the facilitators (and any other officials concerned with the course); this will help you greatly in planning future training programmes.
Construction of a flipchart

The flipchart may be easily constructed from locally available materials and is most useful for small group work. The materials you will need are as follows:

Two pieces of wood 3 cm × 10 cm, 185 cm in length
One piece of wood 3 cm × 10 cm, 180 cm in length
Two pieces of wood 3 cm × 10 cm, 83 cm in length
One piece of wood 3 cm × 5 cm, 83 cm in length
One sheet of plywood, 110 cm × 83 cm
One hinge
Two screws, 8 cm long, each fitted with a wing nut
Nails
Glue
A supply of "butcher's paper" or newsprint

Details of the construction are shown in Fig. 1.

When you use the flipchart in your work, you will also need a supply of felt-tipped marker pens.
Construction of a rear projection screen/daylight viewing box

The rear projection screen/daylight viewing box is relatively simple to construct from locally available materials.

The screen seen from the front, where the learners sit.

You will need the following:
- One sheet of plywood (or heavy-duty cardboard), 80 cm × 65 cm, to form the back of the box. Cut a panel 60 cm × 45 cm out of the centre; this is where the screen will be located.
- One piece of frosted glass, 60 cm × 45 cm; this will form the screen.
- Two sheets of plywood, each about 70–90 cm wide but with unequal sides (one side about 120 cm long, the other about 80 cm long). These pieces form the top and bottom of the box; if necessary, the top can be made of relatively lighter material, but the bottom must be heavy for stability.
Fig. 2. Construction of the daylight viewing box

- Two pieces of plywood (or heavy-duty cardboard), 65 cm × 70–90 cm, to form the sides of the box.

Details of the construction are shown in Fig. 2.

The projector should be set up so that the image is projected on to the screen from behind the box (see Fig. 3); the learners will then view from the front of the box. The distance between the projector and the screen will depend on the
Fig. 3. The daylight viewing box in use

focal length of the projector lens and on the size of picture you wish to produce. A certain amount of experimentation will probably be necessary, but it is quite possible to project slides very satisfactorily in a room from which daylight cannot be excluded.
ANNEX 3

Equipment and reagents required for training course

It is difficult to predict exactly what equipment and supplies you will need for the training course, and financial constraints may limit what you can buy. Considerable savings are possible if some items can be made from locally available materials.

Optical equipment

In addition to the equipment mentioned in Learning Unit 6 of the Learner’s Guide you will need the following items:

- blue (opaque) filters for the substage microscope lamp
- objective markers (diamond-pointed) for “ringing” interesting parasites and specimens

1 per learner

1 per group of 4–5 learners

Other equipment

- balance for weighing chemicals (capacity 200 g, readable to 0.01 g) 1 for the laboratory
- deionizer to produce water for mixing with stain (a still, operated by gas, kerosene or electricity, may also be used, but is less economical) 1 for the laboratory
- resin charges for the deionizer, as recommended by the manufacturer
- electric hair-driers for drying slides 2 for the laboratory
- 4-digit tally counters, hand-operated 2 for each learner
- timing clocks, timing from 1 minute to 1 hour, fitted with alarm bells 1 per group of 4–5 learners
- Lovibond Comparators, with discs for pH 6.0–7.6, using bromothymol blue as indicator 2 for the laboratory
- plastic basins for washing slides and glassware, approx. 40 cm diameter, 15 cm deep 6 for the laboratory
- wooden slide-drying racks, grooved, each to hold about 40 slides 1 per group of 4–5 learners
- boxes of paper tissues 1 per group of 4–5 learners
- wooden boxes for microscope slides, with hinged lids, for 100 slides stored vertically 1 per learner, plus about 6 spares
- wooden boxes for microscope slides, with hinged lids and carrying handles, for 50 slides each side stored horizontally (sometimes called field collection boxes or WHO slide boxes) 2 per group of 4–5 learners
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity &amp; Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>lint-free cotton cloths for drying slides</td>
<td>2 per group of 4–5 learners</td>
</tr>
<tr>
<td>white, non-sterile, absorbent cotton wool in 500-g packages</td>
<td>1–2 packages per group of 4–5 learners</td>
</tr>
<tr>
<td>clipboards, 18 cm × 23 cm</td>
<td>1 per group of 4–5 learners stocks as appropriate</td>
</tr>
<tr>
<td>record forms</td>
<td></td>
</tr>
</tbody>
</table>

**Plastic and glassware**

- dropping bottles (glass or polyethylene), capacity 60 ml, with pipettes and rubber teats: 20
- narrow-necked hard white glass bottles with ground glass stoppers, capacity 250 ml: 20
- as above, capacity 500 ml: 20
- glass or polyethylene measuring cylinders, with spout, capacity 10 ml, 0.5 ml divisions: 10
- as above, capacity 100 ml, 5 ml divisions: 10
- as above, capacity 250 ml, 10 ml divisions: 10
- as above, capacity 500 ml, 20 ml divisions: 10
- “half white” microscope slides, 7.6 × 2.5 cm, thickness 1.0–1.2 mm, smooth-ground edges, packets of 72: as required
- glass conical flasks, capacity 250 ml: 10
- as above, capacity 500 ml: 6
- as above, capacity 1000 ml: 6
- glass or polyethylene staining troughs, with ribbed interior for 20 double-thickness slides, with lids: 20
- glass or polyethylene funnels, diameter 15 cm: 6
- rimless glass test-tubes, 1.9 × 15 cm: 100
- glass pipettes with rubber teats: 100
- glass beakers with spouts, capacity 100 ml: 20
- as above, capacity 250 ml: 10
- as above, capacity 500 ml: 10
- glass or polyethylene bottles for distilled water, capacity 4.5 litres, with stoppers and taps: 4
- graduated pipettes, 10 ml capacity, 0.5 ml divisions: 20
- curved white staining plates, porcelain or plastic, 4–6 mm depression: 10

**Reagents and stains**

- Giemsa stain powder: 30 g
- Giemsa stain solution (best quality), in bottles of 250 ml: 40 bottles
- immersion oil (tropical quality), in bottles of 25 ml: 10 bottles
- xylene (pure, sulfur-free quality as for histology): 10 litres
methyl alcohol (anhydrous, acetone-free), in bottles of 250 ml
5 litres

glycerol (neutral, anhydrous), in bottles of 250 ml
5 litres

methylated spirit
5 litres

potassium dihydrogen phosphate
in sufficient quantity to prepare 100 litres of
5 litres

disodium hydrogen phosphate
buffered water, pH 7.2

5 family-size packets

of powder detergent

or 5 litres of liquid
detergent
Sample multiple-choice questions

Note: The correct answer to each question has been marked with an asterisk.

1. When not in use, a microscope should be kept:
   (a) on the laboratory bench.
   (b) in the original box.
   (c) in a place protected from dust.
   (d) in the refrigerator.
   (e) under the laboratory bench.

2. The immersion lens of a microscope should be cleaned with:
   (a) alcohol.
   (b) detergent.
   (c) acetone.
   *(d) xylene (xylol).
   (e) soap solution.

3. The total magnification of a compound microscope is calculated by:
   *(a) multiplying the individual powers of the ocular (eyepiece), the prism and the objective.
   (b) adding the powers of the ocular, the prism and the objective.
   (c) subtracting the power of the ocular from the power of the objective.
   (d) dividing the power of the objective by the power of the ocular.
   (e) the manufacturer — the total magnification of the microscope is fixed and cannot be altered.

4. The ideal range of total magnification for the routine diagnosis of malaria is:
   (a) ×6 to ×10.
   (b) ×4 to ×40.
   (c) ×6 to ×100.
   (d) ×40 to ×400.
   *(e) ×600 to ×1000.

5. Which of the following is not a white blood cell?
   (a) Monocyte.
   (b) Lymphocyte.
   *(c) Thrombocyte.
   (d) Basophil.
   (e) Neutrophil.

6. Approximately how many red blood cells are there per microlitre of human blood?
   (a) 500.
   (b) 5 000.
   (c) 50 000.
   (d) 500 000.
   *(e) 5 000 000.
7. Approximately how many white blood cells are there per microlitre of human blood?
   (a) 80.
   (b) 800.
   *(c) 8000.
   (d) 80000.
   (e) 800000.

8. Approximately how many platelets are there per microlitre of human blood?
   (a) 100.
   (b) 1000.
   (c) 10000.
   *(d) 100000.
   (e) 1000000.

9. What, ideally, should be used to clean microscope slides before they are used for making blood films?
   (a) Warm water.
   *(b) Warm water and a detergent.
   (c) Immersion oil.
   (d) Xylene (xylo).
   (e) Methylated spirit (70%).

10. What should be used to clean slides after blood films have been examined and are to be kept for re-examination?
    (a) Warm water.
    (b) Warm water and a detergent.
    (c) Immersion oil.
    *(d) Xylene (xylo).
    (e) Methylated spirit (70%).

11. What should be used to write a patient’s name on the thin blood film?
    (a) Ball-point pen.
    (b) Fountain pen.
    *(c) Pencil.
    (d) Crayon.
    (e) Needle.

12. With what is the thin blood film fixed?
    (a) Tap water.
    (b) Distilled water.
    (c) Methylated spirit (70%).
    *(d) Methyl alcohol (methanol).
    (e) Hot air (hair drier or incubator).

13. Which of the following commonly causes autofixation of the thick blood film?
    (a) Desiccation.
    (b) Cold.
    *(c) Heat.
    (d) Vibration.
    (e) Dust.
14. What is used to dehaemoglobinize the thick blood film?
   (a) Tap water.
   *(b) Distilled water.
   (c) Methylated spirit (70%).
   (d) Methyl alcohol (methanol).
   (e) Hot air (hair-drier or incubator).

15. What should be used to clean slides that have been examined so that they can be reused to make fresh blood films?
   (a) Warm water.
   *(b) Warm water and a detergent.
   (c) Immersion oil.
   (d) Xylene (xylol).
   (e) Methylated spirit (70%).

16. What is the approximate diameter of a round thick blood film for routine malaria diagnosis?
   (a) 0.5 cm (1/5 inch).
   *(b) 1 cm (1/3 inch).
   (c) 1.75 cm (2/3 inch).
   (d) 2.5 cm (1 inch).
   (e) Any size.

17. Thick and thin blood films for routine malaria diagnosis are usually stained with:
   *(a) 3% Giemsa for 45 minutes.
   (b) 45% Giemsa for 3 minutes.
   (c) Giemsa stock solution for 45 minutes.
   (d) Giemsa stock solution for 3 minutes.
   (e) Giemsa stock solution plus 3% methyl alcohol (methanol) for 10 minutes.

18. What diluent is added to Giemsa stock solution to prepare Giemsa stain?
   (a) Methyl alcohol (methanol).
   (b) Acetone.
   (c) Tap water.
   *(d) Distilled or deionized water.
   (e) Boiled water.

19. The correct range of pH for staining blood films with Giemsa stain is:
   (a) 6.6—7.6
   (b) 6.6—7.0
   *(c) 7.1—7.3
   (d) 7.4—7.6
   (e) 7.5—8.6

20. To avoid confusion when several people are collecting blood samples from patients, which finger should be cleaned and pricked?
   (a) The thumb.
   (b) The first finger (next to the thumb).
   (c) The second finger.
   *(d) The third finger (ring finger).
   (e) The fourth finger.
21. What is used to clean the patient’s finger when a blood sample is taken?
   (a) Acetone.
   (b) Xylene (xylol).
   * (c) Methyated spirits (70%).
   (d) Methyl alcohol (methanol).
   (e) Water.

22. Human malaria is best described as a disease of:
   (a) mosquitos
   * (b) the blood
   (c) bad air
   (d) swamps
   (e) adults.

23. What is the most common species of human malaria in the tropical countries of Africa?
    * (a) Plasmodium falciparum.
    (b) Plasmodium vivax.
    (c) Plasmodium malariae.
    (d) Plasmodium ovale.
    (e) Mixed infections of Plasmodium falciparum/P. vivax.

24. Which species of human malaria has crescent-shaped gametocytes?
    * (a) Plasmodium falciparum.
    (b) Plasmodium vivax.
    (c) Plasmodium malariae.
    (d) Plasmodium ovale.
    (e) All four species of human malaria.

25. The most common species of malaria parasite in semitropical countries such as Afghanistan, China, India, Islamic Republic of Iran, northern Pakistan and Viet Nam is:
    (a) Plasmodium falciparum.
    * (b) Plasmodium vivax.
    (c) Plasmodium malariae.
    (d) Plasmodium ovale.
    (e) mixed infection of Plasmodium falciparum/P. malariae.

26. In which species of human malaria are Maurer’s dots often seen in the infected red blood cell?
    * (a) Plasmodium falciparum.
    (b) Plasmodium vivax.
    (c) Plasmodium malariae.
    (d) Plasmodium ovale.
    (e) All the human malarias.

27. Malaria pigment is produced from:
    (a) the nucleus of the parasite.
    (b) the cytoplasm of the parasite.
    (c) the membrane of the host red blood cell.
    * (d) the haemoglobin of the host red blood cell.
    (e) the stippling of the parasite.
28. Which of the following species is most likely to have a mature schizont with 18 mature merozoites?
   (a) Plasmodium falciparum.
   * (b) Plasmodium vivax.
   (c) Plasmodium malariae.
   (d) Plasmodium ovale.
   (e) None.

29. Which of the following is most commonly seen with multiple infections of trophozoites in the red blood cells?
   * (a) Plasmodium falciparum.
   (b) Plasmodium vivax.
   (c) Plasmodium malariae.
   (d) Plasmodium ovale.
   (e) Plasmodium malariae/P. vivax.

30. The name of the sexual form of the malaria parasite is:
   (a) trophozoite.
   (b) schizont.
   * (c) gametocyte.
   (d) merozoite.
   (e) erythrocyte.

31. Malaria is transmitted from person to person by:
   (a) all mosquitoes.
   (b) male culicine mosquitoes.
   (c) male anopheline mosquitoes.
   (d) female culicine mosquitoes.
   * (e) female anopheline mosquitoes.

32. The life cycle of the human malaria parasite is:
   * (a) mosquito salivary glands → human liver cells → human blood cells → mosquito stomach → mosquito salivary glands.
   (b) mosquito salivary glands → mosquito stomach → human liver cells → human blood cells → mosquito salivary glands.
   (c) human liver cells → mosquito stomach → mosquito salivary glands → human blood cells → mosquito salivary glands.
   (d) human blood cells → human liver cells → mosquito salivary glands → mosquito stomach → mosquito salivary glands.
   (e) human liver cells → human blood cells → mosquito salivary glands → mosquito stomach → mosquito salivary glands.

33. What is the red-staining part of the malaria parasite called?
   * (a) Nucleus (chromatin).
   (b) Cytoplasm.
   (c) Pigment.
   (d) Haemoglobin.
   (e) Host cell.

34. What is the blue-staining part of the malaria parasite called?
   (a) Nucleus (chromatin).
   * (b) Cytoplasm.
   (c) Pigment.
   (d) Haemoglobin.
   (e) Host cell.
35. What chemicals are used to make phosphate buffer for staining blood films?
   *(a) Sodium hydrogen phosphate (anhydrous) and potassium dihydrogen phosphate (anhydrous).
   (b) Sodium chloride and potassium chloride.
   (c) Sodium phosphate and potassium phosphate.
   (d) Disodium chloride (anhydrous) and potassium dichloride.
   (e) Sodium hydrogen phosphate (anhydrous) and potassium dihydrogen chloride.

36. The average number of white blood cells per microscope field (at $\times 700$ magnification) should be:
   (a) 1
   (b) 2
   (c) 10
   *(d) 20
   (e) 100.

37. The number of thick film microscopy fields to be examined for routine malaria diagnosis is:
   (a) 10
   (b) 20
   *(c) 100
   (d) 200
   (e) 1000.

38. If a Giemsa-stained blood film is too red, the probable reason is:
   *(a) pH too low (too acid).
   (b) pH too high (too alkaline).
   (c) concentration of the stain too high (not dilute enough).
   (d) concentration of the stain too low (too dilute).
   (e) none of the above.

39. Which of the following is the best way to determine the level of malaria in a community at any particular time?
   *(a) Blood film collections.
   (b) Ask the community leader.
   (c) Spleen surveys.
   (d) Ask the local doctor.
   (e) Ask the parents of schoolchildren.

40. Which of the following is the most efficient agent for safely sterilizing materials used in taking blood samples?
   (a) Soap and water.
   (b) Methyl alcohol (methanol).
   (c) Drying.
   *(d) Sodium hypochlorite (bleach).
   (e) Freezing.
ANNEX 5

Questionnaire for evaluation of training

Instructions for completion of questionnaire

Use the following code to indicate the extent to which you agree or disagree with each of the statements made in the questionnaire:

1. Disagree strongly
2. Disagree
3. Agree
4. Agree strongly.

These numbers are printed alongside each question. You should circle the number that corresponds most closely to your opinion.

The difference between options 1 and 2 and between options 4 and 5 is one of degree only. To oblige you to express a definite opinion, no code 3 has been included (except for question 12); this allows a "satisfaction index" to be calculated for each question.

Take your time over completing the questionnaire. You do not have to put your name on it if you would rather not, but please answer the questions as frankly as possible.

Section I. Overall assessment of the training activity

1. Overall, the organization of the training programme was satisfactory.
2. The training programme covered all the subject matter in adequate detail. (If you disagree with this, state which subjects should have been given greater coverage.)

Comments:


3. The tutors and facilitators for this training course had sufficient knowledge and teaching ability to provide you with the necessary skills and competence.
4. The time allocated to each part of the training was adequate relative to the total time available. (If you disagree with this, state which particular topic should have been allotted more or less time.)

Comments:

Section II. Relevance and usefulness of the different teaching methods

5. Overall, the teaching methods used in this training course were effective.

Comments:

6. The use of the various teaching methods listed below was quite appropriate.

Large group presentations

Comments:

Practical demonstrations (laboratory)

Comments:
<table>
<thead>
<tr>
<th>Activity</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>5</th>
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Section III. Assessment of teaching materials

7. The audiovisual materials (slides, overhead projection transparencies) used in the training were very helpful. 1 2 4 5

Suggestions for improvement:

8. The teaching materials provided were satisfactory in all respects. 1 2 4 5

Suggestions for improvement:

Section IV. Implementation of training; attitude of tutor and facilitators

9. The general atmosphere of the training course made this a good learning experience. 1 2 4 5

Comments:

10. Every effort was made to help you achieve the learning objectives. 1 2 4 5

Comments:
11. You were able to achieve all the learning objectives of the training programme.

Comments:

________________________________________
________________________________________
________________________________________
________________________________________

Section V. Overall evaluation of the training

12. What overall rating would you give to this training programme? (Circle your response.)

   1  2  3  4  5
Lowest Highest

13. With regard to this training experience, state the following (giving actual examples):

   (a) the three aspects that impressed you most favourably

       __________________________________________
       __________________________________________
       __________________________________________

   (b) the three aspects that impressed you least favourably

       __________________________________________
       __________________________________________
       __________________________________________

14. Do you have any additional comments regarding any aspect of the training programme? If so, please make them below.

       __________________________________________
       __________________________________________
       __________________________________________
       __________________________________________
Analysing responses to the questionnaire

The following method will allow you to analyse the responses to the questionnaire quite simply and quickly. Take a fresh (uncompleted) copy of the questionnaire; against each question, mark the learners’ responses. For example:

5. Overall, the teaching methods used in this training course were effective.

\[ \begin{array}{ccc}
1 & 2 & 4 & 5 \\
\text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\
\end{array} \]

This shows that two learners considered the teaching methods were not effective while 28 agreed that they were effective.

Now multiply the number of answers by the corresponding coefficient:

\[(2 \times 2) + (10 \times 4) + (18 \times 5) = 4 + 40 + 90 = 134\]

The “satisfaction index” is calculated as a percentage. For the above example, the number 134 is multiplied by 20 (i.e. 100 divided by the maximum coefficient, 5) and divided by 30 (the number of learners):

\[ \frac{134 \times 20}{30} = 89.3\% \]

Since the satisfaction index is calculated in such a way that 60% represents “average” satisfaction, you should make a note of any questions for which the index is below 60%. (If there is none, identify the five questions for which the index is lowest and the five for which it is highest.) Let the learners know the results of this questionnaire at the final evaluation session on the last day of the training programme.
Effective management of malaria relies heavily on accurate and timely diagnosis, which in turn depends on sufficient numbers of health workers being trained in appropriate microscopy techniques. Recognition of the increasing need for such personnel prompted the publication of this comprehensive, two-part training module on basic malaria microscopy. The module is one of three, each concerned with a different aspect of the fight against malaria, and is intended for use in training courses devoted exclusively to diagnostic microscopy or as part of broader teaching programmes.

Part II – the Tutor’s Guide – is intended for use by those involved in the organization and administration of a training course. There is extensive advice on selection of learners, course design and timetabling, provision of equipment and facilities, and evaluation – of both the learners and the course itself. Guidance is also provided on the best means of helping learners to achieve the objectives defined in each of the discrete Learning Units that are central to the course. Greatest emphasis is laid on practical work in the laboratory, but suggestions are also made for lecture topics, demonstrations, group discussions and field work. Multiple-choice “quizzes” are an effective and generally popular means of evaluating learners’ progress, and numerous suitable questions and answers are supplied in an annex. Feedback from learners is identified as a means of improving future training, and another annex provides a suitable questionnaire covering all aspects of the course, including the abilities of its organizers.

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