An Innovative Laboratory Examination in Pharmacognosy

Alice M. Clark

Note from the Editor: When I saw this examination in use, I encouraged Dr. Clark to share it with our readers, along with comments about the experience. We solicit similar submissions by our faculty colleagues to JPT. *Not everything published here must be a full-blown paper. One of the aims of* JPT *is communication of information for the enrichment of teaching in pharmacy.*

I approached this laboratory examination in a different way because:

1. I wanted to force the students to *talk* to me (via their written answers) as though I were a customer/patient.
2. I wanted to test their ability to understand a question put to them in a way they might not expect (something I believe might happen more often in the future than they might think).
3. I wanted to test their ability to explain what they had done and learned in lab, and I believed one of the ways to do this was to make them explain it to someone who really did not have *any* technical background.
4. I wanted to illustrate that often it is difficult for them to see the practical applicability of the information they are being taught, but that it can turn up in the most unexpected ways.
5. I wanted to have some fun with an exam (for a change), and I was in the mood for a little creative writing. I also thought they might better remember both those questions to which they

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knew the answers and those to which they did not. This would provide yet a little more education in the exam process.

I believe that I accomplished most of these goals. The students, overall, performed exceptionally well, and I was surprised (but delighted) to see that if I gave them an opportunity to talk to me, I could discover a remarkable number of layers of knowledge hiding beneath the surface. This kind of a test is also an excellent way to tell when I have failed miserably in making a point clear. After reading the same bizarre, off-the-wall answer from 50 students, I would have to accept that it was my own fault for presenting it the way I did. Fortunately, if I am doing a decent job, this should be a rarity.

Although I do not have any way to verify this, I also believe this kind of test has the potential for giving the students a boost in confidence. At first they appeared dismayed that the exam did not follow the routine multiple choice, true-false, fill-in-the-blank format. Then, it appeared that they viewed it the way I wanted them to: as an opportunity to tell me what they knew. Many of them took excessive advantage of this opportunity, and many discovered that I really was right all semester when I told them repeatedly that they know more than they think.

I believe I came to know the students a little better—all 110 of them! I recommend this approach strongly, but temper the recommendation with a warning that this is a very time-consuming process. It took me a long time to write the exam, and when I had finished grading the exams (reading every word of every page of every student's exam), I felt that I had been born with this exam. But, having said that, I have to admit that it was one of the most educational things I have ever done, and I intend to try to incorporate more of this sort of approach as much as possible in my future teaching efforts. We all benefit from it!

LAB EXAM (75 PTS.)

I. The year is 1995, and you have recently opened the only pharmacy in Shuquabuta, Mississippi. Earth Day is rapidly approaching, and, as an expert in drugs, you have been invited by the

Shuquabuta Central High School Science Club to present a discussion on how the tropical rain forests of the world are potential sources of new drugs. The students are particularly interested in the discovery of new antibiotics, since no known antibiotics are effective against the mutant strain of *Staphylococcus aureaus* carried in the stinger of the Killer Bee, and thus, the epidemic of KBF (Killer Bee Fever) continues to spread unabated. Your presentation on Earth Day included a background discussion citing several important drugs that were obtained from plants and a definition of an antibiotic. Further, you noted that while most clinically useful antibiotics were obtained originally from soil microorganisms (of which there are many types), the same discovery and isolation processes are applicable to plants (with the exception of the isolation of the organisms from the environment). Finally, you briefly described how a single, pure chemical compound is obtained from a plant. The students are inspired by your presentation, are eager to learn more, and have asked the following questions to which you should provide answers:

A. When you extract the leaves of the tree, how do you know then that the extract contains a potential new antibiotic? Is there a procedure used to test for the presence of antibiotics in a crude extract, and how does it work? (4 pts.)

B. How would you separate the individual components of the mixture to obtain pure compounds for further study? What technique could be used? (4 pts.)

II. Your Earth Day presentation was such a resounding success that the local police force and county sheriff's office have invited you to present a workshop regarding drugs of abuse. You have noted in your presentation that, among other things, many of the important drugs of abuse are obtained from plants, including morphine from opium. The officers are impressed with your technical knowledge and pose the following questions:

A. How, exactly, do they get morphine from the plant? Are there other, similar drug substances in the same plant, and what makes morphine so unique that it can be separated from these other, similar drugs? What kinds of chemicals do they need to get the stuff out? How exactly is it done? Please

draw a diagram that illustrates it more clearly. (8 pts.)

B. I was in Jackson last week at a meeting, and I heard a guy from one of those big forensics labs on the coast talking about being able to tell the difference between heroin and morphine by something called a TLC and an R_f number. What does TLC mean, and how do you get that R_f number? (6 pts.)

C. This guy also said that morphine does not dissolve in water. Is there something they do to it to make it dissolve in water so they can inject it into their veins? (2 pts.)

III. A local high school student, inspired by your Earth Day presentation, wishes to undertake a project for the science fair in which she proposes to isolate antibiotic-producing microorganisms from the soil surrounding her family's catfish pond. She has asked your assistance in answering the following questions:

A. Are there procedures or methods that I can use to be more selective in isolating certain kinds of microorganisms? (5 pts.)

B. I know I have this one soil microorganism that has antibiotic activity because I tested the crude extract like you described. Is there a technique I can use to tell whether there is more than one antibiotic in the crude extract without having to separate each individual component in the extract mixture first? If so, what is the technique called, and how does it work? (4 pts.)

IV. One of your customers is diabetic and uses Clinitest® tablets to monitor her sugar levels. She comes in upset because suddenly she is seeing a positive test in spite of carefully monitoring her diet. You check her computer prescription file for possible clues.

A. What drug(s) are you looking for? (6 pts.)

B. What other product for testing sugar levels *in urine* could you recommend to your customer to avoid false positive tests. (4 pts.)

V. The year is 1993, and you are the pharmacist at Shuquabuta County Hospital. Due to limited financial resources, there is no lab technician on duty during your shift. A patient is admitted with a serious upper respiratory tract infection. The physician realizes that it would be wise to do a susceptibility test and asks you to get one started now so that the empirical treatment can be modified as soon as possible. The nurse provides you with an appropriate sample from the patient containing the organism in question in a liquid form.

A. How would you prepare the plate (explain streaking technique) for the susceptibility test? (3 pts.)

B. What procedure would you use to test the antibiotics the physician is considering? (2 pts.)

C. It is your shift again when it is time to read the plate. Make your readings and fill in the data below. The plate, reference chart, and ruler are shown in Figure 1. (12 pts.)

Antibiotic	**Zone of Inhibition (mm)**	**Susceptible or Resistant?**
*A*mpicillin		
*Ch*loramphenicol		
*E*rythromycin		
*M*ethicillin		
*S*treptomycin		
*N*eomycin		
*C*efazolin		
*P*enicillin G		

D. What results do you report to the physician as drug of choice? (2 pts.)

VI. You have decided to join the Navy and see the world beyond Shuquabuta. One of the frequent prescriptions you are asked to prepare in the clinic is an aqueous suspension of procaine Penicillin G. You need 2.4 million units. Using data below, calculate the number of milligrams of procaine Pen G you must weigh out to make one suspension.

A. Show all work! (8 pts.)

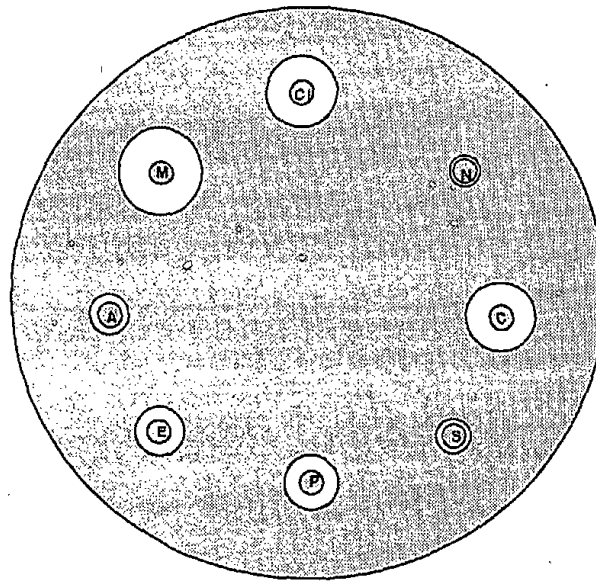
Procaine Pen G m.w. = 570 g/m

Sodium Pen G m.w. = 356 g/m

B. A buffer is often used in preparing this suspension. Should the pH be greater or less than 7? Why? (HINT: Recall the balanced chemical equation you had to write for the lab report.) (5 pts.)

BONUS: Name three of the drugs that you mentioned in your Earth Day presentation as examples of important drugs that are natural products. (3 pts.)

FIGURE 1



Interpretative Chart of Zone Size
Inhibition Zone Diameter (mm)

Antibiotic	Disc Content	*Resistant* Organisms	*Susceptible Organisms* Intermediate	Susceptible
A Ampicillin	10 µg	11 or less	12-13	14 or more
Cl Chloramphenicol	30 µg	12 or less	13-17	18 or more
E Erythromycin	15 µg	13 or less	14-17	18 or more
M Methicillin	5 µg	9 or less	10-13	14 or more
S Streptomycin	10 µg	11 or less	12-14	15 or more
N Neomycin	30 µg	12 or less	13-16	17 or more
C Cefazolin	30 µg	14 or less	15-17	18 or more
P Penicillin G	10 units	20 or less	21-28	29 or more