APPENDIX A

Format Used To Develop the Neuroscience Labs and Classroom Activities

(For more information about this format, refer to p. 16 of the introduction of this book.) Modified from the NABT publication *Biology "On A Shoestring,"* funded by the National Science Foundation under grant number ESI-9154112. (***Note**: Some of the information listed below, such as objectives and materials, has been pulled into the margin section of each lab to make it easier to find.*)

Directions for Teachers

Note: In "Directions for Teachers," the first time the phases of the Learning Cycle are listed, the entire word and the icon are given: E Exploration; C Concept/Term Introduction; and A Application. In some other sections of the activity, the icon alone is used.

Synopsis ...The synopsis summarizes the main concepts of the lab.

Level ...Icons () representing the number of neurons indicate the level of difficulty of the lab: a "one neuron" lab is less difficult than a "two neuron" lab. The level may vary from one part of the lab to another. For example, the exploration phase may be a "one neuron" activity, and the application phase may be a "two neuron" activity.

Student Prior Knowledge ...This section indicates the prior knowledge students need before participating in the activity.

Integration ...This section includes the following

Into the Biology Curriculum ...This section indicates biology courses suggesting where the lab can best fit into the biology curriculum.

Across the Curriculum ...This section indicates other courses, such as physics or chemistry, where the concepts found within the activity could also be used.

Objectives...The objectives describe measurable outcomes of concepts, content, processes, skills, and attitudes students should understand and be able to explain and do at the conclusion of the lab.

Getting Ready ...This section includes the following

- *Length of Lab* ...This section gives a suggested number of days and minutes within a 45-minute class period required for the activity. Suggested time requirements and brief descriptions of what students will do are given for each phase of the lab (E, C, and A).
- *Materials Needed* ...Materials needed are given for a class of 24 students.
- *Preparation Time Required* ...The estimated number of hours

or minutes of preparation time for all tasks for each phase (E, C, and A) of the activity is included. Brief descriptions of what the teacher will need to do, if anything, to prepare for each phase are included.

- *Directions for Setting Up the Lab*
  - Directions for such tasks as preparing solutions and constructing apparatus are given here as needed for each phase of the activity (E, C, and A). If a phase is not listed here in a particular lab, no special directions are needed for that phase.
  - Alternative sources for materials or alternative materials may be given here.

Teacher Background ...This section includes nontechnically written information giving the scientific context of the lab.

Safety Notes ...The safety notes are lab specific. (Icons () are used to indicate sections on safety.)

Procedure ...This section describes ways for the teacher to involve students actively in each phase of the activity. The emphasis is on scientific processes rather than scientific facts. Specific suggestions and questions are given for the teacher to use when developing the activity using the Learning Cycle. The following sections are included:

E ***Exploration*** ...This section may give students immediate hands-on experience with a concept related to the activity, with minimal introduction by the teacher. It may be designed to reveal and/or challenge misconceptions. Students use their hands and minds to explore, investigate, and find patterns. A numbered list of suggested procedures for this section may be given in the teacher section only; these are not to be given to students. The teacher can then make the decision as to whether or not to have students use these procedures.

C ***Concept/Term Introduction*** ...This section describes a way for the teacher to help students explain the patterns they have discovered in the *Exploration* phase. The concepts and terms of the lab are given names. It includes creative ideas for the teacher to focus students on the exploration, such as exciting questions, and examples of similar or related experiments that have been completed or are currently under way.

A ***Application*** ...In this section, students apply what they have learned to other situations. Experimental design may be part of the application phase. Where applicable, one or more sample hypotheses and sample procedures are included for teacher use only. Icons are used to indicate which sample procedure goes with which sample hypothesis.

Teaching Tips ...This section includes lab-specific trouble spots that anticipate where students may have problems. Important points to emphasize for the smooth running of the activity are included, such as the source of a needed piece of equipment.

Suggested Modifications for Students Who Are Exceptional ...This section includes lab-specific suggestions for modifying the lab for students who are exceptional. Special needs addressed in the labs are listed alphabetically.

Answers to Questions in "Directions for Students" ...This section provides answers to questions in the "Directions for Students" section for each phase

E, C, and A

Subsections are given under each phase as appropriate, including answers to Focus Questions, Experimental Design Questions, and Analysis Questions.

References ...References listed in this section are those that are cited specifically in the text of the lab.

Suggested Reading ...References listed in this section are sources of further reading on the lab topic.

NOTE: Lab-specific cooperative learning suggestions are placed in the sections of "Directions for Teachers" where they are most appropriate.

Directions for Students

Introduction ...This section includes major questions that provide focus to the lab for the student. The introduction is NOT meant to provide answers to the lab or information as to how to design an experiment.

Materials ...If students do not design experiments, this section lists materials that an individual or small group of students will need to participate in the ***Exploration*** phase of the activity. For activities in which students design experiments, materials are not listed.

Safety Notes ...The safety procedures are lab specific and student oriented, and are marked by an icon ().

Procedure ...Focus questions and questions from an introductory teacher demonstration are integrated into each of the following sections as appropriate.

E ***Exploration*** ...This section includes questions that help students develop hypotheses about what they have observed during the ***Exploration*** phase.

C ***Concept/Term Introduction*** ...This section leads students to think about the meaning of their observations in the ***Exploration*** phase. The section may include a list of what students will do. Students may design experiments to gather quantitative data to answer the questions posed in the ***Exploration*** phase.

A ***Application*** ...In this section, students will conduct their experiments if an experiment is part of the lab, as well as collect and analyze data. Focus questions may be included here to get them started. If an experiment is not part of the lab, students will conduct activities as appropriate for that lab.

Analysis ...This section varies from lab to lab. Its purpose is to help students better understand their experiences with this lab.

APPENDIX B

Appendix B was written by teachers participating in the summer 1992 NABT/SFN Neuroscience workshop at Wake Forest University.

Scientists' Guidelines for Preparing Activities for High School Students

(For more information about how to use these guidelines, refer to p. 15 of the introduction of this book.)

Before the Visit — Scientist

1. Assess the students' background and interest beforehand. This could be done by a visit and/or an observation of the high school classroom at least one day in advance. If a visit cannot be made, arrange with the teacher to see a videotape of the class in action.
2. Prepare the material to be presented with the teacher. The visit should be a team effort.
3. Have materials for your presentation available beforehand, such as handouts, pre-labs, or charts.
4. Keep the vocabulary on the level of the learners.
5. Narrow the topic to be presented. The activity should be done in one time period with natural break points. Note the attention span of the students.
6. Think about your appearance and your potential rapport with the students.

Before the Visit — Teacher

7. Prepare name tags for the students.
8. Plan time together with the scientist before the visit. If possible, arrange for an observation of your class prior to the visit to show the following:
   - size of the facility
   - equipment available at the school.
9. Give the scientist a copy of your lesson plans with goals, objectives, and other materials used.
10. Brief the scientist on what the school expects in terms of forms required, safety precautions, etc.

The Visit — Scientist

11. Explain to students why you are a scientist.
12. Keep the vocabulary on the proper level. Introduce no more than 10 new words.
13. Use analogies related to common knowledge.
14. Use visual, concrete aids, e.g., cartoons.
15. Demonstrations should involve students. Student involvement

is a must.

16. Introduction should be short and to the point.
17. Use everyday references or "links" exemplifying what will be presented. Check the relevance with the teacher.
18. Minimize your research. Maximize generalities. Research is important, but don't use the entire time allotment for it.
19. Have an activity prepared. Do something. Students may have had "exploration" of the topic before your visit, and during the visit students could deal with "applications." Realize that students have short (10-minute) attention spans.
20. Bring engaging materials that are safe and acceptable, and can be enjoyed by all; also bring slides that depict your workplace.
21. Demonstrate and explain the appropriate use of equipment; provide alternate methods for high school.
22. Prepare activities for both college preparatory and non-academic students; be aware that AP courses don't have time to add labs to the curriculum.
23. Don't talk down or talk over the heads of students.
24. General teaching techniques:
    - Include humor.
    - Have a catchy introduction.
    - Question students rather than lecture.
    - Think of questions to ask students beforehand.
    - Show excitement.
    - Read the audience. Use eye contact.
    - Circulate throughout the room.
25. Don't be surprised if students ask anything — be as prepared as one can be to deal with inappropriate student questions.

After the Visit — Scientist

26. Evaluate your presentation.
27. Arrange to bring the class to the lab, if possible.
28. Consider that the encounter should be several days for several hours; not just a one-time event.

After the Visit — Teacher

29. A courtesy or thank-you note should be sent to the scientist.

CREDITS

Hearing in the Dark

Page 22, Figure 1

Adapted from Howard Thiery, Manchester High School, Manchester, CT.

Page 23, Figure 3

Adapted from Moffett, D., Moffett, S., and Schauf, C. (1993). *Human physiology*. 2nd ed. St. Louis: Mosby Year Book, Inc. Adapted and reprinted with permission from Marsha J. Dohrman.

Page 24, Figures 4a and 4b

Adapted from Howard Thiery, Manchester High School, Manchester, CT; Mark Temons, Muncy High School, Muncy, PA; and Robert Foreman, University of Oklahoma College of Medicine, Oklahoma City, OK.

What Else Do Ears Do?

Page 37, Figure 1; Page 41, Figure 4; and Page 42, Figure 5

Adapted from Robert Foreman, University of Oklahoma College of Medicine, Oklahoma City, OK.

Page 43, Figure 6; and Page 44, Figure 7

Adapted from Howard Thiery, Manchester High School, Manchester, CT.

What's the Connection?

Page 60, Figure 1; Page 61, Figure 2; and Page 62, Figure 4

Adapted from Society for Neuroscience (1990). *Brain facts: A primer on the brain and nervous system*. Lydia Kubiuk. 11 Dupont Circle, NW, Suite 500, Washington, DC 20036.

Neural Processing Activity

Page 80, Figures 5a and 5b; and Page 81, Figure 6

Adapted from Patricia Ulrich, Amherst Senior High School, Snyder, NY.

"Rewiring" the Brain

Page 97, Figure 3

Reprinted with permission from Daniel Weinberger, National Institute of Mental Health, Washington, DC.

Page 98, Figure 4

Reprinted with permission from E. D. London et al. (1990). *Arch Gen Psych*.

Page 100, Figure 6

Adapted from Curtis, H. and Barnes, N.S. *Biology*. 5th ed. New York: Worth Publishers. Figure 42–13, p. 869. Reprinted with permission.

Do You Get the Point? — Making Sensory Comparisons

Page 114, Figures 1a and 1b

Adapted from Natural History and Ecology of *Homo sapiens* (1991). *What does your homunculus look like? Mapping your brain*. The Woodrow Wilson National Fellowship Foundation. Reprinted with permission.

Page 116, Figure 4; and Page 117, Figure 5

Adapted from Robert Foreman, University of Oklahoma College of Medicine, Oklahoma City, OK.

Page 124, Graphs 1 and 2

Adapted from Mark Temons, Muncy High School, Muncy, PA; and Robert Foreman, University of Oklahoma College of Medicine, Oklahoma City, OK.

No Pain, No Gain

Page 138, Figure 1; Page 139, Figure 2; and Page 140, Figure 3

Adapted from Society for Neuroscience (1990). *Brain facts: A primer on the brain and nervous system*. Lydia Kubiuk. 11 Dupont Circle, NW, Suite 500, Washington, DC 20036.

Page 142, Figures 4a and 4b

Adapted from Stephanie Collins, Orchard Park High School, Orchard Park, NY.

Stress and the Nervous System

Page 156, Figure 1

Adapted from Society for Neuroscience (1990). *Brain facts: A primer on the brain and nervous system*, Lydia Kubiuk. 11 Dupont Circle, NW, Suite 500, Washington, DC 20036.

Page 160, Figure 4

Adapted from Everly, G.S., Jr. and Sobelman, S.A. (1987). *Assessment of the human stress response*. New York: AMS Press, Inc.

Page 161, Figure 5a

Adapted and reprinted with the permission of Biodot Company, Indianapolis, IN.

Page 161, Figure 5b

Adapted from Grayco Industries, Westwood, NJ.

Page 159, Table 1

Adapted from Guyton, A.C. (1996). *Textbook of medical physiology*. 9th ed., p. 156, Figure 13–17.