The Riot and the Dance Lab Manual

THE RIOT AND THE DANCE LAB MANUAL

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PUBLISHER'S NOTE

This is the Lab Manual for *The Riot and the Dance,* a new biology text from Dr. Gordon Wilson that focuses on teaching students the integrated fundamentals of biology in an approachable and yet detailed way. The Lab Manual is an important tool to show students how the concepts they are learning relate to real life. As such, you'll use a lot of "real life" materials. Each lab begins with a clearly labeled "Materials" list, many of which should be available in your kitchen or grocery store. For materials that must be specially ordered, we recommend one of these online supply sources: Carolina Biological Supply Company, Bio Corporation, and Ward's Science. Make sure you give yourself enough time to receive these materials in the mail! Some labs also require some slight preliminary preparation, so be sure to check the "Preparation" section of each lab ahead of time as well.

Several labs call for students to watch videos online on YouTube or other sites—the twenty-first century version of classroom film strips! To save having to type in all of those URLs, we've prepared a list of all the video links you will need for the course: visit http://logospressonline.com/products/lab-manual-for-the-riot-and-the-dance/ . You'll probably want to bookmark this in your browser for easy access. You can contact us online (www.logospressonline.com) or by phone (208.892.8074) if you have any questions.

The goal of this Lab Manual is to stir up curiosity about all of life from cells to sharks to ecology—along with a greater desire to praise the Creator of it all. Enjoy!

SUGGESTED YEAR-LONG SCHEDULE

Below is a suggested schedule for working through The Riot and the Dance Textbook, Lab Manual, and Teacher's Guide, meeting five days a week over two semesters. If you meet fewer times per week, condense the schedule as needed. Each week will have at least two days of teaching and reading through that week's material, along with review, weekly quizzes & exams, and 25 labs.

WEEK	DAY	LECTURE/LABORATORY
1	1	Introduction
	2	Begin Ch. 1: A Smidge of Chemistry
	3	Finish Ch. 1
	4	Review Questions for Quiz
	5	Ch. 1 Quiz (Ch. 1 review)
2	1	Begin Ch. 2: Biomolecules
	2	Finish Ch. 2 & Review Questions
	3	Ch. 2 Quiz
	4	Review for Exam
	5	Unit 1 Exam
3	1	Begin Ch. 3: A Short History of Microscopy
	2	Finish Ch. 3
	3	***Lab 1: The Microscope***
	4	Review Questions for Quiz
	5	Ch. 3 Quiz
4	1	Begin Ch. 4: Intro. to Cell Basics
	2	Finish Ch. 4 & Review Questions
	3	***Lab 2: Basic Cell Structure***
	4	Ch. 4 Quiz
	5	Begin Ch. 5: Organelles of the Eukaryotic Cell
5	1	Finish Ch. 5 & Review Questions
	2	***Lab 3: Diffusion and Osmosis 1***
	3	***Lab 4: Diffusion and Osmosis 2***
	4	Ch. 5 Quiz & review for Exam
	5	Unit 2 Exam
6	1	Begin Ch. 6: Basics of Metabolism
	2	Finish Ch. 6
	3	***Lab 5: Enzymes***
	4	Review Questions for Quiz
	5	Ch. 6 Quiz
7	1	Begin Ch. 7: Photosynthesis
	2	Continue Ch. 7
	3	Finish Ch. 7 & Review Questions
	4	Ch. 7 Quiz
	5	Begin Ch. 8: Cellular Respiration

WEEK	DAY	LECTURE/LABORATORY
8	1	Continue Ch. 8
	2	Finish Ch. 8 & Review Questions
	3	Ch. 8 Quiz & review for Exam
	4	Unit 3 Exam
	5	Begin Ch. 9: The Central Dogma
9	1	Finish Ch. 9 & Read "DNA Replication" in Ch. 12
	2	***Lab 6: The Central Dogma 1***
	3	***Lab 7: The Central Dogma 2***
	4	Review Questions for Quiz
	5	Ch. 9 Quiz
10	1	Begin Ch. 10: The Lac Operon
	2	Finish Ch. 10
	3	***Lab 8: The Lac Operon***
	4	Review Questions for Quiz
	5	Ch. 10 Quiz
11	1	Begin Ch. 11: Recombinant DNA Technology & Genetic Modification
	2	Finish Ch. 11 & Review Questions
	3	***Lab 9: Recombinant DNA Technology***
	4	Ch. 11 Quiz & review for Exam
	5	Unit 4 Exam
12	1	Begin Ch. 12: Mitosis & Cell Division
	2	Finish Ch. 12
	3	***Lab 10: Mitosis & Cell Division***
	4	Review Questions for Quiz
	5	Ch. 12 Quiz)
13	1	Begin Ch. 13: Meiosis
	2	Finish Ch. 13
	3	***Lab 11: Meiosis***
	4	Review Questions for Quiz
	5	Ch. 13 Quiz
14	1	Begin Ch. 14: Basics of Mendelian Genetics
	2	Finish Ch. 14 & Review Questions
	3	***Lab 12: Mendelian Genetics***
	4	Ch. 14 Quiz & review for Exam
	5	Unit 5 Exam

WEEK	DAY	LECTURE/LABORATORY
15	1	Part 1 Review
	2	Part 1 Review
	3	Part 1 Review
	4	Part 1 Review
	5	Part 1 Comprehensive Exam
16	1	Part 2 Intro & begin Ch. 15: Classifying Life
	2	Finish Ch. 15
	3	***Lab 13: Classification***
	4	Review Questions for Quiz
	5	Ch. 15 Quiz
17	1	Begin Ch. 16: Viruses & Prokaryotes
	2	Finish Ch. 16
	3	Review Questions for Quiz
	4	Ch. 16 Quiz
	5	Begin Ch. 17: The Algae: Plant-like Protists
18	1	Finish Ch. 17 & Review Questions
	2	Ch. 17 Quiz
	3	***Start Lab 14: Kingdom Protista***
	4	Review for Exam
	5	Unit 6 Exam
19	1	Begin Ch. 18: Animal-like and Fungal-like Protists
	2	Finish Ch. 18
	3	***Continue Lab 14: Kingdom Protista****
	4	Review Questions for Quiz
	5	Ch. 18 Quiz
20	1	Begin Ch. 19: Kingdom Fungi
	2	Finish Ch. 19
	3	***Lab 15: Kingdom Fungi***
	4	Review Questions for Quiz
	5	Ch. 19 Quiz
21	1	Begin Ch. 20: Kingdom Animalia
	2	Finish Ch. 20 & Review Questions
	3	Ch. 20 Quiz
	4	Review for Exam
	5	Unit 7 Exam
22	1	Begin Ch. 21: Phylum Porifera
	2	Finish Ch. 21
	3	Review Questions for Quiz
	4	Ch. 21 Quiz
	5	Begin Ch. 22: Phylum Cnidaria
23	1	Finish Ch. 22
	2	Ch. 22 Review Questions
	3	***Lab 16: Phyla Porifera & Cnidaria***
	4	Ch. 22 Quiz
	5	Begin Ch. 23: The Worms

** Optional: Instead of day 3 lecture continue Lab 14 if you want more time to observe specimens.*

WEEK	DAY	LECTURE/LABORATORY
24	1	Finish Ch. 23 & Review Questions
	2	Ch. 23 Quiz
	3	***Lab 17: The Worms***
	4	Review for Exam
	5	Unit 8 Exam
25	1	Begin Ch. 24: Phylum Mollusca
	2	Finish Ch. 24
	3	***Lab 18: Phylum Mollusca***
	4	Review Questions for Quiz
	5	Ch. 24 Quiz
26	1	Begin Ch. 25: Phylum Arthropoda
	2	Continue Ch. 25
	3	***Lab 19: Phylum Arthropoda***
	4	Continue Ch. 25
	5	Finish Ch. 25
27	1	Review Questions for Quiz
	2	Ch. 25 Quiz
	3	Begin Ch. 26: Phylum Echinodermata
	4	Finish Ch. 26
	5	***Lab 20: Phylum Echinodermata***
28	1	Review Questions for Quiz
	2	Ch. 26 Quiz
	3	Review for Exam
	4	Unit 9 Exam
	5	Begin Ch. 27: Phylum Chordata
29	1	Finish Ch. 27
	2	***Lab 21: Phylum Chordata 1***
	3	***Lab 22: Phylum Chordata 2***
	4	Review Questions for Quiz
	5	Ch. 27 Quiz
30	1	Begin Ch. 28: Kingdom Plantae
	2	Finish Ch. 28 & Review Questions
	3	***Lab 23: Kingdom Plantae 1 (the mosses and ferns)***
	4	
	5	Ch. 28 Quiz
31	1	Begin Ch. 29: The Basics of Ecology
	2	Finish Ch. 29 & Review Questions
	3	***Lab 24: Kingdom Plantae 2***
	4	Ch. 29 Quiz & review for Exam
	5	Unit 10 Exam
32	1	Part 2 Review
	2	Part 2 Review
	3	***Lab 25: Ecology***
	4	Part 2 Review
	5	Part 2 Comprehensive Exam

LABORATORY 5

ENZYMES

MATERIALS

- Water
- 1 potato
- Blender
- Wire mesh strainer
- A few crystals of copper sulfate ($CuSO_4$)
- 1 bottle of hydrogen peroxide
- 10 test tubes
- Metric ruler
- Test tube holder
- A few drops of distilled white vinegar
- A graduated dropper (that can at least dispense about 3 ml)
- Stopwatch

PREPARATION

In preparation for Lab 5 make sure you have read Chapter 6 "Basics of Metabolism" in *The Riot and the Dance* (pp. 85–93).

Catalase is an enzyme that is very common in the cells of plants and animals. A common waste product of metabolism is hydrogen peroxide (H_2O_2) and is toxic to the cell. Therefore God has provided the cell with an enzyme that can convert hydrogen peroxide into water (H_2O) and oxygen gas (O_2), which are both harmless. One catalase enzyme can break down millions of hydrogen peroxide molecules per minute! When you mix potato juice (which contains catalase) with hydrogen peroxide it will begin to bubble (the bubbles are oxygen gas, a product of the reaction) which tells you that catalase is doing its job. Water (the other product) produced by the reaction will not be measurable or noticeable.

- Make filtered potato juice the day before the lab:
    1. Peel one potato and cut it up into 3 or 4 pieces.
    2. Place it in a blender with 1 cup of water.
    3. Blend at fastest setting (like you're making a potato smoothie)
    4. Filter the blended potato through a screen strainer to remove the potato pulp. You should have a little more than a cup of pinkish-brown potato juice for your experiments.
    5. Refrigerate and let the potato juice sit overnight.
- Make copper sulfate ($CuSO_4$) solution: Dissolve a few crystals in 2 ml of water. Copper sulfate doesn't dissolve easily, so don't try to get all the crystals to dissolve. If you stir the water until it turns bluish, that's fine.

OBJECTIVES

i. Define enzyme, active site, substrate, denaturation, and non-competitive (allosteric) inhibition.

ii. Know the catalase chemical reaction.

(substrate) (enzyme) (product) (product)

$$\underset{\text{peroxide}}{2H_2O_2} \rightarrow \text{catalase} \rightarrow \underset{\text{water}}{2H_2O} + \underset{\text{oxygen gas}}{O_2}$$

iii. Know how to prepare potato juice (which contains plenty of catalase enzyme).

iv. Describe the effect of enzyme concentration, temperature, low pH, and a heavy metal on enzyme activity.

EXERCISES

A. Definitions

Use the textbook glossary to define these terms. Again, think about the definitions while doing the experiment.

enzyme: _____

active site:_____

substrate: _____

denaturation: _____

non-competitive (allosteric) inhibition:_____

B. Experiments

Catalase reaction at room temperature

1. Add 3 ml of potato juice to a test tube.
2. Add 3 ml of hydrogen peroxide to another test tube.
3. Pour the hydrogen peroxide into the potato juice tube. Cap with thumb, flip upside down once to mix. The reaction will start. The visible product of the reaction will be oxygen bubbles.
4. Start stopwatch immediately after mixing. Let the reaction go for 1 minute.

5. At the end of 1 minute measure the height of the column of bubbles (from the surface of the liquid to the top of the bubble column). Record the height in mm in the table on p. 29 in the "control" column.

Catalase reaction on ice (the ice bath is to slow down Brownian motion of the enzyme and the substrate)

6. Add 3 ml of potato juice to a test tube (chill in ice bath)
7. Add 3 ml of hydrogen peroxide to another test tube (chill in ice bath)
8. Pour the hydrogen peroxide into the potato juice test tube. Cap with thumb, flip upside down once to mix. The reaction will start.
9. Place the mixture back into the ice bath.
10. Start stopwatch immediately after mixing. Let the reaction go for 1 minute.
11. At the end of 1 minute measure the height of the column of bubbles. Record the height in mm in the "On Ice" column of the table.

Catalase reaction after boiling the potato juice

12. Add 3 ml of potato juice to a test tube.
13. With test tube holder, hold potato juice test tube in boiling water for 30 seconds.
14. Add 3 ml of hydrogen peroxide to another test tube.
15. Pour the hydrogen peroxide into the potato juice test tube. Cap with thumb, flip upside down once to mix.
16. Start stopwatch immediately after mixing. Let the reaction go for 1 minute.
17. At the end of 1 minute measure the height of the column of bubbles. Record the height in mm in the "Boiled Enzyme" column of the table.

Catalase reaction at low pH

18. Add 3 ml of potato juice to a test tube.
19. Add a couple drops of distilled white vinegar to the potato juice test tube (mix it well).
20. Add 3 ml of hydrogen peroxide to another test tube.
21. Pour the hydrogen peroxide into the potato juice test tube. Cap with thumb, flip upside down once to mix.
22. Start stopwatch immediately after mixing. Let the reaction go for 1 minute.
23. At the end of 1 minute measure the height of the column of bubbles. Record the height in mm in the table below in the "Low pH" column.

Catalase reaction with heavy metal ($CuSO_4$)

24. Add 3 ml of potato juice to a test tube.
25. Add 3 or 4 drops of copper sulfate ($CuSO_4$) solution to the potato juice test tube (mix it well)
26. Add 3 ml of hydrogen peroxide to another test tube.
27. Pour the hydrogen peroxide into the potato juice test tube. Cap with thumb, flip upside down once to mix.
28. Start stopwatch immediately after mixing. Let the reaction go for 1 minute.
29. At the end of 1 minute measure the height of the column of bubbles. Record the height in mm in the table below in the "Heavy Metal" column.

	Control (room temp)	On Ice (~32^0 F)	Boiled Enzyme	Low pH	Heavy Metal
Height of O_2 bubble column					

Under what conditions did the catalase have maximum performance?

_____

Why was there less product made when both the enzyme and substrate were kept cold on ice? _____

_____

Why were there very few or no oxygen bubbles at the low pH?

_____

Why were there very few or no oxygen bubbles when a heavy metal was present? _____

_____

LABORATORY 6

THE CENTRAL DOGMA 1

MATERIALS

- A computer to watch online videos

PREPARATION

Make sure you have read the "DNA Replication" section in Chapter 12 "Mitosis and Cell Division" and the "RNA Transcription" section in Chapter 9 "The Central Dogma" in *The Riot and the Dance* (pp. 121–126; 143–145).

OBJECTIVES

i. Be able to describe the process of DNA Replication. Given a short sequence of DNA, be able to produce a complimentary strand of DNA.
ii. Be able to describe the process of RNA Transcription. Given a short sequence of DNA, be able to produce a complimentary strand of RNA.
iii. Know the definitions of the terms listed in the exercises.

EXERCISES

A. Definitions

Use the textbook glossary to define these terms, and think about the definitions while doing the exercises.

gene: _____

nucleotide: _____

DNA replication: _____

DNA polymerase: _____

RNA transcription: _____

RNA polymerase: _____

B. Video

DNA Replication

1. Visit http://logospressonline.com/riot and download the demonstration videos link. (You'll want to bookmark that document in your browser for easy reference in future labs). Click the link for the Laboratory 6 video, "Central Dogma," and watch up to the 6:50 mark. Maybe watch it twice to get the idea down. Once you're ready, proceed with the lab.

Example of DNA Replication

2. Using this short double-stranded segment of DNA, I'll show you how DNA replication constructs the new strands from the old strands.

T G T T C G A G C G T C A T T T C A A C C

A C A A G C T C G C A G T A A A G T T G G