Planarian Behavior – Biology II Honor

**Overview**

Work in pairs for this lab. You will directly observe planarian movement. You will then formulate a hypothesis about planarian behavior, and propose an experiment to test this hypothesis. Your experiment should be focused on one of the various types of stimuli listed below. Your experiment must collect both qualitative and quantitative data. Think about how you can increase the sample size of your observations to minimize the effect of confounding variables.

**The animal**

Hydra oligactis, the animal we are using this week, is a planarian. Planarians are in the phylum Platyhelminthes (which means “flat worm”), which contains about 25,000 species, most of which are in the tapeworm and fluke groups. These are parasitic, living in other organisms where they can cause serious disease such as schistosomiasis (See Sadava, Fig. 31.15, and pp 695-696). Other flat worms are native to salt water, fresh water, or moist soil. Platyhelminthes are the simplest bilaterally symmetric and triploblastic animals (meaning they have all three primary germ layers: endoderm, mesoderm, and ectoderm). Planarians have a single opening, the mouth, found on the

ventral surface. It leads to a well-developed, highly branched gastrovascular cavity which

is the site of both digestion and circulation of nutrients. There is no separate exit, so

undigested food has to leave by the mouth. There is no system within the body to

distribute oxygen, this constrains flatworms to be flat, as they must respire by diffusion and no cell can be too far from the outside. Planaria are quite active, moving by contraction of muscle fibers that are oriented in different directions, in a manner similar to how we move our tongues around. The direction of movement is controlled by the nervous system, which consists of an anterior “brain” consisting of large ganglia. Two ventral nerve cords run the length of the body from the ganglia. Between the ventral nerve cords are transverse nerves arranged like a ladder. In the anterior end are two eyecups containing photoreceptors that are stimulated by light. Also in the anterior end are pits containing chemoreceptors that respond to certain chemicals.

**Behavior: Orientation and Movement**

When an animal changes its movement in response to environmental factors such as light,

temperature, moisture, or chemicals, it may do so in several different manners.

• Kinesis—orientation without respect to the direction of the stimulus

o Orthokinesis—A change in the rate of movement

o Klinokinesis—A change in the rate of turning

In kinesis, the movement remains random, but the stimulus may change the animal’s

speed, angle of movement, or amount of turning. If it is an effective negative stimulus,

the kinesis will result in the organism being further from the adverse stimulus. When

more suitable conditions are encountered, the animal simply moves less and stays in that

area. Kinesis results in random movement into better locations.

• Taxis—A directed, non-random, response to the stimulus.

Positive taxis is a movement toward a stimulus; negative taxis is a movement away from

a stimulus. Taxes are frequently identified with the environmental condition to which the

organism is responding. Taxes are not as random as kineses because they involve

movement in a definite direction. There are several different types of planarian taxes that

you can observe in the laboratory:

1. **Thigmotaxis** is a response to touch. Place a planarian in a container of water.

After the planarian begins to swim, touch it gently with the pipette. Observe the

response.

2. **Phototaxis** is a response to light. Photoreceptors in the eyecups can detect

direction as well as the intensity of light. Planarians usually orient themselves to

light so that the two eyecups are equally stimulated. Shine a light into one end of

a container of water. Place a planarian in the water. Observe the response. Note

whether it moves toward or away from the source of light. Is the planarian

positively or negatively phototactic?

3. **Chemotaxis** is a response to a chemical stimulus. Planarians use chemoreceptors

to locate food. They move either toward or away from concentrations of dissolved

chemicals associated with food. Place a small pinch of food in one corner of the

container of water. Place a planarian at the other end of the container. Observe the

response. Does it respond to the food? If so, does it move toward or away from

the food? How does the planarian respond to the different kinds of food?

4. **Gravitaxis** is a response to gravity. Place a planarian in a container of water. Take

a depth reading of the location of the planarian with a ruler. Observe where the

planarian is located. Does it seem to be benthic (bottom dwelling) or planktonic

(free-floating or slowly swimming near the surface)?

5. **Rheotaxis** is a response to water current. Place the planarian in a circular Petri

dish that is filled halfway with water. To provide water movement, make a gentle,

circular current in the dish by squeezing air out of a plastic pipette or by blowing

air out rubber tubing connected to an air jet. Observe the direction the planarian

moves. After it is moving in one direction, with or against the current, reverse the

direction of the applied current. Again, observe the direction the planarian moves.

**General Data collection and analysis information**

You will be collecting quantitative data and qualitative on planarian behavior. To do this, you will need to create data table in your lab notebook. Use the provided grid to track and quantify the movement/location of the planaria. Choose a specific time interval to observe the planaria. Close observation is key. Example…

1. In what proportion of the observations in a defined period was the animal oriented

with its head towards a given direction?

2. What was the average orientation of the animal during a defined period?

3. In how many different squares was the animal found in a defined period?

4. What proportion of time was spent in a given half (or a given quarter, etc) of the

dish (for example the portion containing the stimulus)?

5. What proportion of animals were in a given square (or half dish, etc) at a given

time?

6. etc.

**Making Observations**

**Part 1: Normal Behavior.** Be careful when you move the planarians into the containers of water. Place a planarian in a Petri dish by gently sucking them into a plastic pipette and gently expelling them with water into the dish. Note how they move for five minutes, practice quantitative approaches to collecting data on their movements. Observe the response of planarians to a piece of food. Place a piece of food at the edge of the dish, and a planarium in the center. Monitor the movement of the planarium until you see a pattern of movement. What is the movement? Does the movement appear to be a kinesis or taxis? How would you analyze and present the data to test your idea?

**Part 2: Planning an Experiment** Generate a hypothesis about Planarian behavior in response to a stimulus The stimulus can be any one or more of the ones listed above, or it can be something else. In your lab journals carefully plan your experiment. Include you independent variable, dependent variable(s) and several control variables. Clearly list your experimental groups and control groups. Write a hypothesis in If, then format and write out your experimental rational. The carefully describe not only the experiment, but also the analysis you will use to test your hypothesis. Consider the following issues as you formulate your hypothesis and design an experiment to test it.

1. A hypothesis that cannot be tested is worthless.

2. Be sure that you are testing one variable only.

3. Do everything you can to eliminate the possibility of observer bias. If possible,

collect and analyze data in a masked manner. To do this, partners may mask

information from each other, or you may recruit another student to “blind” the

observer.

4. Record the location or response of the planarians at definite timed intervals, for

example every 10 seconds or every minute.

5. If appropriate to your experimental design, put the planarians at different

locations when you place them in the container.

6. Describe the procedure in sufficient detail in your lab notebook that it can be

repeated in the future. A good experiment must be repeatable, in fact you may

want to exactly repeat your experiment next week.

7. Use the grid supplied by the teacher.

Show your Experimental Design to your teacher before beginning experiments.

Carry out the experiment to test your hypothesis. As you perform the experiment and begin to collect data, you may want to modify your experimental design. Feel free to do so, but make sure you make these changes clear in your lab notebook. Remember, your experiment must be repeatable by you or anybody else.

**Statistical Analysis**

Whenever possible, design your experiments and data collection so that you will have

numbers from which you can calculate the Mean and the Standard Deviation of your

quantitative measurements.

**Useful links:**

The animal:

http://www.ucmp.berkeley.edu/platyhelminthes/platyhelminthes.html

Taxis vs Kinesis:

http://cas.bellarmine.edu/tietjen/Research/Robots/Kinesis%20and%20Taxis.htm

Painless statistics:

http://abacus.bates.edu/~ganderso/biology/resources/statistics.html

**This Laboratory Exercise Modified From:**

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laboratory exercise. Pages 375-379, in Tested studies for laboratory teaching,

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