Fruit Fly Field Trip

Objective:
For 1st-4th graders to learn about fruit fly life cycle and have fun identifying mutants using technology: microscopes, DinoXcopes and magnifying glasses.

For 4th- 8th graders to learn about fruit flies as a model organism, have fun learning about DNA and mutations by identifying our fruit fly mutants, and perform a "taxis" assay with the flies and make predictions and collect data about their behavior and how genes affect behavior.

Materials:

1. Fruit flies in normal housing tubes with all life stages. (1 for each kid)
    a) Tubes are a labeled 1-5

1) White eyes, 2) curly wings and white eyes, 3) short wings, 4) airplane wings, 5) wildtype

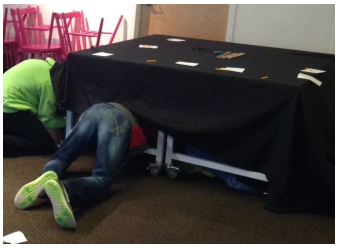
2. 1 Fruit fly tube of food (no flies) (for kids to smell food)

For younger kids:

4. DinoXcopes and laptop computers
5. Magnifying glasses
6. Stereo microscope

For Taxis experiment:

3. 3-5 Wildtype flies in long 10ml pipets with parafilm at the ends: (1 tube with 3-5 flies for each kid)
4. Timers (1 for every 2 kids)
5. Black table cloths. Have black table cloths over tables so kids can go under the tables into darkness for their taxis behavior experiments
6. white light flashlights
7. Rulers
8. markers
9. scrap paper



Introduction Icebreaker: 5 mins
"We're going to be experimenting with fruit flies today but first we're going to play a quick game. This game is called "Stand on the Line". If you agree with what I say, then stand on this line, if you disagree then stand on this line. If you don't know, then you can stand in the middle of the two lines."
(Some of these statements are geared for the older kids performing the taxis experiments.)

1. I like to eat pizza.
2. I like to eat fruit
3. I like science.

4. Fruit flies prefer to eat rotting fruit.
5. Fruit flies have brains.
6. I prefer to stay in complete darkness all day long for days and weeks at a time without ever seeing the sun.
7. If I am in a tunnel and I see light at 1 end, that is the direction I will head. I will move towards the light.
8. Fruit flies and humans share some of the same genes or recipes that make up our body parts.
9. Moths move towards the light.
10. Fly larvae and maggots move away from the light.

Experiment: Follow the powerpoint slides

Intro: 15-30 mins

1. Before you give them a tube, warn them not to shake the tube and not to push the cotton at the top of the tube down into the tube. Give them a tube of flies where you can see all life stages. Ask them what they see, what is the stuff at the bottom of the tube? do they see worms? they might see their black heads in the food. Briefly discuss the fruit fly life cycle.
2. Why do we neuroscientists study fruit flies?

   -To learn more about how WE humans work (fruit flies are a model organism. Most kids think we study flies because we want to learn more about them because they are important for our ecosystem-this is not so! We learn more about how human bodies work using simpler organisms like flies and worms.)

   The same genes that make their body parts are the same genes that make our body parts

   “If I were to tell you to make cookies, what kind of cookie would you make? So, you’d all make different cookies and the recipe is slightly different but they’re still all cookies made with similar ingredients. Just like our arms and fly arms and dog arms/appendages are all arms but they end up looking different.”
3. So scientists can look at a genome or our DNA and predict what might be a gene but to know what that gene does, we either delete it or mutate it. All of our DNA is different from each other-we all have different mutations. We’re all essentially mutants.
   a. Have them observe the tube of mutants and
   b. Predict what they think their mutant is.

   (For older kids, this can be done without use of tools if you have limited time but for younger kids, have them use the microscope, dinoscope and magnifying glasses to observe.
   c. Have them switch with others to observe all 1-5 tubes to predict what they think all the mutants are.
   d. Make sure little kids all get opportunities to use microscope and dinoxcopes.

Part 2 for older kids: 10 mins

4. Pass out the 10ml pipet with flies in it.
5. Hold the tubes still and observe the position of the flies. How are they behaving?
6. Invert the vial and observe the position of flies after 15 sec, 30 sec being sure to hold the tube still
    a. What was the flies' response?
    b. Was there an orientation movement? If so, what was the stimulus?
7. Try gently tapping the tube so that all the flies fall to the bottom of the tube.
    a. What was the flies' response?
    b. Was there an orientation of movement? If so, what was the stimulus?

Introduce taxis: One type of behavior easily observed in fruit flies is called **taxis**: the response of a living thing to an external stimulus. The response can take the form of movement towards or away from the stimulus. A common type of taxis is called **phototaxis**, which is movement of organisms in response to light. Moths show a **positive** phototaxis when they flutter around lights at night. Cockroaches, on the other hand, show a **negative** phototaxis—they scurry into dark corners when a flashlight is shined on them. **Geotaxis** is the movement of living things in response to the Earth's gravity.

8. Discuss with your pal and decide what kind of taxis these flies are performing. You have 10 seconds.

9. Ask for the class response.

Part 3: 15 mins

10. Your challenge is to figure out how to test if the flies are moving towards the light (positive phototaxis) or just that they move up (negative geotaxis or against gravity)?

Pick which method of measurement you thought worked the best.

(to test this they can:. Repeat steps 6, 7 with the lights off. Then repeat steps 6, 7 with the lights off and holding a flashlight underneath the tube so they will have to do positive geotaxis and positive phototaxis.

encourage groups by being specific not just "good job"

"oh, that is a clever way to measure."

"You're the only group to measure it that way."

Allow 5-8 mins, announce 1 minute left, give 5, 4, 3, 2, 1 to regroup

a. How/what did they measure
b. What were their results?

Part 4:

If you have a longer class period, have 10ml pipets with mutant flies and test if there is a difference in taxis between wildtype and mutant flies. Do the genes mutated in the mutant fly affect the ability of the fly to phototaxis or geotaxis?

BACKGROUND

Why are Fruit Flies important for mankind?

1. The fruit fly is a very useful model to study the genetic bases of feeding behaviors as vertebrate and invertebrate organisms show striking similarities in their chemosensory systems.

2. Feeding: eating behavior- mankind has a huge problem with our eating behaviors. Some people like to call it the obesity epidemic. how is it we decide to eat potato chips vs fruit? lets first understand how flies choose-look at different genes that might control it.

3. Fighting: When most people think of aggression, they think of road rage, physical fights, and violent crime. However, not all aggression is bad. Aggression is adaptive, helping people and animals alike to guard their homes from intruders and protect their children from threats. Problems arise when aggression is taken too far, escalating abnormally and becoming violent. Neuroscientists are working to identify brain regions, neurotransmitters, and genes that are involved in escalated aggression and violence. First, we decide if an aggressive behavior is learned or inherited. Males are picked as pupae so they never see another male fight yet they know certain moves. This research may one day help identify individuals at risk of developing dangerous behaviors and new treatments to prevent such episodes in at-risk individuals. Humans fight too-some humans are more aggressive/mean and we're trying to find out why to see if we can help them live normal, non-aggressive lives.

4. Geotaxis and Phototaxis: One type of behavior easily observed in fruit flies is called **taxis**: the response of a living thing to an external stimulus. The response can take the form of movement towards or away from the stimulus. A common type of taxis is called **phototaxis**, which is movement of organisms in response to light. Moths show a **positive** phototaxis when they flutter around lights at night. Cockroaches, on the other hand, show a **negative** phototaxis—they scurry into dark corners when a flashlight is shined on them. **Geotaxis** is the movement of living things in response to the Earth's gravity.

5. Smells: Do flies smell? How do they know if they are eating food or poison? Do flies have preferences similar to humans? We understand how smell works but not preferences. why do we choose 1 smell over another? **chemotaxis** is the movement of organisms in response to chemicals.

Drosophila melanogaster is an organism that has been studied in the scientific community for more than a century. Thomas Hunt Morgan began using *Drosophila melanogaster* for genetic studies in 1907. The common fruit fly lives throughout the

world and feeds on the fungi of rotting fruit. It is a small fly, and one could question why so much time and effort have been directed to this organism. It is about the size of President Roosevelt's nose on a dime, but despite its small size, the fly is packed with interesting physical and behavioral characteristics. Its genome has been sequenced, its physical characteristics have been charted and mutated, its meiotic processes and development have been investigated, and its behavior has been the source of many experiments. Because of its scientific usefulness, *Drosophila* is a model research organism. Its name is based on observations about the fly; the fly follows circadian rhythms that include sleeping during the dark and emerging as an adult from a pupa in the early morning. This latter behavior gave rise to the *Drosophila* genus name, which means "lover of dew." The explanation for the species name *melanogaster* should be clear after observing the fly's physical features. It has a black stomach. No doubt the dew-loving, black-bellied fly will continue to make contributions to the scientific community.

Adult fruit flies are attracted to substances that offer food or an environment in which to lay eggs and develop larvae. Typically those environments are rotting or fermenting fruit. Adult fruit flies are attracted to bright light, and their larvae move away from bright light. Adult fruit flies also demonstrate a negative geotaxis; they climb up in their chambers or vials against gravity. Movement toward a substance is a positive taxis. Consistent movement or orientation away from a substance is a negative taxis. The flies could also exhibit a behavior that is not oriented toward or away from the stimulus; rather, the stimulus elicits a random response. Such behavior would be considered a kinesis.