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Animal Behavior with Pill bugs

Background Research:

Pill bugs also known as rollie pollies, for their ability to roll up into balls, are not the insects that people believe they are. In fact they aren't insects at all, rather crustaceans. Pill bugs have seven pairs of legs except when they are initially born. They have six pairs of legs until their first molt where they gain another pair. Pill bugs are hatched from eggs that the mothers carry in a pouch. Pill bugs also have gills, yet they cannot breath submerged in water with them. Pill bugs typically live in humid, damp areas in which they thrive. Some examples of popular areas they are found are compost piles, under leaf litter, in pine straws, behind bark, under logs, potted plants, and rubble. Pill bugs are generally herbivores; their diet consists of decaying matter, vegetables, cardboard, and their own fecal waste. Pill bugs don't dispose of waste in the normal ways of most animals, they actually do not urinate. Their bodies can tolerate the ammonium gas which then passes directly through the exoskeleton. An interesting fact is that they can drink from their anus, they use these special tube shaped structures called uropods to do so. Also sick Pill bugs turn a bright blue, cyan type color, confirming the presence of an indovirus. While observing the pill bugs it is noticed that they are constantly moving around observing their environment. When approached by another pill bug they don't really seem to notice they just go along with their own business. The only time pill bugs really stop focusing on the task they are doing is when they feel threatened and they roll up in a tiny ball.

Our Variables:

-Wet VS. Dry

The "wet" variable will be produced by the use of the classroom's tap water being put into a beaker then through the use of a pipet, dropped onto the sand while inside the chamber.

-Water VS. Sugar Water

The water variable will be performed in the same way that the "wet" variable was in the other part of the experiment. The sugar water variable will be achieved by taking lukewarm water from the classroom's tap and filling a beaker with 40 mL of such water. Next adding 3 teaspoons of sugar and stirring until dissolved throughout. Then using a new pipet to drop a set amount of the beaker's liquid.

Independent Variable:

-Time

Dependent Variable:

-Location of the Pill bugs

Controlled Variables:

-The amount of liquid in each experiment

-The length of each trial

-Each person kept the same task for both experiments

Hypotheses:

Wet VS. Dry

Null Hypothesis: There is no significant statistical difference between the amount of Pill bugs that will go to the wet VS. dry.

Hypotheses: A statistically significant number of Pill bugs will go towards the "wet" side, retaining moisture, than the "dry" side.

Water VS. Sugar Water

Null Hypothesis: There is no significant statistical difference between the amount of Pill bugs that will go towards the water VS. sugar water.

Hypothesis: A statistically significant number of Pill bugs will go towards the "sugar water" side VS. the "water" side.

Experiment Specifications:

-We performed one trial for each pair of variables due to time restrictions.

-Each trial performed was over a 15 minute setting of observation and data being recorded every 45 seconds based on the location of the Pill bugs.

-All experimentation used the same amount of water, being 15 mL of regular tap water and 15 mL of Sugar water solution.

-Each trial performed consisted of the use of 10 Pill bugs, 5 Pill bugs beginning on each side.

Materials:

-16 Pill bugs

-Sand

-Water

-Chamber

-Overhead Sheet

-Pipette

-100 mL Beaker

-Sugar

-One Teaspoon Measuring Spoon

-iPhone(for the stopwatch function)

Procedure:

Wet VS. Dry

1. Gather materials needed for experimentation(Pill bugs, Sand, Water, Chamber, Overhead Sheet, 100 mL Beaker, iPhone and Pipette).
2. Begin by giving each group member a role. One person controls the stopwatch function of the iPhone, calling out every 45 second time interval. One person takes the callout from the person controlling the time and counts the number of Pill bugs on each side. The last person makes a chart and takes note of the count of Pill bugs from the counter.
3. Place a handful of sand into the chamber on both sides, enough to give a good layer on the chamber floor, but not too high so the Pill bugs can easily climb out.
4. Designate one side of the chamber to be the "wet" side and take the pipet, fill to the 1 mL mark, then drop the water. Repeat this until 15 mL of water has been dropped onto the sand. Be careful and make sure the liquid is dropped only onto the "wet" side.
5. Leave the other side, which is considered the "dry" side, with just sand, no additions.
6. Gather the Pill bugs out of their current chambers and place 5 Pill bugs on both the "wet" and "dry" sides, keeping a finger in the middle so they cannot cross over to the other area until the experiment is ready to begin.
7. When ready to begin the person controlling the time will begin the stopwatch and the person creating the divide in the chamber lifts their finger so the Pill bugs can pass between each side of the chamber. Then immediately place the overhead sheet on top of the chamber so the Pill bugs can't escape.
8. Proceed with the experimental specifications, as highlighted earlier in the report, by recording the number of Pill bugs on each side every 45 seconds for a period of 15 minutes.
9. Finish recording data and clean up materials. Store materials for use in the next experiment.

Water VS. Sugar Water

1. Gather materials needed for experimentation(Pill bugs, Sand, Water, Lukewarm Water, Sugar, One Teaspoon Measuring Spoon, Chamber, Overhead Sheet, 100 mL Beaker, iPhone and Two Pipettes).
2. Begin by giving each group member a role. One person controls the stopwatch function of the iPhone, calling out every 45 second time interval. One person takes the callout from the person controlling the time and counts the number of Pill bugs on each side. The last person makes a chart and takes note of the count of Pill bugs from the counter.
3. Place a handful of sand into the chamber on both sides, enough to give a good layer on the chamber floor, but not too high so the Pill bugs can easily climb out.

4. Designate one side of the chamber to be the “water” side and take the pipet, fill to the 1 mL mark, then drop the water. Repeat this until 15 mL of water has been dropped onto the sand. Be careful and make sure the liquid is dropped only onto the “water” side.
5. Designate the other side, which is considered the “sugar water” side. Fill the 100 mL beaker to the 40 mL mark with lukewarm water. Then add 3 teaspoons of sugar using the measuring spoon. Stir thoroughly with pipette until the sugar is dissolved throughout the entirety of the beaker. Fill the pipette to the 1 mL mark, then drop the sugar water. Repeat this until 15 mL of sugar water has been dropped onto the sand. Be careful and make sure the liquid is dropped only onto the “sugar water” side.
6. Gather the Pill bugs out of their current chambers and place 5 Pill bugs on both the “water” and “sugar water” sides, keeping a finger in the middle so they cannot cross over to the other area until the experiment is ready to begin.
7. When ready to begin the person controlling the time will begin the stopwatch and the person creating the divide in the chamber lifts their finger so the Pill bugs can pass between each side of the chamber. Then immediately place the overhead sheet on top of the chamber so the Pill bugs can’t escape.
8. Proceed with the experimental specifications, as highlighted earlier in the report, by recording the number of Pill bugs on each side every 45 seconds for a period of 15 minutes.
9. Finish recording data and clean up materials. Store materials for use in the next experiment.

Data:

Wet VS. Dry

Time(Minutes)	Wet(Water)	Dry
0:45	2	8
1:30	2	8
2:15	3	7
3:00	3	7
3:45	1	9
4:30	4	6
5:15	4	6
6:00	5	5
6:45	1	9
7:30	1	9
8:15	1	9
9:00	1	9
9:45	3	7
10:30	1	9
11:15	2	8
12:00	4	6
12:45	2	8
13:30	4	6
14:15	3	7
15:00	3	7

Water VS. Sugar Water

Time(Minutes)	Water	Sugar Water
0:45	7	3
1:30	6	4
2:15	2	8
3:00	6	4
3:45	5	5
4:30	6	4
5:15	6	4
6:00	6	4
6:45	5	5
7:30	5	5
8:15	6	4
9:00	6	4
9:45	4	6
10:30	4	6
11:15	6	4
12:00	5	5
12:45	7	3
13:30	7	3
14:15	5	5
15:00	8	2

Chi-Squared Analysis:

Wet VS. Dry

-First, begin by finding the average number of Pill bugs on each side, which turned out to be 2.5 for the "wet" side and 7.5 for the "dry" side.

-Then we continued by using the chi-squared calculation technique, 2.5 and 7.5 being our experimental values and 5 being the predicted values.

$[(2.5-5)/5]^2 + [(7.5-5)/5]^2 = 0.5$

-In our experiment the calculation was of the first degree and the value to accept the null hypothesis presented is any value below 3.84, ours being 0.5, thus, the null hypothesis is accepted.

Water VS. Sugar Water

-First, begin by finding the average number of Pill bugs on each side, which turned out to be 5.6 for the "water" side and 4.4 for the "sugar water" side.

-Then we continued by using the chi-squared calculation technique, 5.6 and 4.4 being our experimental values and 5 being the predicted values.

$[(5.6-5)/5]^2 + [(4.4-5)/5]^2 = 0.0288$

-In our experiment the calculation was of the first degree and the value to accept the null hypothesis presented is any value below 3.84, ours being 0.0288, thus, the null hypothesis is accepted.

Analysis Questions:

1.There is a difference between innate and learned behaviors when it comes to animals. Innate behaviors are behaviors that are programed into an animal through genetics and get passed from generation to generation. They are not formed based on experience, but are known from birth. Learned behaviors are not present at an animals birth, but rather built by experiences and trial and error. An example of an innate behavior of our pill bugs was as soon as they were disturbed they would roll up into little balls to protect themselves. This is an innate behavior because it a defensive tactic that they are born with and they know immediately how to roll up and not move. All learned behaviors are permutable meaning they can change over time compared to innate behavior that is rigid and has repetition. An example of a learned behavior from our pill bugs was how they learned to escape. Even with the overhead sheet on top of the chamber the pill bugs were still trying to get out. After a couple of failed attempts to climb the wall without falling the pill bugs learned a new way. They learned to use each other to pile on top of one another and escape that way. This is a learned behavior because based experience they could not get out of the chamber on their own, but learned to use each other to get out.

2. Kinesis and Taxis are both similar in the sense that they are both a type of movement. The difference between the two is that Kinesis is a form of undirected movement. Meaning it is completely random with no meaning behind it. Taxis is movement that is directed for one reason or another. This type of movement is caused by a stimulus of some sort, in the case of our experiment it would be the different environments. In our experiment we believe that the type of movement demonstrated by the pill bugs was that of Kinesis. This is because even if one side seemed slightly favored it always stayed within the range of possible error to the point where we accepted the null hypothesis. If we reject the null hypothesis then it would be directed, but it is not. With more time we believe that the pill bugs would start to show more of a directed movement, as they would be able to assess their environment more to find the best suitable area, but given the time constraints of the experiment the movement seems more random then what would be considered directed.

3. Chemotaxis is the movement of an organism in a direction in correspondence to a gradient of increasing (positive) or decreasing (negative) of a particular substance. With our hypothesis in mind we said that more pill bugs would go the moisture side instead of the dry said, and they would go towards the sugar water side instead of the plain water side. After our experiments we concluded that both of these predictions did not come true, and we accepted the null hypothesis. What this concludes is that the substances did not have a positive or negative chemotaxis effect on the pill bugs. If we would have rejected our null hypothesis then there would have been a positive and negative chemotaxis shown, but since we accepted there was not.

4. One uncontrolled sensory factor that may have skewed our results was having sand that may have been slightly damp when we used it for our trials. We didn't make sure to completely dry the sand, so we had to make the other side more wet to try and combat the issue. The issue could have been fixed if we would have used a heat lamp to fully dry the sand before our trials. Another uncontrolled sensory factor that may have skewed our results was using other group's Pill bugs, instead of only our own. We ran into a roadblock in which a portion of our Pill bugs escaped their overnight container. Due to these circumstances we had to use other group's Pill bugs along with the portion that failed to escape. Skewed results may have occurred because Pill bugs from different locations can react different to new habitats. This issue could have been fixed if we would have better secured our Pill bugs for the overnight stay in the classroom.

5. The responses that the Pill bugs had to the transfer from their container where they were living to the experimental chamber presented a innate behavior rather than a learned behavior. When stimulated by the touch of a human all of the Pill bugs would curl up into little balls. This represents an innate behavior because it would be impossible for every Pill bug that was collected for experimentation to go through life thus far and have the exact same experiences. On

top of the fact that the Pill bugs were collected in different locations, meaning that they must have differences in the things they have had to go through.

Conclusion:

Wet VS. Dry

We hypothesized that in the Wet VS. Dry experiment the Pill bugs would gravitate towards the “wet” side of the chamber. This hypothesis was based on the plethora of background information gathered on the species prior to experimentation. Yet, through experimentation the raw numbers taken into account and averaged out proved our hypothesis to be quite incorrect. Throughout the 15 minute period of experimentation the Pill bugs averaged 7.5 on the “dry” side of the chamber and a measly 2.5 on the “wet” side. While the initial numbers reject our hypothesis we also must take the Chi-squared Analysis into account. Through which we got a sum of 0.5, less than the first degree cutoff value for the degrees of freedom, being 3.841. Thus we fail to reject the null hypothesis which means that there is nothing impacting the Pill bugs to act irregularly, thus our hypothesis is rejected as well.

Water VS. Sugar Water

We hypothesized that in the Water VS. Sugar Water experiment the Pill bugs would gravitate towards the “Sugar Water” side of the chamber. This hypothesis was based on the background information gathered on the species prior to experimentation and prior experiences with many species being attracted to sugar. Yet, through experimentation the raw numbers taken into account and averaged out proved our hypothesis to be incorrect. Throughout the 15 minute period the Pill bugs averaged 5.6 on the “water” side of the chamber and a relatively close 4.4 on the “sugar water” side. While the initial numbers reject our hypothesis we also must take the Chi-squared Analysis into account. Through which we got a sum of 0.0288, less than the first degree cutoff value for the degrees of freedom, being 3.841. Thus we fail to reject the null hypothesis which means that there is nothing impacting the Pill bugs to act irregularly, thus our hypothesis is rejected as well as in our Wet VS. Dry experiment.

Works Cited:

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