

The Magnus Effect: A practice in using a meter tape.

a. Description:

- i. This activity is excellent. Students will have a very enjoyable day and learn something in the process. Students will practice measuring using a meter tape. They will measure the distance at which they can “fly” a pen which will also demonstrate the Magnus Effect. They will get multiple attempts.
- ii. Students will also learn how to create or practice creating a spreadsheet that will calculate averages.

b. Time:

- i. 55-110 minutes. Time will be completely dependent on how good students are at creating spreadsheets and inputting data.
- ii. It will also greatly depend on how you want to complete the lab. You can do the short method which is to just fly the pens and have students practice taking measurements or the long method which requires students to create a spreadsheet. I have done both methods. I include the spreadsheet because it teaches a skill that can be very useful.

c. Whole class instruction:

- i. I explain what the Magnus Effect is and show a video by Veritasium who does an excellent job explaining this phenomenon.
 1. <https://www.youtube.com/watch?v=2OSrvzNW9FE>
 2. Or Youtube Search: Magnus Effect Veritasium
- ii. I then explain the activity to the student. I also explain the competition and pass out the instruction for creating a spreadsheet. I demonstrate the Magnus Effect on a pen and fly it a few times just because it is entertaining. While I am demonstrating I also give them some different methods of flying the pen.
 1. You can watch some of these techniques in this video.
 2. <https://www.youtube.com/watch?v=Tii1gZ5qcQU>

d. Activity:

- i. Move all the desks to either side of the room so that you have a nice wide aisle in the middle of your room.
- ii. I split the class into groups of four because I give prizes to the group with the longest average distances.
- iii. Students will first create their spreadsheet using the instructions.
- iv. Students will then place their names on a sticky note of which I will collect prior to beginning the activity. The sticky note is a placeholder with which I use to mark the location of the farthest pen's landing.
 1. I mark where it hits first, not where it stops.
- v. After collecting the sticky notes, I pick one sticky note and the tournament begins. Each student during each round will get 3 pens to fly, by spinning the pen backwards.
- vi. I use a pointer to mark the location of the pens. When the student has flown all three pens, I place the sticky note next to the meter tape.
- vii. The student then comes on over and reads the distance using meters, centimeters, and millimeters. I will be right there to help them read it.
- viii. The student will call out his/her distance to his/her group. The entire group will keep each other's distances.
- ix. Every student will get to read the tape at least once and every student will get three tries to fly the pen.

- x. Now I get rid of half of the class's sticky notes. So if I started with 30 students, I will get rid of 15 sticky notes that belong to students who didn't get in the top 15. Because splitting in half sometimes is not going to be an even number, I will then add one so in my example above I will actually get rid of 14 and keep 16.
- xi. The top 16 in this example get another three pens. Those who have been eliminated will now place zeros in the rest of the cells.
- xii. The top 16 will read the tape and call out their distances, then we go again and eliminate 8 more and then repeat and eliminate 4.
- xiii. The last 4 in this example would then get to go one more time. All those who have been eliminated will be placing zeros in each trial that they did not compete in.
- xiv. I give prizes to the student who consistently stayed in and won the last flight, the group with the highest class average, the person with the longest distance overall, and the person with the individual best average. I give a grand prize to the student with the farthest distance in all of my classes. My classes personal best is 6 and a half meters.

e. My reflections:

- i. I have learned to use a rolling chair and being seated when marking the pen's location. This will save a teacher from getting cramps in their hamstrings from bending over to place the sticky notes.
- ii. Everybody will create their own spreadsheet. I have tried it where a group leader will keep a spreadsheet for the entire group, but have found that while that person is working the others just visit. Not only that, but I have decided I want all of my students to get an opportunity to create spreadsheets and calculations.
- iii. Because I am just doing my best to eyeball where the pens are landing, if I have distances that are fairly close and those sticky notes are close to being eliminated, I will keep them all (all the ones that are not obvious loser pens), just because I could have marked them slightly off originally.
- iv. A rule I have created is that if a pen falls off the front of the launch pad table, that counts as a try. If the student accidentally flick it behind them, I let them have another shot.
- v. I do not allow "Unauthorized flights." The first year I did this lab, it wasn't long before multiple students had taken their pens apart and were flying them back and forth. This led to chaos.
- vi. Also I warn them that they are not to fly pens during other classes. I had a few teachers my first year who were upset about random pens that would just shoot up into the air.
- vii. Your launch pad needs to be the smoothest surface possible.
- viii. I jump in on the competition. It is fun trying to win, which by the way, I have yet to be the champ.
- ix. Here is a video tutorial on creating the calculations in the spreadsheet if you haven't ever taught them before, this could help. The second link demonstrates pen flying techniques.
 - 1. <https://youtu.be/MWNzjki1bho>
 - 2. <https://www.youtube.com/watch?v=2OSrvzNW9FE>

Flying Bic Pen Measurement Lab

Formula hints: 10 mm in 1 cm, 25.4 mm in 1 inch, 304.8 mm in 1 foot

1. Write your name on a sticky note and create a Google Spreadsheet naming it "Flying Pen Measurements."
2. Create 9 columns called, "Player's Name," "Flight 1," "Flight 2," "Flight 3," "Flight 4," and "Player's Average mm," "Player's average cm" "Player's average Inch," "Player's Average ft."
3. In the "Player's Name" column list all the students in your group.
4. In the "Player's Average mm" column create a formula that would calculate the average of a player's pen flight distances.
5. Use the cell copy tool of your first formula and use it to copy the formula for each player.
6. In the "Player's Average cm" column, create a formula that will convert numbers in your mm column into cm. 1 cm = 10mm
7. Use the cell copy tool of your first formula and use it to copy the formula for each player.
8. In the "Player's Average inch" column, create a formula that would convert the numbers in your mm column into inches. 25.4 mm = 1 inch
9. Use the cell copy tool of your first formula and use it to copy the formula for each player.
10. In the "Player's Average ft" column, create a formula that would take the mm and convert them into feet. 304.8 mm = 1 foot
11. Use the cell copy tool of your first formula and use it to copy the formula for each player.
12. On the 8th row of the "Player's Name" column create a row called "Groups total average."
13. On the 8th row in the "Player's Average" column create a formula that would calculate the overall average of your group.
14. Use the cell copy tool of your formula and use it to copy the formula each measurement column.
15. Each player will have 3 tries each round using 3 different pens from the pen cup.
16. The furthest pen will be the distance recorded.
17. Distances will be recorded in mm.
18. Distances will be estimated and marked where the pen first hits an object (floor, table, chair, student, etc...)
19. The unbiased teacher will do the marking.
20. The competition will be played in the style of a single elimination tournament. If you keep winning you get to keep playing. Each round, half of the players will be eliminated until there are two, three or four of you left. Once we are down to the last 2, 3, or 4 players we will play a final round ranking them 1st, 2nd, 3rd, and 4th.
21. Once you get eliminated you will mark the rest of the columns as "0."
22. Your goal is to not only stay in the tournament, but to perform as well as you can to help your group's average.
23. Winners are: the players who get to the last round, the group with the highest average distance, the highest individual average distance, and the farthest distance during the entire tournament.
24. During your turn, observe how others are flying their pens. When you get a chance carefully observe how your pens fly and why you think they did what they did. Try different pens. Try different ways of flying the pens.