Rising Science

How Different Colored Water affects Evaporation Rate
M3-17 PHYSICS

Question

My science fair question is:

“How does the color of water affect its evaporation rate?”

Abstract

This project was about the color of water changing how fast the water samples evaporate. The purpose of this experiment was to determine the color of water that evaporates the slowest, as that one sample would work better for field work, conserving water on trips, and basic survival if it came down to it. The water would still be non-toxic and drinkable, as it is only a liquid food dye. My hypothesis was, "If I have red, blue, yellow, and undyed water sitting out to evaporate, then the blue water-dye will evaporate the quickest, because blue is lower on the color spectrum than the other colors." Procedure is relatively simple- have 20 cups of each group filled with 60 ml of the respective group's water type. Leave the cups outside, record the amount evaporated after a day with a measuring cup. Out of all of the groups, the yellow dyed water evaporated the slowest, then blue, red, and finally the control group. I came to the conclusion that this was due to a material mixed in with the yellow dye that resisted evaporation and that the more materials there are in a solution/mixture, the slower the evaporation rate.

Hypothesis

The hypothesis I developed for this experiment based on my research is "If I have red, blue, yellow, and undyed water sitting out to evaporate, then the blue water-dye will evaporate the quickest, because blue is lower on the color spectrum than the other colors."

Materials

- 80 identical size small water containers
- About 5 liters of sink (not distilled) water
- 1-2 large tables (2-3 meters by 1 meter)
- An open, in-the-sun area that is all the same level/elevation.
- A measuring cup
- Soap/cleaning method
- A spoon/mixing device (no whisk)
- A Sharpie (thin/ultra-fine)
- Measuring tape/ruler (metric)
- McCormick Assorted Food Color and Egg Dyes (around 2-3 boxes; contains red, yellow, and blue dyes in drops)
- A timer/stopwatch that can lap
- A pencil/pen
- A spiral/paper that can hold a fairly large table
- Gloves
- Safety Glasses (ones that look cool are optional)
- Camera/picture-taking device

Procedure

1. Gather all materials.
2. Review safety concerns and precautions. Put on gloves and safety glasses.
3. Set up tables outside with no rain or dark skies, have them level and on same elevation; weather should look good and be as close to the same temperature as possible.
4. Mark all of the containers with a Sharpie (ultra-fine) a .5 cm above the bottom of the container, using a ruler to measure.
5. Make sure all marks are equal and level, and all marks are same distance from bottom of container.
6. Let all marks dry (this should take about 5-10 minutes max, plan accordingly with weather).
7. As quickly and carefully as possible, use the measuring cup to fill 40 containers 75% full of sink water. This way, it is proportional to the size of container. 1 liter container, 0.75 liter of water, etc.
8. Leave the 40 containers inside at a low temperature (preferably below or at 70 degrees Fahrenheit, or 294.261 degrees Kelvin) while filling up rest of containers.
9. Once all filled 75%, divide the containers into 4 groups of 10- label each container its group name of either RED, BLUE, YELLOW, or CONTROL using Sharpie.
10. Drop 4 drops (this can be proportional at the rate of 20 drops per liter) of each color dye into its respective group, leave CONTROL alone.
11. Once done, move all labeled containers with help of others (to make this as quick and unbiased as possible) to the tables. Organize each section (2 tables mean 4 equal sections) so that all like-dyed water samples are together and that 2 groups are on each table.
12. Start timer/stopwatch when all containers are ready and in position.
13. Take pictures or a video of each section as it progresses towards empty.
14. Make a table with the categories RED, BLUE, YELLOW, and CONTROL.
15. Once the water line has dropped below the Sharpie mark, lap the timer (the time stays at the same rate, it just records the exact moment you lapped it) for the first "evaporated" container and write the time of the evaporation in the container's respective table category.
16. Repeat step 15 with all of the containers as soon as they're considered evaporated. Make sure to take pictures of each container when it is evaporated.
17. Once all containers are evaporated, gather all data and analyze.

Procedure

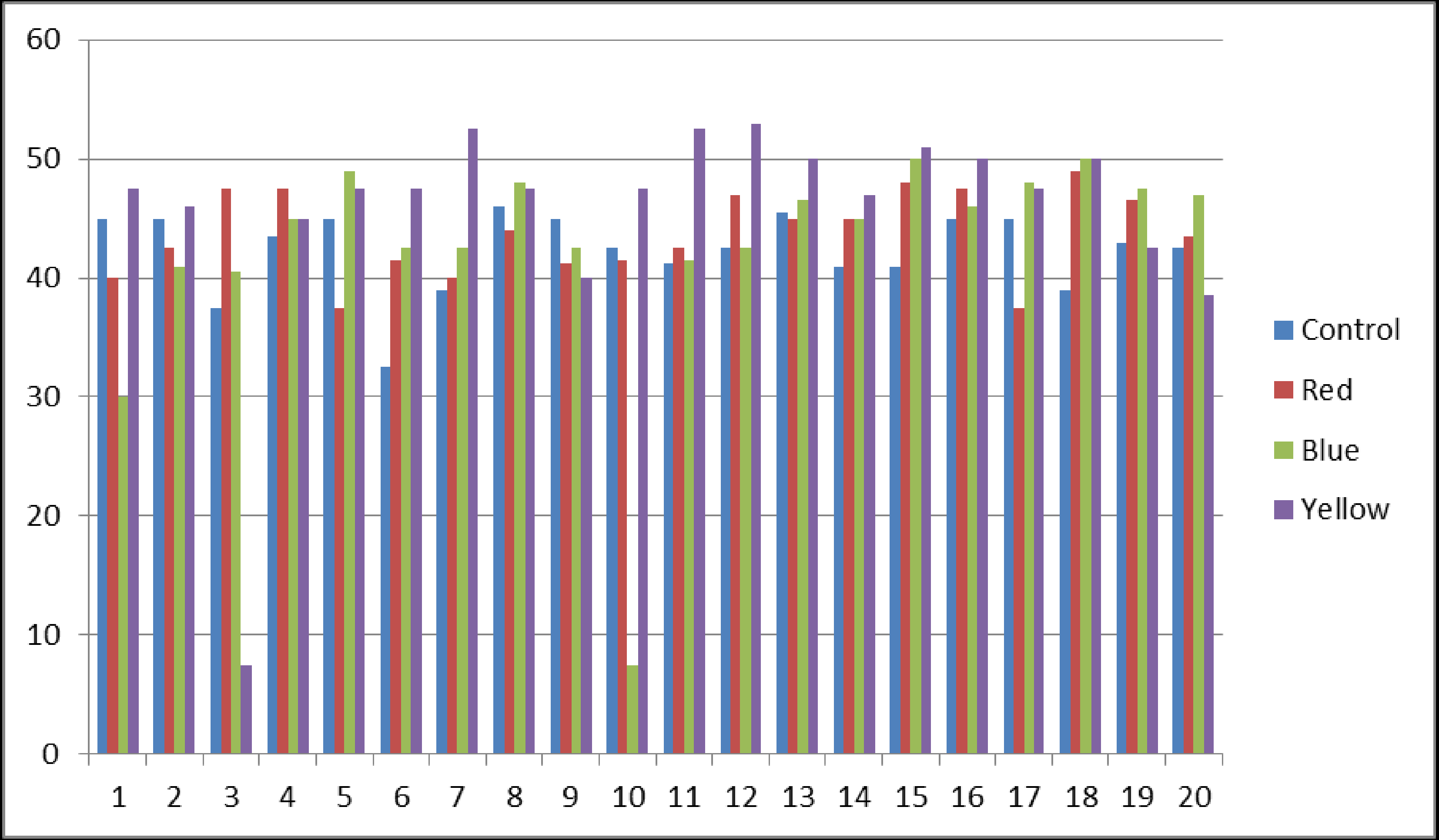
18. Clear the tables, washing your hands and the containers.
19. Repeat steps 7-18 with the other 40 containers not used in the first test group.
20. Compile all data, and thoroughly study it to come to a conclusion of possible bias or reasons for the results.
21. Using the conclusion, filter out bias and prove the hypothesis either true or false.
22. Share with other scientists to check work and peer review, it's done.

Variables

Independent: The color of the water
Dependent: The evaporation rate
Control: Standard, undyed water

Pictures

Results



The Y-Axis is measured in milliters, the X-Axis is the sample number. The graph shows how much water remains after the time period of 27 hours, 23 minutes.

Results

	Control (ml)	Red (ml)	Blue (ml)	Yellow (ml)
1	45	40	30	47.5
2	45	42.5	41	46
3	37.5	47.5	40.5	37.5
4	43.5	47.5	45	45
5	45	37.5	49	47.5
6	32.5	41.5	42.5	47.5
7	39	40	42.5	52.5
8	46	44	48	47.5
9	45	41.25	42.5	40
10	42.5	41.5	37.5	47.5

Amount of water left in each cup after 27 hours and 23 minutes

Results

	Control (ml)	Red (ml)	Blue (ml)	Yellow (ml)
11	41.25	42.5	41.5	52.5
12	42.5	47	42.5	53
13	45.5	45	46.5	50
14	41	45	45	47
15	41	48	50	51
16	45	47.5	46	50
17	45	37.5	48	47.5
18	39	49	50	50
19	43	46.5	47.5	42.5
20	42.5	43.5	47	38.5

Amount of water left in each cup after 27 hours and 23 minutes

Conclusion

From these results, I can conclude yellow dyed water evaporates the slowest (for the brand I used). My hypothesis wasn't supported because the blue sample group didn't evaporate the slowest, like I had predicted/guessed. The reasoning behind this is most likely more complex liquids take longer to evaporate (more materials in water correlates with longer evaporation). The yellow dye therefore had either materials in it that resisted evaporation, or simply a lot more materials than the other dyes.

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- By 1900, Many Foods, Drugs, and Cosmetics Available in the U.S. Were Artificially Colored. However, Not All of the Coloring Agents Were Harmless and Some Were Being Used to Hide Inferior or Defective Foods. A Careful Assessment of the Chemicals Used for Coloring Foods at the Time Found Many Blatantly Poisonous Materials Such as Lead, Arsenic, and Mercury Being Added. In Many Cases, the Toxicities of the Starting Materials for Synthesizing Coloring Agents Were Well Known and Could Be Toxins, Irritants, Sensitizers, or Carcinogens. "Color Additives: FDA's Regulatory Process and Historical Perspectives." *Color Additives: FDA's Regulatory Process and Historical Perspectives*. N.p., n.d. Web. 15 Sept. 2016.

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