Teacher Name: ___________________________________

Science Fair Judging Rubric Board Number: ____________________

Category	Max Points	Criteria	Points Earned
Problem Statement	5	A complete well written description of the question/problem being solved	
Background Research	10	• Sufficient background information should be provided for the reader to understand the question being investigated (5 points) • In-text citations are used to show where facts came from (3 points) (for example: "According to Santrock in 2013. . ." • 5 sources listed in the Bibliography section are discussed (2 points)	
Bibliography	5	5 sources, including publication date, title of article, author, date the article was accessed, and web address	
Hypothesis	5	A testable prediction on what the outcome of the experiment will be; **if/then statement**	
Variables	15	• Independent Variable: what is being changed between the different test groups • Dependent Variable: what is being measured • Constants: what is kept the same for all groups • Control group: the standards for comparison/ the group where the independent variable is not applied	
Materials and Procedures	10	• Materials: a list of all objects used, including specific details such as type, size, brand, amount (5 points) • Procedures: the specific steps/actions needed to perform the experiment (5 points)	
Data and Results	15	• Data Table: shows the measurements for the individual trials, and the average (units included) (5 points) • Data Graph: includes title, x-axis label, y-axis label, and correct display of the data on the table (5 points) • Results: the table and graph are clearly stated in words (5 points)	
Conclusions and Applications	10	The conclusion section should include the following points: • Was the hypothesis supported? • What errors occurred? • How can the experiment be improved for the future? • What was learned/ results explained? • How can it be used in the real world?	
Abstract	10	A clear well-written paragraph summarizing the entire project, including: problem statement, hypothesis, brief methods/procedures, brief results and conclusions	
Appearance	10	The display is near, clear, and organized. See Display Directions for appropriate placement of each section	
Scientific Value/ Creativity	5	The project (considering that this is middle school) is meaningful and contributed valuable information to the understanding of our world. The way the problem was solved or the original question was new, original, or creative.	
Total	100	Please add up all your points and write the total points earned	

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Science Fair Poster Template

BOARD SIZE: 36in X 48in

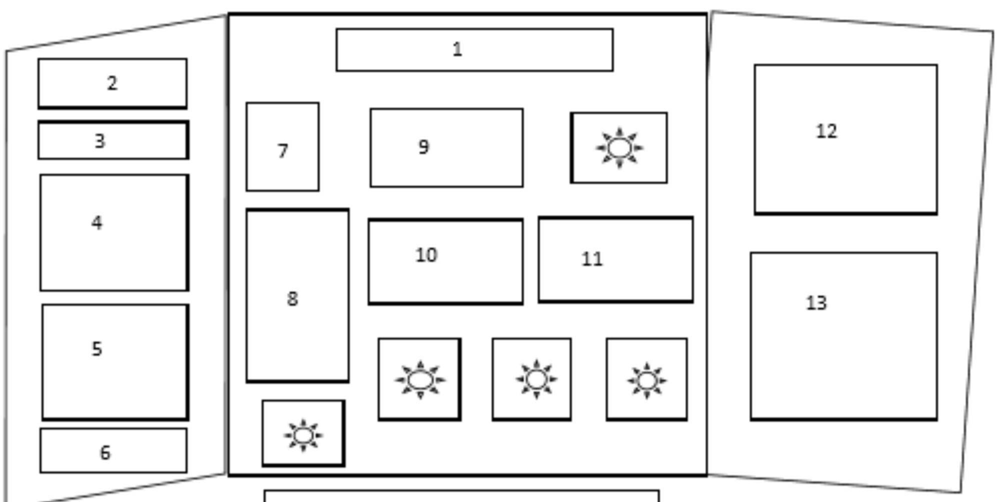
MUST INCLUDE:

- ⇒ Name, Section, Grade, Archimede-an Middle Conservatory (on back)
- ⇒ Title
- ⇒ Abstract
- ⇒ Research
- ⇒ Bibliography
- ⇒ Problem Statement
- ⇒ Hypothesis
- ⇒ Variables
  - ⇒ Independent
  - ⇒ Dependent
  - ⇒ Control
- ⇒ Materials List
- ⇒ Procedures
- ⇒ Data Chart (s)
- ⇒ Graph (s)
- ⇒ Results paragraph
- ⇒ Conclusion

DISPLAY TIPS:

1. **LABEL!!!!!!!**
2. TYPE Work!!!
3. Include Pictures (Cover face with stickers)
4. Create Border around poster
5. Mount white paper over colored paper:

Ex:



1: Title	7: Materials
2: Problem Statement	8: Procedures
3: Hypothesis	9: Variables
4: Research	10: Data Chart
5: Abstract	11: Graph
6: Bibliography	12: Results
☼ Pictures	13. Conclusion

Label Each Section:

Ex:

HYPOTHESIS:

If/Then/Because Statement

BACK OF BOARD:

- ⇒ Name, Section
- ⇒ Grade
- ⇒ Archimedean Middle Conservatory

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Sample Project that was rated Superior last year:

Which Filtration Material Leads to the Best Drinking Water

Abstract

The purpose of my science fair project was to study the effects of different filtration materials on drinking water filtration efficiency. My hypothesis for this project was that if I use different types of carbons, granulated activated carbon or powdered activated carbon to filter contaminated water, then the powdered activated carbon will be a more efficient filter to produce drinkable water because it has a larger surface area, which can absorb more contaminants. The constants variables in my experiment were the amount of food coloring, amount of carbon, amount of coffee filters, amount of water and amount of filtration time per cup; the control variable was the group with no filter. The variables in my experiment were independent variable: the types of water filters and dependent variable: how purified the water is after filtering it. The way that I measured the responding or dependent variable was using a color rating scale system where 0 equals clear and 10 equals darkest. The results of this experiment were that the filtration with no carbon and 0 drops of dye concentration produced an average of 0 in the color rating scale after treatment; no carbon with 2 drops of dye concentration produced an average of 7; and no carbon with 5 drops of dye concentration produced an average of 10. The data collection for the granulated activated carbon showed that using 0 drops of dye concentration produced an average of 0 in the color rating scale after treatment; granulated activated carbon with 2 drops of dye concentration produced an average of 5.67 and granulated activated carbon with 5 drops of dye concentration produced an average of 9. The data collection for the powdered activated carbon showed that using 0 drops of the dye concentration produced an average value of 0 on the color rating scale after treatment; powdered activated carbon with 2 drops of dye concentration produced an average value of 0; and powdered activated carbon with 5 drops of dye concentration produced an average value of 0. The group that was treated with granulated activated carbon showed little change in the color rating after the treatment. The group that was treated with powdered activated carbon showed the greatest change in the color rating after the treatment. The results show that my hypothesis should be accepted because after conducting the experiment we could visually confirm, by using a color rating system, that the powdered activated carbon could filter more efficiently the contaminated water. If I were going to do this experiment again in the future or expand on this experiment I would use additional types of filtration materials and other types of contaminants.

Problem Statement

The purpose of this experiment is to study the effects of different filtration materials on drinking water filtration efficiency.

Background Research

The purpose of my experiment is to study the effects of different filtration materials on drinking water filtration efficiency. I became interested in this topic when I noticed that water could taste different depending on the source or where it came from. Water filtration is one of the safest methods of providing clean drinking water.

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In 2007 it was proven by the World Health Organization (WHO) that billions of people lack access to a safe and purified water supply (Kozisek F., 2004).[1] Because of this, millions of people die each year from diseases due to the unhealthy and unfiltered water.[2]

The Natural Resources Defense Council (NRDC)[3] published a study in 2003 conducted by Eleanor Green that talks about how some factors such as pollution and corrosion of the water pipes contaminate the supply of public water. For example, water may test well at the source it originates from, but public water may still pick up contaminants on the way to your house. These contaminants may cause a health risk to some people.

Water purification can help remove harmful contaminants from water. Filtration physically blocks or chemically removes contaminants. [4] However, carbon filtration, which I will be testing in this experiment, is a relatively cheap and efficient way to purify water. Some carbon filters work better than others depending on their design and motive.

Together, these facts show that using a water filter could be a solution to obtain clean drinking water, but it is still not known which material would work best.[5] This experiment is served to find out which carbon material can selectively remove dangerous contaminants from drinking water while retaining healthy mineral deposits that balance the pH of drinking water.

Bibiliography

Dr. Bennett, Susanne. "The Hidden Dangers of Drinking Water." HuffPost. 2012. https://www.huffingtonpost.com/dr-susanne-bennett/drinking-water_b_1680027.html

Bleed, Wes. "Water Quality Association releases national opinion survey." Water Quality Association, 2018.

https://www.wqa.org/resources/news-releases/id/124/water-quality-association-releases-national-opinion-survey

Cuffary, Benedette. "Materials in Water Filtration." Azocleantech, 2016. https://www.azocleantech.com/article.aspx?ArticleID=582

Greene, Eleanor. "The Facts About Water Filters." Green America, 2018.

https://www.greenamerica.org/green-living/facts-about-water-filters

Jacobs, H. "What Do Carbon Filters Remove From Water?" LiveStrong.com, 2017.

https://www.livestrong.com/article/193977-what-do-carbon-filters-remove-from-water/

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[1] Greene, Eleanor. "The Facts About Water Filters." Green America, 2018.

[2] Cuffary, Benedette. "Water Quality Association releases national opinion survey." Water Quality Association, 2018.

[3] Kozisek F. "Health risks from drinking demineralised water." World Health Organization, Geneva, 2004.

[4] Jacobs, H. "What Do Carbon Filters remove from Water?". LiveStrong.com, 2017.

[5] Cuffary, Benedette. "Materials in Water Filtration." Azocleantech, 2016.

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Kozisek F. "Health risks from drinking demineralised water." World Health Organization, Geneva, 2004. https://www.who.int/entity/water_sanitation_health/dwq/nutrientschap12.pdf (PDF) .

Hypothesis

If I use different types of carbons, granulated activated carbon or powdered activated carbon to filter contaminated water, then the powdered activated carbon will be a more efficient filter to produce drinkable water because it has a larger surface area, which can absorb more contaminants.

Variables

Independent/Manipulated Variable:

The types of water filters.

Dependent/Respondent Variable:

How purified the water is after filtering it.

Constant Variables:

Amount of food coloring

Amount of carbon

Amount of coffee filters

Amount of water

Amount of filtration time per cup

Control Variables:

The group with no filter

Materials

Six granulated activated charcoal (carbon) – 2 ounces per container
Six powdered activated charcoal (carbon) – 4 ounces per container
Ninety (Thirty per trial) transparent plastic cups - 20 ounces each plastic cup
Two food colorings (blue) -16 ounces each container
Ten plastic spoons to stir each solution – standard size
Two cups of Tap water for each plastic cup
One hundred and eight (Thirty-six per trial)- Coffee filters (bleached or unbleached)- size 4
Nine Rubber bands – standard size
One Measuring cup – to measure at least 2 cups (500 mL)
One timer to time ten minutes of stirring each solution- standard size

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One Roll of Paper towels- standard size
One digital scale that can measure in 0.1 grams increments
One permanent marker to label the plastic cups – standard size
One safety face mask – standard size
One camera to record information /details – standard size
One lab notebook to write down the data – standard size

Procedures

Preparing Your Samples and Filters before each trial Experiment:

- To begin the first trial, arrange a total of 21 plastic cups on a table (flat surface). There will be a total of three trials.
- Pour 24 cups of tap water into large containers (2 cups of tap water per plastic cup).
- Three plastic cups will be used with the blue food coloring (one with no food coloring and two with blue food coloring).
- With a permanent marker, label three plastic cups, one for each blue dye concentration: 0 drops per plastic cup of liquid, 2 drops per plastic cup of liquid and 5 drops per plastic cup of liquid.
- Nine plastic cups will be used for the carbons (three plastic cups with no carbons, three plastic cups with granulated activated carbon and three plastic cups with powdered activated carbon).
- With a permanent marker, label the nine plastic cups: 3 plastic cups will be labeled as no carbon "NC", 3 plastic cups will be labeled as granulated activated carbon "GC" and 3 plastic cups will be labeled as powdered activated carbon "PC". Additionally, the label should indicate the amount of blue food coloring/dye concentration: 0, 2 or 5 drops per cup of liquid in the plastic cup.
- Organize the two types of carbons (granulated activated carbon and powdered activated carbon).
- Use a digital scale to weigh the grams of carbon: 3 grams of granulated activated carbon and 3 grams of powdered activated carbon per plastic cup. A total of 6 plastic cups will individually contain one type of carbon. Three plastic cups will contain 3 grams of granulated activated carbon and three plastic cups will contain 3 grams of powdered activated carbon. Use a safety face mask and avoid dispersing the powdered activated carbon into the air; try not to breathe in the particle.
- The rest nine cups will be used for the filtration process (empty plastic cups with coffee filters). Each plastic cup will be assembled by placing four coffee filters (one on top of the other) in each plastic cup and using one rubber band to attach and secure the coffee filter to the plastic cup.
- Place the 10 plastic spoons on the table (flat surface).
- Organize the food coloring for the three plastic cups. The amount of blue food coloring-dye concentration per plastic cup: 0, 2 or 5 drops per cup of liquid.
- Place the timer, lab notebook and the camera in the table /flat surface.

Experimental Procedure: (1st Process of the experiment)

- First, you will prepare the water samples that you are going to filter. You will use the blue food color dye as a model contaminant that needs to be removed from the water. Prepare three food color solutions, each with a blue color dye concentration.
- With a permanent marker, label three cups, one for each blue color dye concentration: 0 drops per cup of liquid, 2 drops per cup of liquid and 5 drops per cup of liquid.
- Measure 2 cups (about 500 mL) of tap water into each plastic cup using the measuring cup.
- You will only add blue food color dye to two of the three plastic cups. The first cup (0 drops per cup of liquid) will remain colorless. You will have 2 cups of liquid in each of your plastic cups. Add 4 drops of blue color dye to the plastic cup that is labeled with 2 drops per cup of liquid and add 10 drops of blue color dye to the plastic cup that is labeled 5 drops per cup of liquid.
- Stir each of the solutions with a clean spoon to disperse the blue food color evenly.

- Prepare the activated carbon for your filter. You will test three different experimental conditions (granular activated carbon, powdered activated carbon and no activated carbon) for each of the blue color dye concentrations. Note: Avoid breathing in the activated carbon powder and try not to disperse too much of the powder into the air.
- Label 3 plastic cups for each form of carbon tested. Make sure that your label is specific to the type of activated carbon and the blue color dye concentration that you are going to test. With a permanent marker, label the nine plastic cups: 3 plastic cups will be labeled as no carbon "NC", 3 plastic cups will be labeled as granulated activated carbon "GC" and 3 plastic cups will be labeled as powdered activated carbon "PC". Additionally, the label should indicate the amount of blue food coloring-dye concentration: 0, 2 or 5 drops per cup of liquid in the plastic cup.
- Your label should tell what form of carbon and which blue color dye concentration you will use for that plastic cup (0, 2 or 5 drops per cup of liquid. At the end, you should have 9 labeled plastic cups.
- Use a digital scale to weigh out 3 grams of granular activated carbon into each plastic cup that you labeled with granular carbon "GC". Then add 3 grams of powdered activated carbon into each plastic cup with the respective label "PC". The remaining 3 plastic cups (no activated carbon) "NC" stay empty. *Note*: Avoid breathing in the activated carbon powder and try not to disperse too much of the powder into the air.
- There should be 3 empty plastic cups and 6 plastic cups filled with activated carbon: 3 plastic cups with the powdered activated carbon and 3 plastic cups with the granulated activated carbon.
- Next, you will set up filters for the different forms of activated carbon and blue color dye concentrations.
- Label 9 plastic cups in total, one for each testing condition: 3 plastic cups will be labeled as no carbon "NC", 3 plastic cups will be labeled as granulated activated carbon "GC" and 3 plastic cups will be labeled as powdered activated carbon "PC". Additionally, the label should indicate the amount of blue food coloring dye concentration: 0, 2 or 5 drops per cup of liquid in the plastic cup.
- Take 4 coffee filters and stack them into each other. Press the filters into the top of a cup, fold their edges over the cup's rim, and secure them with a rubber band. (Repeat this step for the remaining filtration cups).

Filtering Your Samples: (2nd Process of the experiment)

Now you will prepare an additional 9 cups for your colored water samples. When starting your filtration process, you should have a set of 9 cups for each experimental condition (27 plastic cups total).

- Before starting the filtering process, prepare your water samples for each filter using the water samples previously prepared during the experiment.
- For each experimental condition (granular activated carbon, powdered activated carbon and no activated carbon), label 3 fresh plastic cups with 0 drops per plastic cup of liquid, 2 drops per plastic cup of liquid and 5 drops per cup of liquid.
- With a measuring cup, add 0.5 cups (about 120 mL) of the blue color dye solutions that was prepared in the experiment portion, to each of the plastic cups with the respective label.
- Before you switch to the next dye concentration, rinse out the measuring cup and clean it with a paper towel. The measuring cup should be completely clean and dry.
- Arrange all your prepared plastic cups. For each experimental condition and blue color dye concentration, place the colored water sample, the activated carbon (granulated activated carbon, powdered activated carbon, no carbon), and the filtration cup next to each other. There should be 9 cups for each of the 3 experimental conditions (27 in total).
- Before beginning the filtration experiment, prepare a data collection table to write down and start compiling all the data. Copy this table into your lab notebook three times, once for each type of carbon (granular activated carbon, powdered activated carbon, no activated carbon).
- Rate the color of your water samples on a scale from 0–10, where 0 is completely clear and 10 is the darkest. You will have to choose a number to assign to the intermediate cup, which may vary

slightly depending on the type or color of food color you use, which in our case is blue. We chose to assign a value of 7 to our 2 drops/cup of liquid sample, since it is fairly dark.

- Assess all your water samples before the filtration. Within a specific dye concentration, they should all look the same. They all will start out with an assigned color number before filtration. These will be your starting (before filtration) values.
- With your camera, take a photo of all your solutions before starting the filtration. Make sure that all the pictures are taken with the same lighting, background, and camera settings (it is probably best to use a white background) so you can compare them to each other.
- Continue with the filtration.
- Start with the filtration experiment using the granular activated carbon.
- Pour each concentration of the prepared dye solutions into the respective plastic cups containing the granulated activated carbon that was previously prepared during the experiment. Important: Pour slowly so you avoid creating a lot of powder dust in the air. Remember to try and avoid breathing in the particles by using a safety face mask.
- Set your timer to 10 minutes and quickly stir each solution with the granulated activated carbon using a clean spoon.
- After 10 minutes, pour the water and granulate activated carbon mixture into the filters that were prepared and let the water seep through the filters. Note: Make sure that the water drains out of the filters completely and collects in the cup below the filter. There should not be any water remaining in the filter.
- Next, continue with the filtration experiment using powdered activated carbon.
- Slowly pour each concentration of the prepared dye solutions into the respective plastic cups containing the powdered activated carbon that was prepared during the experiment. Important: Pour slowly so you avoid creating a lot of powder dust in the air. Remember to try and avoid breathing in the particles by using a safety face mask.
- Set your timer to 10 minutes and quickly stir each solution with the powdered activated carbon using a clean spoon.
- After 10 minutes, pour the water and powdered activated carbon mixture onto the filters that were prepared during the experiment and let the water seep through the filters. Make sure that no water is staying inside the filters.
- For the filtration experiment using no activated carbon, pour each of the prepared water samples onto the filtration cups prepared for this condition. Again, let the water seep through the filters completely.
- Let the solutions in each cup seep through the 4 layers of coffee filter. Write down your observations about the collected water samples after filtration in your lab notebook. Did any of the water samples change color? Do you observe a difference depending on dye concentration or type of activated carbon?
- Assess the color of all the filtered water samples. Carefully remove the coffee filters to have a better look inside the plastic cup. Assign each of the water samples a color code number based on the color scale. Write down your results in your data collection table.
- With your camera, take a photo of all the solutions that were collected in the filtration cups after the filtration experiment. Make sure that all the pictures are taken with the same lighting, background, and camera settings (it is probably best to use a white background) so you can compare them to each other.
- Once you have filled out your data for trial 1, set up and perform two more filtration trials. Experiments should be performed at least three times to confirm that the results are showing the same trend or similar results.

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Data Collection Table: No Carbon

Carbon Type: No Carbon Label: (NC)		Color Rating After Treatment (o=clear; 10=darkest)			
Dye Concentration [drops/cup of liquid]	**Color Rating Before Treatment (grading system)**	**Trial 1** **Date: 10/6/2018**	**Trial 2** **Date: 10/8/2018**	**Trial 3** **Date: 10/10/2018**	**Average**
0 drops	0	0	0	0	0
2 drops	7	7	7	7	7
5 drops	10	10	10	10	10

Data Collection Table: Granulated Activated Carbon

Carbon Type: Granulated Activated Carbon Label: (GC)		Color Rating After Treatment (o=clear; 10=darkest)			
Dye Concentration [drops/cup of liquid]	**Color Rating Before Treatment (grading system)**	**Trial 1** **Date: 10/6/2018**	**Trial 2** **Date: 10/8/2018**	**Trial 3** **Date: 10/10/2018**	**Average**
0 drops	0	0	0	0	0
2 drops	7	6	5	6	5.67
5 drops	10	9	9	9	9

Data Collection Table: Powdered Activated Carbon

Carbon Type: Powdered Activated Carbon Label: (PC)		Color Rating After Treatment (o=clear; 10=darkest)			
Dye Concentration [drops/cup of liquid]	**Color Rating Before Treatment (grading system)**	**Trial 1** **Date: 10/6/2018**	**Trial 2** **Date: 10/8/2018**	**Trial 3** **Date: 10/10/2018**	**Average**
0 drops	0	0	0	0	0
2 drops	7	0	0	0	0
5 drops	10	0	0	0	0

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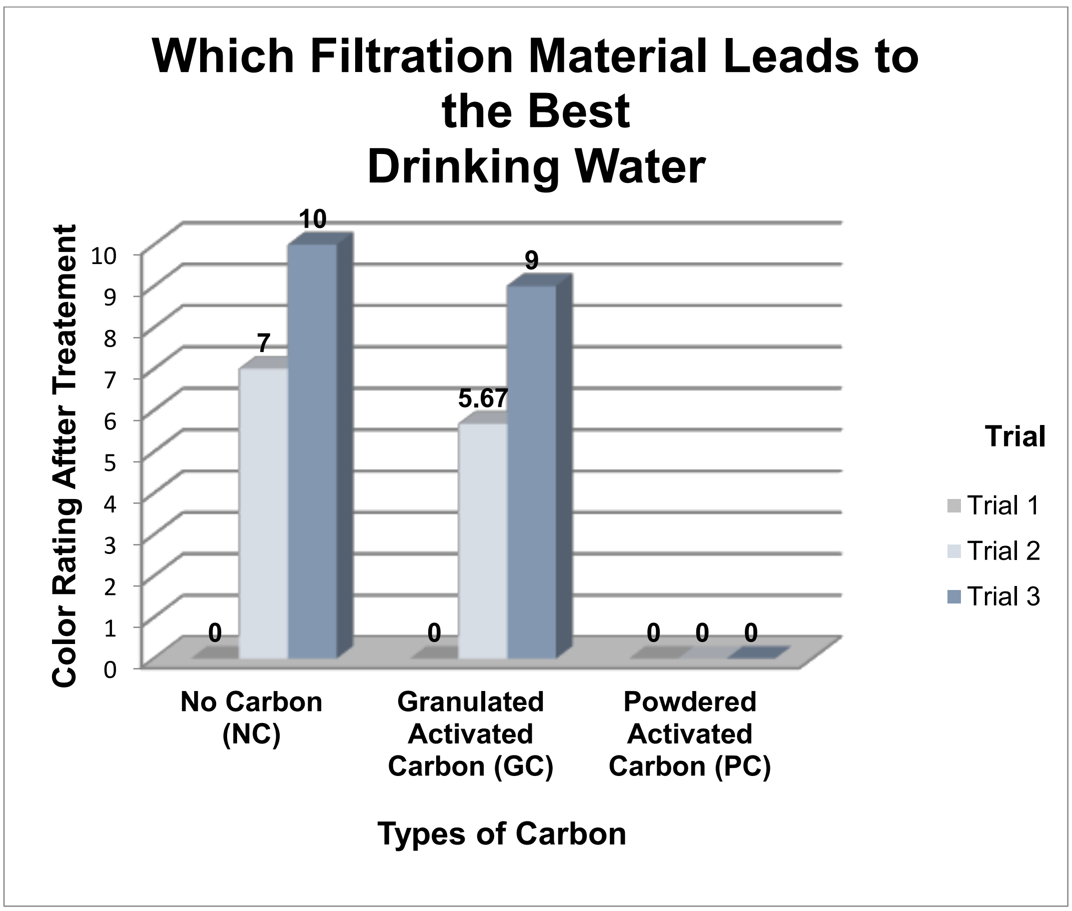
Data Collection Table: Overall Summary

e Concentration [drops/cup of liquid]	No Carbon (NC)				Granulated Activated Carbon (GC)				Powdered Activated Carbon (PC)			
	Trial 1	Trial 2	Trial 3	Average	Trial 1	Trial 2	Trial 3	Average	Trial 1	Trial 2	Trial 3	Average
0 drops	0	0	0	0	0	0	0	0	0	0	0	0
2 drops	7	7	7	7	6	5	6	5.67	0	0	0	0
5 drops	10	10	10	10	9	9	9	9	0	0	0	0

Graph



Results

The original purpose of this experiment is to study the effects of different filtration materials on drinking water filtration efficiency.

The results of the experiment once the three trials were completed showed that the filtration with no carbon (NC) and 0 drops of dye concentration produced an average of 0 in the color rating scale after treatment; no carbon (NC) with 2 drops of dye concentration produced an average of 7 in the color rating scale after treatment; and no carbon (NC) with 5 drops of dye concentration produced an average of 10 in the color rating scale after treatment. The data collection for the granulated activated carbon (GC) showed that using 0 drops of dye concentration produced an average of 0 in the color rating scale after treatment; granulated activated carbon (GC) with 2 drops of dye concentration produced an average of 5.67 on the color rating scale after treatment; and granulated activated carbon (GC) with 5 drops of dye concentration produced an average of 9 on the color rating scale after treatment. The data collection for the powdered activated carbon (PC) showed that using 0 drops of the dye concentration produced an average value of 0 on the color rating scale after treatment; powdered activated carbon (PC) with 2 drops of dye concentration produced an average value of 0 on the color rating scale after treatment; and powdered activated carbon (PC) with 5 drops of dye concentration it produced an average value of 0 on the color rating scale after treatment. The group that was treated with no filter (NC) showed no change in the color rating after treatment. The group that was treated with granulated activated carbon (GC) showed little change in the color rating after the treatment. The group that was treated with powdered activated carbon (PC) showed the greatest change in the color rating after the treatment. As the powered activated carbon's surface area to volume ratio is greater than that of the granulated activated carbon, it makes it more efficient for filtration as the surface area exposed is much larger.

Conclusion

My hypothesis was that if I use different types of carbons, granulated activated carbon or powdered activated carbon to filter contaminated water, then the powdered activated carbon will be a more efficient filter to produce drinkable water because it has a larger surface area, which can absorb more contaminants. I base the hypothesis on the idea that the powdered activated carbon will be more efficient as the water would take longer to filter through it because the surface area to volume ratio is greater. The results indicate that this hypothesis should be considered true because the results of this experiment demonstrated that powdered activated carbon has better absorption properties. The water filtered more quickly through the granulated activated carbon than it did with the powdered activated carbon, which allowed more time for the contaminants to bond. The errors that occurred during my experiment were that on occasions I had to recalibrate the digital scale by .2 or .3 grams to ensure that every activated carbon sample had the same weight. Because of the results of this experiment, I wonder if different lighter shades of dye color and concentration and other types of carbon filters, would have a different effect on filtering the contaminants from the water. If I were to conduct this science fair project again, I would improve it by using lighter food coloring dye such as yellow or orange; I would also use other types of activated carbons to filter the water such as bead activated carbon or impregnated carbon. In conclusion, this experiment taught me that carbon, in its powdered form, does a better job at filtering contaminants from water. This knowledge gained from my experiment can help people because they will be able to effectively filter out contaminants from water to produce filtered drinking water. Additionally, knowledge about water filtration could also save your life if you are ever lacking fresh water and are in need of it. Many major natural disasters such as extended drought, hurricanes, floods, tsunamis, earthquakes, among others, may impact the quality and quantity of fresh clean water and this experiment provided a solution to filter contaminated water and make it drinkable and readily available. All of this will help minimize deceases, health concerns and even deaths due lack of purified water.