**SCIENCE FAIR HANDBOOK**

**DESERT HILLS MIDDLE SCHOOL**

**2013**

**Table of Contents**

Time Line, due dates and check list 2

Checklist 2

Steps to Prepare a Science Fair Project 3

Find a Science Fair Project You’ll Love 4

Gather Background Information 5

Develop a Scientific Process 6

Identify Variables 6

Write a Hypothesis 6

Write a Procedure 7

Run a Controlled Experiment and Record Your Data 8

Write Your Science Fair Report 9

Abstract 9

Problem/Purpose 10

Research 10

Data 10

Results 10

Construct an Exhibit or Display 11

Appendix 1: Example Data Sheet 12

Appendix 2: Writing a Bibliography 13

Appendix 3: Example Completed Experiment Report 15

Appendix 4: Example Report 18

Appendix 5: Example Display Board 28

Appendix 6: Scoring Rubric 29

**COUNT DOWN TO DESERT HILLS SCIENCE FAIR 2013 STUDENT TIME LINE**

This may be the first time you have had to attempt a long range project, so it is very important to prepare a schedule and stay organized. Science fair projects often require several weeks for completion. Don’t let a due date that is many weeks away throw your planning off; there are many things to do. Here is a suggested schedule that provides you with ample time to complete all phases of the project.

Check off each step as you go, keeping track of what has been done and what needs to be done.

|  |  |  |
| --- | --- | --- |
| **Due Date** | **Check Off** | **Activity Description**  **(What you should be doing)** |
| December 7, 2012 |  | **Read** through Science Fair Information Packet with a parent/guardian. |
| December 7, 2012 |  | **Begin** researching your topic. See page 4 |
| **December 17, 2012** |  | **Turn in completed 2013 Science Fair Sign-up Packet.** |
| **December 18, 2012** |  | **Turn in Preliminary Experiment Plan**  Complete the following sections: Testable question, hypothesis, variables, brief procedure and data table. |
| December 20, 2012 through January 17, 2013 |  | **Conduct the experiment and collect data and results.**  Keep all information in a **journal**. Keep a log of all activities.  Write an abstract. |
| January 18, 2013 |  | **Begin** writing abstract, research and results |
| **January 21, 2013** |  | **Turn in Completed Experiment Report** |
| January 21-25, 2013 |  | **Write** report. |
| **January 25, 2013** |  | **Turn in Typed Rough Draft of Report** |
| Week of January  28-31, 2013 |  | **Write** the final draft of your report.  **Build** your display  **Practice** your presentation for the judges. |
| **February 1, 2013** |  | **Turn in Project Display Board and Report** |
| February 4-8, 2013 |  | Be prepared to **give a 3-5 minute presentation** that describes your project to the class. |
| February 12, 2013 |  | **Science Fair** in Desert Hills Library |
| February 13, 2013 |  | **Awards Ceremony** in commons Wednesday evening |
| March 2013 |  | **Mid-Columbia Science Fair** located in Columbia Center Mall. |

**STEPS TO PREPARE A SCIENCE FAIR PROJECT**

1. **FIND A SCIENCE FAIR PROJECT YOU’LL LOVE**

Choose something that will keep your interest during the project as well as something you WANT to learn about. Talk to teachers, parents, or librarians for ideas. A question about your hobby might be an excellent starting point. \*\*\*Remember that a Science Fair project is a test you do to find an answer to a question, not just showing what you know about something.

1. **GATHER BACKGROUND INFORMATION**

Become an expert on your topic. Gather information from books, magazines, the internet, people and even companies. Keep notes about where you got your information for your bibliography. **From this point on, everything you do should be recorded in your Log/Journal.**

1. **DEVELOP A SCIENTIFIC PROCESS**

**Identify the Variables**: State the purpose of your experiment. What are you trying to find out? Write a scientific question. Select a manipulated and a responding variable. How will they be measured? What variables will you control?

**Write Your Hypothesis**: The hypothesis is your **educated** guess of what the answer to your question will be. **Your hypothesis is based on your research.** Your hypothesis should be written in the If-then-because format if possible.

**Write a Procedure:** Write a detailed description of how you will do your experiment. The procedure should include how you will change the manipulated variable, how you will measure the responding variable, and how you will control all other variables. Your procedure should be detailed and complete enough that another person could duplicate your experiment exactly.

1. **RUN A CONTROLLED EXPERIMENT AND RECORD YOUR DATA**

Do the experiment as described in your procedure. Keep notes of everything you do, and of all your measurements and observations. Write down everything you can think of, you never know what you will need.

1. **REPORT YOUR RESULTS WITH GRAPHS AND/OR CHARTS**

What happened in your experiment? Answer that question, and then put the results in graphs and/or charts. People like to see visual representations of data; it helps them make sense of all the data you collect.

1. **WRITE A SHORT REPORT AND AN ABSTRACT**

**Report:** Tell the story of your project in 2 or more pages. Tell what you did and exactly how you did it. This report will give interested readers a comprehensive look at your project. Your report should include information collected during your research as well as a complete description of your experiment, data and results. Include a bibliography page that shows where you gathered background information.

**Abstract:** A short (< 250 words) summary of your investigation

1. **CONSTRUCT AN EXHIBIT OR DISPLAY**

Draw in your audience with a fun, bright, neat and informative display. Tell your audience what you did, how you did it and what you found out. Show them that you used the scientific method. Use graphs, charts and clear bold lettering to highlight your display. Your display should include a written conclusion and abstract. The display board has to be neat; it **does not** have to be typed.

1. **DESIGN AND PRACTICE YOUR PRESENTATION**

Your presentation explains your project: Why it interested you, how you conducted your experiment, and what your results were. Were there problems? How did you solve them? By looking neat, speaking clearly and avoiding other distracting behaviors, you will make an excellent impression on the judges and/or your class mates.

**FINDING A SCIENCE FAIR PROJECT YOU’LL LOVE**

**STEP 1: PICK A TOPIC THAT EXCITES YOU**

Whether it’s music, soccer, astronomy or even video games, anything you enjoy can become a science project. Write down a topic that fascinates you (example: skateboarding).

**STEP 2: NARROW YOUR TOPIC**

Did you ever notice something interesting while doing a favorite activity? Your observation may have made you wonder, ‘How does (something) affect (something else)?’ (Example: how does the grit on grit tape affect my ability to hold the skateboard on a jump?) If you can’t think of anything, do some research on your topic. Check out your school or local city library for information/ideas, Google your topic of interest (use your topic as a search word, or search using your topic followed by ‘science fair project’ (example: skateboard science fair projects), watch you-tube videos about your topic. Talk to your parents, teachers and librarians. Narrow your idea down until it is a question about a single idea. **Write your ideas in your science log/journal.**

**STEP 3: ASK A QUESTION THAT CAN BE ANSWERED IN AN INVESTIGATION OR EXPERIMENT**

1. To make sure you’ll be able to test your idea, write what you want to find out in the form of an investigative or researchable question. Try to write your question in the ‘How does (something) affect (something else)?’ format.
2. Can you create an experiment to answer your question? Is your experiment possible to conduct? If not, try narrowing your topic again (Go back to step 2 or even step 1).

**STEP 4: CHALLENGE YOURSELF**

Ask yourself, is my topic challenging enough to keep me interested until the end of January? If not, go back to step 1 or step 2 and think of a topic that will keep you interested.

**RESEARCH: DECIDING ON YOUR TOPIC AND GATHERING BACKGROUND INFORMATION**

Gather information to help you decide on a topic and develop a researchable question. Begin by getting an overview of your topic. Encyclopedias contain general information about many topics and are a good starting point. Wikipedia can be a source of ideas, but don’t use is a source of reference information.

Once you have a topic, become an expert on your topic by collecting as much information as possible. Use this information to help narrow your topic to a question that can be answered with an experiment. You also use the information to write your hypothesis. Use your school and local libraries, and search the internet for sources of information. When you find a book on your topic, don’t feel you have to read the whole thing. Look at the table of contents or the index for information relating to your topic. Check the book’s bibliography for other sources you may wish to use. What is the background information needed to make a hypothesis? What do you need to know about the subject?

You will need to write a research section for your report. Research the subject. Become an expert on your subject. Tell the reader about it. For example if your questions is about how fast different shapes of ice melt you will need to learn background information on ice, melting and surface area. Pictures, labeled drawings, charts and graphs always help the reader understand the subject.

When researching your topic, use index cards to record the information and the sources of the information. Each card should have only one idea on it, as well as where you found the information for your bibliography. Read the ‘Developing a Bibliography’ page 12 for instruction for listing resources and references. Create a pocket in your log/journal for the index cards.

**Use index card for note taking**

|  |
| --- |
| Write where the information came from. See appendix 2 for instruction on listing resources. |
|  |
| Only one idea per card. Make sure you use your own words unless you use quotation marks. |
|  |
|  |
|  |
|  |
|  |

**DEVELOP A SCIENTIFIC PROCESS/IDENTIFY VARIABLES AND WRITE A HYPOTHESIS**

**Variables:**

Once you have developed your question, you need to identify your variables.

**The Manipulated Variable (MV):** What you are deliberately changing. **Remember to use metric units.**

**The Responding Variable (RV):** The variable that will change in response to the manipulated variable changing. How are you going to measure this variable?

**Controlled Variables:** Remember you must keep all the variables the same except the variable that you have planned to change or manipulate. Try to identify everything that could affect your responding variable, and make sure they are controlled, or stay constant so they don’t affect your responding variable. Example: If you are testing whether fertilizer affects how tall a plant grows, you would want to make sure that the amount of sunlight stays the same, they all receive the same amount of water, and they are all growing in the same temperature. All of these could affect how tall the plant grows, so they must all stay the same.

**Hypothesis:**

Your hypothesis is your educated guess about what will happen. Write your hypothesis in the ‘If-then-because’ format:

If the \_\_\_\_\_\_\_\_MV\_\_\_\_\_\_ changes/increases/decreases, then the \_\_\_\_\_\_\_\_RV\_\_\_\_\_\_\_\_\_ will

change/increase/decrease because…….

Examples:

Does fertilizer make my plants grow taller?

Investigative question: Does the amount of fertilizer affect how tall my plants grow?

MV: The amount of fertilizer

RV: How tall the plants grow

Controlled variables: amount of sunlight, amount of water, temperature, water/fertilizer schedule.

Control Group: Plant that is treated exactly like the other plants, except it does not receive any fertilizer.

Hypothesis: If the amount of fertilizer increases then the height of the plants will increase because …

Will a heavier toy car travel further than a lighter car?

Investigative question: Does the weight affect the distance a toy car travels?

MV: The weight

RV: Distance the car travels

Controlled Variables: Same toy car, weight is added in the same place, same track

Control Group: Car that is treated exactly like the other cars, except it does not have any weight added.

Hypothesis: If more weight is added to the toy car, then the distance the car travels will increase because…

**WRITING A SCIENTIFIC PROCEDURE**

The procedure is a step by step account of what will be done during your experiment. It is instructions that will be followed as you conduct your experiment.

When writing your procedure; think about the following:

* Is my procedure one which I will be able to complete? Will I have all of the materials needed and the ability to gather the data I desire?
* Have I identified my manipulated variable? Do I provide instructions on how to manipulate the variable within my experiment?
* Have I identified my responding variable? Does my procedure state how I will measure it? If I am using a scale, (1-10) make sure the scale is explained (1 is light, 10 is heavy).
* What are my controlled variables? Does my procedure specifically state how I will control these variables?
* Have I indicated what data I want to collect and how I would like to collect this data? Have I used metric units?
* **Have I repeated my trials, to show that the data I have collected is valid?**
* If I have complex instructions, have I included drawings or diagrams which will help make my procedure more understandable?
* Is my procedure reproducible? Can someone else use my procedure to conduct the same exact experiment?



**RUN A CONTROLLED EXPERIMENT AND RECORD YOUR DATA**

Before you begin your experiment, while writing your procedure, you should decide what type of data you are going to collect during the experiment. Make sure that you have all data tables, charts, etc. prepared BEFORE you begin experimentation.

Use your science log/journal for recording all measurements and observations. **Record/log information on a daily basis** and consider the following items:

* Make sure that accurate metric measurements are given in your data. Give masses in grams, volumes in milliliters, and linear measurements in centimeters or meters.
* It is better to have TOO MUCH data than not enough, so keep a lot of notes. Keep track of more than you think you will need.
* When making an observation, write down the date and time.
* Keep track of materials used, their quantities and cost.
* Consider taking photographs to be used in your research paper or as part of your display.
* You should record any new and unexpected events, reactions and questions which occur to you.
* Include any problems you have had and how you solved them.
* You could include sketches, diagrams, or charts.

C:\Users\linda.barnes\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\OR6822H7\MC900250132[1].wmf

**WRITING YOUR SCIENCE FAIR REPORT**

It is important to be able to share your project with others. One way to share information is in written form. Here are some guidelines for writing the science fair research report. An example of a report is in the appendix.

The research paper should be typed with double spacing. It should include:

* A **TITLE PAGE** which should include your topic, your name, school’s name, grade, teacher, city, state, and zip code.
* **TABLE OF CONTENTS** which tells your audience what your report include on each page.
* **ABSTRACT** – A short (250 words or less) summary of your experiment.
* **PURPOSE** - This is a statement of what you plan to do or your question which you are going to investigate. You should include a hypothesis as to what you think the outcome will be.
* **ACKNOWLEDGEMENTS** – This is a section where you identify people who have helped you during your project.
* **RESEARCH** – Here is where you discuss the information you found during your research period. Tell the reader what you know about your subject, be an expert on your subject.
* **MATERIALS AND PROCEDURE** – Describe the materials you used and then provide a step-by-step explanation of how you conducted the experiment. Include drawings or photographs to help clarify your procedure.
* **DATA** – This is where you share the data that you have collected. You must include your data table and one or more graphs/charts.
* **RESULTS/CONCLUSION** – In this section you will interpret your data, findings and results. Refer back to your question and answer the question. Also, indicate whether or not your findings supported your hypothesis. **YOUR HYPOTHESIS DOESN’T HAVE TO BE RIGHT TO HAVE A GOOD EXPERIMENT.**
* **BIBLIOGRAPHY** – List the books, magazines, pamphlets, or other communications you used to research your topic. See next page.

**WRITE AN ABSTRACT**

An abstract is a short summary giving the most important information about your exhibit. A good abstract should identify the most important aspects of your project and be written so that the reader knows your basic objective or hypothesis, how you designed your experiment, the results of your study, and the conclusions you have made. It should not exceed 250 words in length, but should contain the following information:

* Title
* Objective or hypothesis: The objective, theme, or central idea of your exhibit. What is the basic question you had in mind when you started your project? What was your educated guess regarding your experimentation?
* Methods: A summary of the procedures that were used in the experiment.
* Results: Discuss your data. Compare your results with theoretical values, published data and or expected results.
* Conclusion: Briefly summarize your results. Be specific, do not generalize. Was the objective successfully completed?

**WRITING A PROBLEM OR PURPOSE SECTION**

* What was the purpose? The purpose of this investigation was to find out……….
* Why did you become interested in the experiment?
* Will the information be useful to anyone? The information gained will help others…..

**WRITING A RESEARCH SECTION**

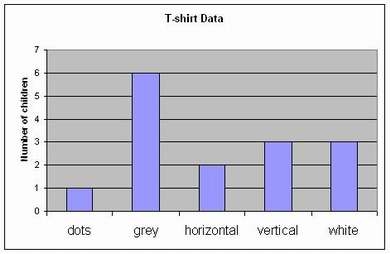
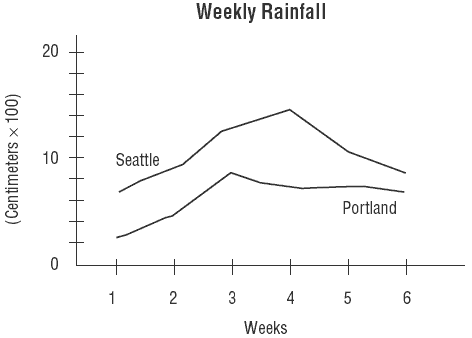
What is the background information needed to make a hypothesis? What do you need to know about the subject? Research the subject. Become an expert on your subject. Tell the reader about it. For example if your questions is about how fast different shapes of ice melt you will need to learn background information on ice, melting and surface area. Pictures, labeled drawings, charts and graphs always help the reader understand the subject.

**ILLUSTRATE YOUR RESULTS/DATA WITH GRAPHS AND CHARTS**

Your daily log of observations will be the best means for sharing the data and information collected during the experiment. Charts and graphs will provide a fine way to share data in an easy to read and understandable fashion. They are also very good to include in both your report and your display. Charts and graphs give your audience a visual representation of the data you have collected.

There are different kinds of charts and graphs. Here are some examples:

**BAR GRAPH LINE GRAPH**

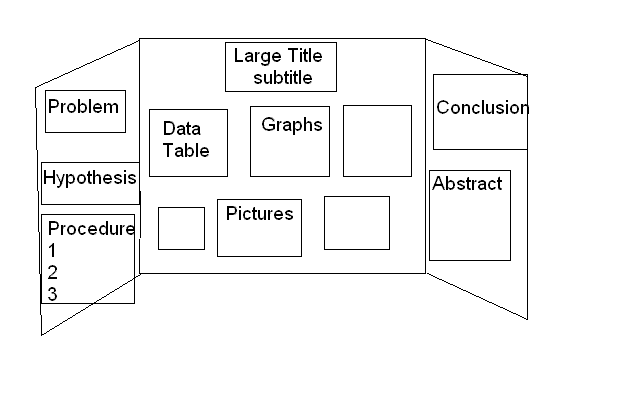
**WRITING A CONCLUSION/RESULTS SECTION**

Discuss the results of your experiment.

* Answer the investigative question.
* Write about the high and low data.
* How was the data different between different trials?
* Did the data confirm what you expected from your research?
* How were your results affected by unexpected events?
* What would you do differently if you repeated this experiment?

**CONSTRUCT AN EXHIBIT OR DISPLAY**

This is a visual way to communicate to others information about the experiment that you have completed. Take your time and do a good job – if you catch your audience’s eye with a nice display, you have the opportunity to impress them with your investigation. Make it bright and interesting to catch the readers eye, but, keep it simple with large print so it is easy to read



Required Items:

Title Question Hypothesis

Materials List Procedure Data Tables and Graphs

Conclusion Bibliography Abstract

Keep the following in mind:

* Construction should be durable and sturdy. Use stiff cardboard, plywood, or other materials to construct your display.
* Labeling should be clear, neat and informative. It does not have to be typed, but it should be neat. Make sure all the labels are correctly spelled.
* Make explanations clear and large enough to read.
* Use photos, diagrams, charts and graphs – these things convey a lot of information in a small space and are worth many words.
* Use color to catch your audience’s attention.
* Look online for examples of display boards. One site is: http://school.discoveryeducation.com/sciencefaircentral/Science-Fair-Presentations/How-to-create-a-Winning-Science-Fair-Display-Board.html
* If someone helped you, give them credit on the board: my mother grew the geranium plants for me. **No names.**
* **DO NOT write your name on the front of the board. Do not include pictures of people.**

**Appendix 1: Example Data Sheet**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **(TITLE)** Does a Plastic Bag Trap Heat? | | | | | |
| **(RV)** Temperature (°F) | | | | | |
| (MV)Bag/No Bag | Time (minutes) | T1 | T2 | T3 | Ave |
| Thermometer  1  Plastic Bag | 0 |  |  |  |  |
| 5 |  |  |  |  |
| 10 |  |  |  |  |
| 15 |  |  |  |  |
| 20 |  |  |  |  |
| 25 |  |  |  |  |
| 30 |  |  |  |  |
|  | | | | | |
| Thermometer  2  No  Plastic Bag | 0 |  |  |  |  |
| 5 |  |  |  |  |
| 10 |  |  |  |  |
| 15 |  |  |  |  |
| 20 |  |  |  |  |
| 25 |  |  |  |  |
| 30 |  |  |  |  |

**Appendix 2: How to Create a Bibliography**

A bibliography is a listing of the resources and references that you have used during the research of your project. It should include information about the magazines, books, internet sources, and interviews you have used in your report. That information is organized so that interested readers could seek out and find the same information that you used in your report.

One of the Science Fair requirements is a bibliography of at least **FIVE** sources you read when researching information about your specific Science Fair project. Remember that you need to research your topic so you can make an educated hypothesis. Your bibliography should not include references to material you read when researching what your project should be. For example, you would not reference the Discovery Channel website that you looked over for ideas for a project.

This is what a real completed bibliography page looks like. Just move all your citation (references), in alphabetical order. Notice that a few of these citations don’t have all of the possible information included in them. That is normal. If some of the information about a source doesn’t apply or is not given, you just leave it out. Make sure you end each citation with a period EXCEPT citations for web sites. The period messes up the web address.

Bibliography

Barnes, Linda. “How to write a Bibliography.”

E-mail to Julie Nelson. 11 November 2012.

Central intelligence Agency. “Albania.”

The World Factbook 2010. April 2, 2011.

http;//www.odci.gov/cia/factbook/al.html

Dretzka, Gary. “Bellagio Casino puts the emphasis on elegance and romance.” Knight-Ridder/Tribune News

Service. December 7, 2010.

Peterson, Joseph. Reptiles and Amphibians.

Holt, Rinehart and Winston, 2009.

Vedder, Eddie. Face to Face Interview. 23 December 2011.

**Citation Examples for the Bibliography**

**Book – one author**

Author’s name. Title of the Book. City: Publishing Co.,

Copyright date.

Reeves, Diane Lindsey. Career Ideas for Kids Who Like Math.

New York: Facts on File, 2000.

**Pamphlet – Treat a pamphlet as you would a book.**

Author. Title. City; Publisher, copyright.

OR  
Title. City: Publisher, copyright.

**Newspaper Article**

Author. “Title of Article.” Name of Newspaper Day Month Year,

Edition: section page numbers.

Montieth, Mark. “Trade Allows Miller to Take More Shots.”

Indianapolis Star 25 Feb. 2002, city ed.: D1.

**Magazine Article**

Author. “Title of Article.” Name of Magazine. Date.

Austin, Anne. “Explore Your Possibilities.” Career World.

Feb/March 2002.

**Internet Site**

Title of project database. Name of editor or project or database (if given). Date or latest update,

Name of sponsoring institution or organization. Date of access and internet address.

Space Career. 24 Feb. 2002, Spacelinks. 27 Feb. 2002

<http://www.spacelinks.com/SpaceCareers/index.shtlm>.

OR

Davis, Kim. “Best Jobs and Best Moves for 2002.”

Ebony Jan. 2002. Electric Library Elementary.

Bigchalk.com, Inc. 27 Feb. 2002.

<http://wwwelibrary.com/s/k6/search.cgi?id>=.

**E-mail**

Last name of writer, First name. “Title of message.”

E-mail to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Day Month Year.

**Interview**

Last name of person interviewed, first name. Type of interview.

Day Month Year interview took place.

**Appendix 3: Example Completed Experiment Report**

**COMPLETED EXPERIMENT REPORT**

|  |  |  |
| --- | --- | --- |
| **QUESTION/PURPOSE:** **Manipulated Variable (MV)** **Responding Variable(RV)**  Will different amounts of sugar in a sugar syrup (MV) affect how much water moves out of an egg through the membrane (RV)? | | |
| **HYPOTHESIS (IF, THEN, BECAUSE)** **:** **Manipulated Variable (MV)** **Scientific Reason (WHY)**  **Responding Variable (RV)**  If I increase the amount of sugar in a sugar syrup, then the amount water that moves out of the egg through the membrane will increase because water moves through a permeable membrane from a high water/low solute solution to a low water/high solute concentration. | | |
| **Manipulated Variable Units**  Amount of sugar in a sugar syrup. | **Responding Variable Units**  Amount water that moves out of the egg | **Controlled Variable(s) Units**  Same temperature water and sugar solution; same amount of solution; same time intervals; same age eggs, same environment. |
| **PROCEDURES: Manipulated Variable (MV)**  **Responding Variable (RV)**  **Controlled Variable(s)**  **Repeated Trials**  **Logical Steps**     1. Put 1 uncooked egg in each jar, make sure each jar is the same 2. Fill jar with vinegar 3. Wait 24 hours until eggshells have dissolved 4. Rinse eggs and jars. 5. Put one egg back in each jar 6. Place eggs in groups of three 7. Place an numbered index card under each jar, with each group having three consecutive numbers, starting with the 100% solution as number 1, 2 and 3 8. Mix solution    1. Jars 1, 2, 3: 100% : 200 ml of Karo syrup    2. Jars 4, 5, 6: 75%: 150 ml of Karo syrup and 50 ml water    3. Jars 7, 8, 9: 50%: 100 ml Karo syrup and 100 ml of water    4. Jars 10, 11, 12: 25%: 50 ml cup Karo syrup and 150 ml water    5. Jars 13, 14, 15: 0%: 200 ml of water 9. Weigh each egg and record on data table. 10. Pour sugar solutions over eggs until they reach the line below the rim. All three jars in a group have the same % solution 11. Set timer for 15 minutes 12. In 15 minutes, use spoon to remove egg, rinse egg with water if needed, dry on towel, and weigh. Record weight on data table. Repeat for each egg in number order. 13. Repeat every 15 minutes until 9 readings are recorded. | | **MATERIALS Measuring Device**   * 15 eggs * Vinegar * 15 small jars, all the same * Sugar syrup (Karo) * Distilled water * Index cards numbered 1-15 * Timer * Scale * Spoons * 2 cup measuring cup * Kitchen towels |

|  |
| --- |
| **DATA TABLE: Title (Manipulated vs. Responding) Trials**  **Units Averages**  **TITLE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Data table is attached.** |
| **Conclusion:**  My hypothesis was correct. As the amount of sugar in the sugar syrup increased, the amount of water leaving the egg through the membrane increased. When I used no sugar (distilled water) the egg gained an average of 4% of its weight. When I used a 100% sugar solution (Karo Syrup) the egg lost an average of 24% of its weight. When I used the highest amount of sugar, the egg gained 28% more water than in a zero sugar solution. |

**Data Table**

Chicken Egg Membrane Osmosis Data Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Egg # | Trial | Corn Syrup | 0 min | 15 min | 30 min | 45 min | 60 min | 75 min | 90min | 105min | 120 min | Water Loss/  Gain | % Water Loss |
| 1 | T1 | 100% | 72.1g | 68.2g | 64.8g | 62.5g | 60.7g | 59.2g | 57.7g | 56.4g | 55.5g | 16.9g | 23% |
| 2 | T2 | 100% | 78.1g | 73.6g | 69.5g | 66.9g | 64.8g | 63.0g | 61.3g | 59.9g | 58.6g | 19.5g | 25% |
| 3 | T3 | 100% | 70.3g | 66.4g | 63.2g | 60.7g | 58.7g | 57.0g | 55.2g | 53.8g | 52.6g | 17.7g | 25% |
|  | Ave | 100% |  |  |  |  |  |  |  |  |  |  | **24%** |
| 4 | T1 | 75% | 71.1g | 66.4g | 63.0g | 60.8g | 59.2g | 58.g | 56.7g | 55.5g | 54.4g | 16.7g | 24% |
| 5 | T2 | 75% | 70.9g | 67.7g | 64.5g | 62.5 | 60.8g | 59.5g | 58.2g | 57.0g | 55.8g | 15.1g | 22% |
| 6 | T3 | 75% | 70.5g | 67.4g | 64.5g | 62.5 | 60.9g | 59.7g | 58.6g | 57.5g | 56.6g | 13.9g | 20% |
|  | Ave | 75% |  |  |  |  |  |  |  |  |  |  | **22%** |
| 7 | T1 | 50% | 73.4g | 69.9g | 66.4g | 64.4 | 62.6g | 61.3g | 60.2g | 59.1g | 58.1g | 15.3g | 21% |
| 8 | T2 | 50% | 84.4g | 78.1g | 73.5g | 70.6 | 68.2g | 66.3g | 64.7g | 63.1g | 61.7g | 22.7g | 27% |
| 9 | T3 | 50% | 78.3g | 73.8g | 69.8g | 67.3 | 65.1g | 63.6g | 62.1g | 60.8g | 59.3g | 19g | 24% |
|  | Ave | 50% |  |  |  |  |  |  |  |  |  |  | **24%** |
| 10 | T1 | 25% | 75.9g | 73.2g | 70.5g | 68.9 | 67.7g | 66.8g | 65.8g | 65.0g | 64.3g | 11.6g | 15% |
| 11 | T2 | 25% | 77.1g | 74.2g | 71.8g | 70.2 | 68.8g | 67.8g | 66.7g | 65.7g | 64.9g | 11.4g | 15% |
| 12 | T3 | 25% | 77.2g | 74.6g | 72.2g | 70.63 | 69.0g | 68.1g | 67.1g | 66.0g | 65.2g | 12.0g | 16% |
|  | Ave | Ave |  |  |  |  |  |  |  |  |  |  | **15%** |
| 13 | T1 | Distilled Water | 73.9g | 75.2g | 76.0g | 76.4 | 76.6g | 76.7g | 76.9g | 76.9g | 76.8g | +2.9g | +4% |
| 14 | T2 | Distilled Water | 67.8g | 69.3g | 70.2g | 70.5 | 70.8g | 71.1g | 71.2g | 71.2g | 71.3g | +3.2g | +4% |
| 15 | T3 | Distilled Water | 71.2g | 72.6g | 73.5g | 73.8 | 74.1g | 74.3g | 74.4g | 74.4g | 74.4g | +3.2g | +4% |
|  | Ave | Distilled Water |  |  |  |  |  |  |  |  |  |  | **+4%** |

**Appendix 4: Example Report**

Chicken Egg Membrane Osmosis

Mrs. Nelson

Desert Hills Middle School

Sponsor – Parent

Kennewick, WA 99338

Chicken Egg Membrane Osmosis

by

Julie Nelson

ABSTRACT

I wanted to find out if a chicken egg membrane would act like the permeable membranes I learned about in biology class. I learned that water moved through a membrane in a process called osmosis. The question I was trying to answer was: Will different concentrations of a solution of sugar syrup and water affect how much water moves through the membrane in 120 minutes? My hypothesis was: If the concentration of sugar syrup increases (more sugar), than the egg will lose more weight because water moves through a water permeable membrane from high water/low solute content to low water/high solute content. I used 4 different concentrations of Karo sugar solution, 100%, 75%, 50% and 25%. The control was distilled water. I dissolved the eggshells in vinegar, then rinsed off of the eggs and placed them in their sugar syrup solutions. Every 15 minutes for 2 hours I removed the eggs, rinsed them off, dried them and then weighed them. My hypothesis was partially correct. I expected each lower concentration of syrup to have less water loss. The eggs in the 100% and 50% solution lost the most weight, an average of 24% of their original weight. The eggs in the 25% solution lost the least, an average of 15% of their original weight. I think the reason the unexpected results is the water the eggs lost through the membrane diluted the syrup solution, the more water the eggs lost, the more dilute the solution became.

**WILL DIFFERENT CONCENTRATIONS OF A SOLUTION OF SUGAR SYRUP AND**

**WATER AFFECT HOW MUCH WATER MOVES INTO OR OUT OF THE EGG**

**THROUGH THE MEMBRANE IN 120 MINUTES?**

**TABLE OF CONTENTS**

**SCIENTIFIC QUESTION / PURPOSE pg #**

**ACKNOWLEDGEMENTS pg #**

**PURPOSE – HYPOTHESIS pg #**

**REVIEW OF LITERATURE pg #**

**MATERIALS pg #**

**PROCEDURE pg #**

**RESULTS (DATA COLLECTION) pg #**

**CONCLUSION pg #**

**BIBLIOGRAPHY pg #**

**SCIENTIFIC PURPOSE / QUESTON**

Will different concentrations of a solution of sugar syrup and water affect how much water moves into or out of the egg through the membrane in 120 minutes?

**HYPOTHESIS**

If the concentration of sugar syrup increases (more sugar), than the egg will lose more

weight because water moves through a water permeable membrane from high water/low solute content to low water/high solute content.

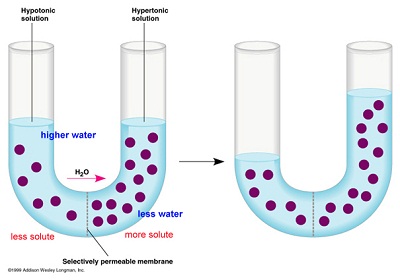
**REVIEW OF LITERATURE**

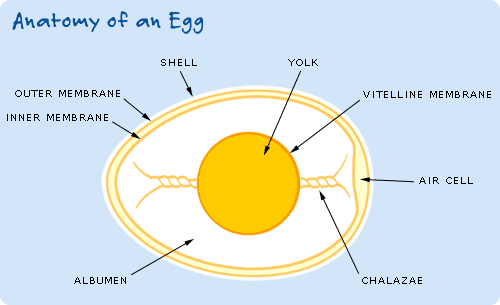
DIFFUSION, OSMOSIS AND MEMBRANES

Membranes are barriers which regulate the movement of substances through them. A membrane has pores, or holes, that allow certain molecules to move through them, while excluding others, depending on their sizes. This is called selective permeability. Most movement of substances across membranes occurs passively as diffusion. The diffusion of water across a membrane is called osmosis.

Substances diffuse through the membrane from areas of high concentration to areas of low concentration. When a substance is more concentrated on one side of the membrane than the other, there is a tendency for the substance to diffuse across the membrane from areas of high concentration to areas of low concentrations, assuming that the substance is able to pass through the pores in the membrane.

The U-shaped tubes below illustrate this principle. Each side of the tube is connected by a permeable membrane which allows water, but not the solute (a dissolved substance such as sugar or salt) to pass through. In the first tube, the right hand side has more molecules of a dissolved solute than the left hand side. Because the right hand side has more molecules of solute than the left side, it has less molecules of water than the left side. The water moves through the membrane from a higher water concentration on the left to an area of lower water concentration on the right. The end result is the right hand U-tube. Both sides have the same amount of water, but the since the membrane pores are too small for the solute to cross, the right hand side of the tube still contains more molecules of solute.





Underneath a chicken eggshell is selectively permeable membrane. The membrane allows oxygen and carbon dioxide molecules to pass through the membrane to and from the growing chick. It also protects the interior of the egg from bacteria. This membrane can be exposed by dissolving the eggshell in an acid such as vinegar.

By making a solution of water and sugar syrup I would be creating a solution that is low water/high solute (dissolved sugar) compared to the inside of the egg. If the egg membrane is permeable, water should move from the egg to the water/sugar syrup solution because the egg has a high water/low solute compared to the sugar solution. I would like to know if the concentration of the sugar syrup solution affects how much water crosses the membrane from the egg to the solution over a 2 hour period of time. I can measure this water loss by weighing the egg before putting it in the water/sugar syrup solution, and then weighing every 15 minutes for 120 minutes.

**Materials:**

* 15 eggs
* Vinegar
* 15 small jars, all the same
* Sugar syrup (Karo)
* Distilled water
* Index cards numbered 1-15
* Timer
* Scale
* Spoons
* 2 cup measuring cup
* Kitchen towels

**Procedure:**

1. Put 1 uncooked egg in each jar, make sure each jar is the same
2. Fill jar with vinegar
3. Wait 36 hours until eggshells have dissolved
4. Rinse eggs and jars.
5. Put one egg back in each jar
6. Place eggs in groups of three
7. Place an numbered index card under each jar, with each group having three consecutive numbers, starting with the 100% solution as number 1, 2 and 3
8. Mix solution
   1. Jars 1, 2, 3: 100% : 200 ml of Karo syrup
   2. Jars 4, 5, 6: 75%: 150 ml of Karo syrup and 50 ml water
   3. Jars 7, 8, 9: 50%: 100 ml Karo syrup and 100 ml of water
   4. Jars 10, 11, 12: 25%: 50 ml cup Karo syrup and 150 ml water
   5. Jars 13, 14, 15: 0%: 200 ml of water
9. Weigh each egg and record on data table.
10. Pour sugar solutions over eggs until they reach the line below the rim. All three jars in a group have the same % solution
11. Set timer for 15 minutes
12. In 15 minutes, use spoon to remove egg, rinse egg with water if needed, dry on towel, and weigh. Record weight on data table. Repeat for each egg in number order.
13. Repeat every 15 minutes until 9 readings (0 time and 2 hours) are recorded.

**Results**

I wanted to know if the concentration of a sugar syrup solution would affect how much water crosses a chicken egg membrane. In this experiment I measured how much water an egg lost through its membrane into a sugar syrup solution. I dissolved the eggshells from chicken eggs which exposed the permeable membrane. I placed the eggs into different percent solutions of Karo syrup and water. I measured the weight of the eggs every 15 minutes for 2 hours. The 100% Karo sugar syrup solution had the lowest water/highest solute concentration (the solute is dissolved sugar). In this solution, the eggs lost more water than in the 75% and 25% solution, but the same as in the 50% solution. The eggs lost an average of 24% of their original weight. In the 75% solution, the eggs lost a little less water, an average of 22% of their original weight. In the 50% solution, the eggs lost the same water as in the 100% solution, an average of 24%. This average percentage seems to be skewed by egg #8, which lost 27% of its original weight. The eggs in the 25% solution lost the least water, an average of 15% of their original weight. The distilled water solution was absorbed by the eggs, they gained 4% of their original weight. Since the distilled water had no solutes, it had a higher water/lower solute concentration than the eggs and the osmosis moved in the reverse direction, from the solution into the eggs. The concentration of the sugar syrup clearly affected how much water left the egg through the membrane. The higher the concentration of sugar syrup, the more water left the egg.

I expected the highest concentration of sugar syrup solution to have the highest water loss from the egg, with each decreasing concentration to have less water loss. Instead, the 50% solution had a higher percentage of water loss than the 75% solution, in fact the average percent water loss was the same as the 100% solution. I believe this was caused by the sugar solution being diluted by the water passing through the membrane from the egg into the sugar syrup solution. I came to this conclusion after evaluating the data and seeing that each progressive measurement resulted in less water loss than the previous measurement. In a future experiment, I would replace the solution each time I measured the eggs, ensuring that the percentage of sugar in the solution remained constant. When I was done with the experiment, I felt that measuring the weight every 15 minutes was unnecessary, that a final weight at the end of the two hours was all that was needed. But if I had not recorded the weights every 15 minutes, I would have not seen the pattern of less water loss as time progressed. For future experiments, since the solution is being replaced every 15 minutes, measuring the weight each time is adding more data to the experiment.

**Chicken Egg Membrane Osmosis Data Table**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Egg # |  | Corn Syrup | 0 min | 15 min | 30 min | 45 min | 60 min | 75 min | 90min | 105min | 120 min | Water Loss/  Gain | % Water Loss |
| 1 | T1 | 100% | 72.1g | 68.2g | 64.8g | 62.5g | 60.7g | 59.2g | 57.7g | 56.4g | 55.5g | 16.9g | 23% |
| 2 | T2 | 100% | 78.1g | 73.6g | 69.5g | 66.9g | 64.8g | 63.0g | 61.3g | 59.9g | 58.6g | 19.5g | 25% |
| 3 | T3 | 100% | 70.3g | 66.4g | 63.2g | 60.7g | 58.7g | 57.0g | 55.2g | 53.8g | 52.6g | 17.7g | 25% |
|  | Ave | 100% |  |  |  |  |  |  |  |  |  |  | **24%** |
| 4 | T1 | 75% | 71.1g | 66.4g | 63.0g | 60.8g | 59.2g | 58.g | 56.7g | 55.5g | 54.4g | 16.7g | 24% |
| 5 | T2 | 75% | 70.9g | 67.7g | 64.5g | 62.5 | 60.8g | 59.5g | 58.2g | 57.0g | 55.8g | 15.1g | 22% |
| 6 | T3 | 75% | 70.5g | 67.4g | 64.5g | 62.5 | 60.9g | 59.7g | 58.6g | 57.5g | 56.6g | 13.9g | 20% |
|  | Ave | 75% |  |  |  |  |  |  |  |  |  |  | **22%** |
| 7 | T1 | 50% | 73.4g | 69.9g | 66.4g | 64.4 | 62.6g | 61.3g | 60.2g | 59.1g | 58.1g | 15.3g | 21% |
| 8 | T2 | 50% | 84.4g | 78.1g | 73.5g | 70.6 | 68.2g | 66.3g | 64.7g | 63.1g | 61.7g | 22.7g | 27% |
| 9 | T3 | 50% | 78.3g | 73.8g | 69.8g | 67.3 | 65.1g | 63.6g | 62.1g | 60.8g | 59.3g | 19g | 24% |
|  | Ave | 50% |  |  |  |  |  |  |  |  |  |  | **24%** |
| 10 | T1 | 25% | 75.9g | 73.2g | 70.5g | 68.9 | 67.7g | 66.8g | 65.8g | 65.0g | 64.3g | 11.6g | 15% |
| 11 | T2 | 25% | 77.1g | 74.2g | 71.8g | 70.2 | 68.8g | 67.8g | 66.7g | 65.7g | 64.9g | 11.4g | 15% |
| 12 | T3 | 25% | 77.2g | 74.6g | 72.2g | 70.63 | 69.0g | 68.1g | 67.1g | 66.0g | 65.2g | 12.0g | 16% |
|  | Ave | 25% |  |  |  |  |  |  |  |  |  |  | **15%** |
| 13 | T1 | Distilled Water | 73.9g | 75.2g | 76.0g | 76.4 | 76.6g | 76.7g | 76.9g | 76.9g | 76.8g | +2.9g | +4% |
| 14 | T2 | Distilled Water | 67.8g | 69.3g | 70.2g | 70.5 | 70.8g | 71.1g | 71.2g | 71.2g | 71.3g | +3.2g | +4% |
| 15 | T3 | Distilled Water | 71.2g | 72.6g | 73.5g | 73.8 | 74.1g | 74.3g | 74.4g | 74.4g | 74.4g | +3.2g | +4% |
|  | Ave | Distilled Water |  |  |  |  |  |  |  |  |  |  | **+4%** |

**Conclusion**

I got the idea for this experiment from a book about science fair projects. I had learned about permeable membranes and osmosis in a biology class, but had not seen a demonstration of the principles. I thought it would be very interesting to see if the egg membrane would act the way I learned membranes were supposed to act.

My hypothesis was partially correct. The amount of sugar solution did affect the amount of water that left the egg, but the 50% solution had the same percentage of water loss as the 100% solution. The largest loss was from the 100% and 50% solution, those eggs lost an average of 24% of their original weight. The 25% solution had the least loss at an average of 15% of the eggs original weight. The egg in the distilled water (the control group) gained an average of 4% of its original weight. The eggs in the 100% solution lost an average of 9% more than the eggs in the 25% solution.

My experiment was a partial success, the 100% solution had the highest average percent loss, tied with the 50% solution, and the 25% had the lowest average water loss. The control group gained water. I think that the experiment would have been more successful if I had replaced the sugar syrup solution each time I weighed the eggs, as I believe that the water from the eggs diluted the solutions. I am interested in following up with experiment by experimenting to find out if replacing the solution every 15 minutes changes the results. I would also like to experiment with different sized solutes to try to find out the size of the pores in the membrane.

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**Appendix 4: Example Display Board**

Problem:

I learned about permeable membranes and osmosis in a biology class, but had not seen a demonstration of the principles. Animal membranes are permeable to water in a process called osmosis. In osmosis water moves from areas of high water/low solute concentrations to area of low water/high solute concentrations. Underneath an eggshell is a permeable membrane. I thought it would be very interesting to see if the egg membrane would act the way I learned membranes were supposed to act. The question I was trying to answer in my experiment was: Will different concentrations of a solution of sugar syrup and water affect how much water moves through the membrane in 120 minutes?

Hypothesis and Procedure”

From report.

Large Title and Subtitle:

CHICKEN EGG MEMBRANE OSMOSIS

Will different concentrations of a solution of sugar syrup and water affect

how much water moves through the membrane in 120 minutes?

Data Table and Graphs:

From report.

Pictures:

Of the equipment and experiment – NOT YOU! No pictures of the people involved.

Conclusion:

My hypothesis was partially correct. The amount of sugar solution did affect the amount of water that left the egg, but the 50% solution had the same percentage of water loss as the 100% solution. The largest loss was from the 100% and 50% solution, those eggs lost an average of 24% of their original weight. The 25% solution had the least loss at an average of 15% of the eggs original weight. The egg in the distilled water (the control group) gained an average of 4% of its original weight. The eggs in the 100% solution lost an average of 9% more than the eggs in the 25% solution.

My experiment was a partial success, the 100% solution had the highest average percent loss, tied with the 50% solution, and the 25% had the lowest average water loss. The control group gained water. I think that the experiment would have been more successful if I had replaced the sugar syrup solution each time I weighed the eggs, as I believe that the water from the eggs diluted the solutions. I am interested in following up with experiment by experimenting to find out if replacing the solution every 15 minutes changes the results. I would also like to experiment with different sized solutes to try to find out the size of the pores in the membrane.

Abstract:

From report.

**Appendix 5: Scoring Rubric**

**DHMS Science Fair Rubric 2012-2013**

Scientific Question

Question is stated 1

Question is detailed 1

Question is testable 2

Question guides the experiment 1

Possible Points **5** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Hypothesis

Hypothesis is stated 1

In if-then-because format 1

Hypothesis is testable 1

Hypothesis is based on research 2

Possible Points **5** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Materials List

Includes measurement tools 1

Measurement is metric 1

Includes sizes and amounts 2

Is complete 1

Points Possible **5** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Experimental Procedures

Procedure is detailed 3

Procedure is sequential 3

Procedure is complete 4

Points Possible **10** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Data

All data is clearly and correctly

labeled with units, symbols, etc. 2

Data was measured accurately 2

Data is complete 2

Data table is present and complete 2

Data is displayed in graph/diagram 3

Data is clearly result of experimental

procedure. 2

Data measured by student 2

Points Possible  **15 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Interpretation and Conclusions

Was the hypothesis correct/incorrect 2

High and low data discussed 6

Variations between trials 4

Discusses unexpected events 1

Discusses changes for future

experiments 2

Points Possible **15** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Written Report

Scientific Question 2

Hypothesis 2

Research 4

Materials and Procedure 4

Data Table 2

Graph 2

Results 4

Conclusion 4

Bibliography 1

Possible Points **25** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Display

Neat (straight lines/cuts, spelling) 3

Visually appealing 2

Contains all required parts 3

Contains only relevant material 2

Possible Points **10** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Oral Presentation

Between 3 and 5 minutes 2

Addresses materials and procedure 1

Addresses results 2

Demonstrates understanding

of subject and experiment 3

Well prepared and practiced 2

Points Possible **10** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**TOTAL POINTS POSSIBLE 100 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**