

# Participating in Science & Engineering Fairs A Practical Approach



<http://edoutreach.wpafb.af.mil>

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**When Somebody Says  
“Science Fair”  
What’s The First  
Thought That Pops Into  
Your Head??**



# A Science Fair Is...



## If You're A Teacher:

- A Tool
- Something To Grade On
- A Creative Outlet for Students

## If You're A Parent:

- Stressful...it's a PAIN!!
- Conflicts...Helplessness
- Potential Source of Pride

## If You're A Student

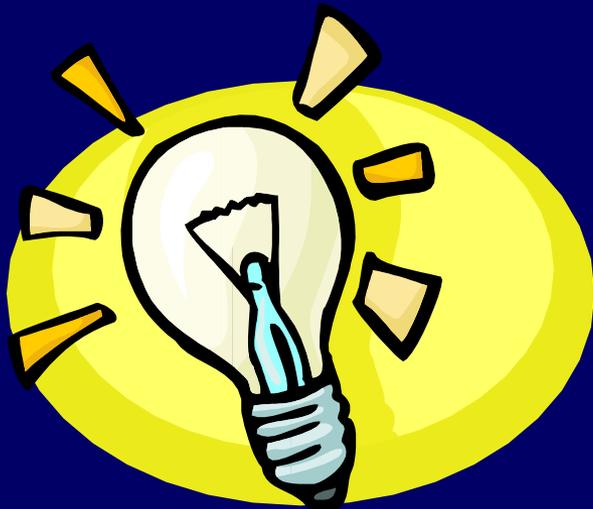
- A Requirement For A Grade
- More Work!!
- Too Many Decisions!!!
- Fear Of Unknown

# What SHOULD You Think Of?



## How You Will Feel After Participating In The Science Fair

- **Pride...Not Relief!**
- **Rewarded...Not Punished!**
- **Reward is an Honorable Goal!!**
- **Motivator Doesn't Always Have To Be Grades!**



***If It Motivates You...  
Work for the Rewards!!!***

***The Important Results  
Will Be By-Products!!***

# A Science Fair Project Is An Opportunity!!

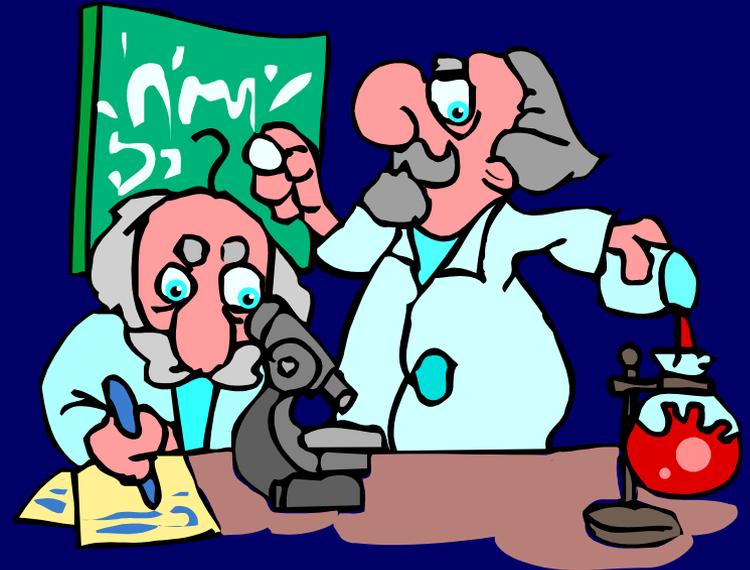


## Lots of Awards!

- Prizes
- Money
- Scholarships
- Summer Jobs
- Entry Into Select Colleges

## By Products:

- Organization Skills
- Critical Thinking Skills
  - Quote Facts, Not Hearsay
- Presentation Skills
- Sense of Self



# The “Recipe” For A Classic Science Fair



If You've Never “Cooked” Before,  
There's A Lot Involved in Baking A Cake!!



## Preparation:

- Do You Have All The Ingredients You Need?
- Do You Have All Right Tools?

## Process:

- Follow The Recipe
- Do Things Step-By-Step
- Leave the Fancy Stuff to the Chefs!!

# The Science Fair Recipe



**QUESTION**

**RESEARCH**

**HYPOTHESIS**

**PROCEDURE**

**EXPERIMENT**

**RESULTS**

**ANALYSIS**

**CONCLUSION**



**Scientific Method**

# Question – Tailor Your Project To You!!



- **Consider Your**
  - **Interests**
  - **Knowledge Base**
  - **Access to Mentors**
  - **Available Equipment**
  - **Natural Surroundings**
- **Make A List of Each**
  - **Look For Matches Between Rows**



**STEP #1 - QUESTION**

# Take A Good Look At Your List!



INTERESTS	KNOWLEDGE/ SKILLS	MENTOR	EQUIPMENT/ SURROUNDING
BASKETBALL	MATH	MARY – CHEMISTRY	RULERS
COMPUTER	COMPUTER GAMES	JIM – GARDENING	SCALES (BATH, FOOD, POSTAL)
BUILDING	DRIBBLING BASKETBALL	BOB – ELECTRONICS	THERMOMETERS
LEGOS	BUILDING THINGS	JANE – MECH ENG	FISH TANK
SWIMMING		BETTY – NURSE	BLOOD PRESSURE MONITOR
BIKING		ROY - PAINTER	STOP WATCH
MEDICINE			VIDEO CAMERA
			LEVEL
			RUBBER BANDS
			PRESSURE GAUGES

**STEP #1 - QUESTION**



# *I Like Basketball, Roy Has Ladders, I have Pressure Gauges...I Wonder How High a Basketball Will Bounce Under Different Pressures?*

INTERESTS	KNOWLEDGE/ SKILLS	MENTOR	EQUIPMENT/ SURROUNDING
BASKETBALL			
COMPUTER	COMPUTER GAMES		SCALES (BATH, FOOD, POSTAL)
	DRIBBLING BASKETBALL		
LEGOS	BUILDING THINGS	JANE – MECH ENG	
		BETTY – NURSE	BLOOD PRESSURE MONITOR
MEDICINE		ROY - PAINTER	PRESSURE GAUGES

**STEP #1 - QUESTION**

# I Like Computers and Medicine. I'm Good at Computer Games. My Friend Betty is a Nurse and Has a Blood Pressure Monitor. I Wonder If Playing Computer Games Raises Your Blood Pressure?



INTERESTS	KNOWLEDGE/ SKILLS	MENTOR	EQUIPMENT/ SURROUNDING
BASKETBALL			
COMPUTER	COMPUTER GAMES		SCALES (BATH, FOOD, POSTAL)
	DRIBBLING BASKETBALL		
LEGOS	BUILDING THINGS	JANE – MECH ENG	
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MEDICINE		ROY - PAINTER	PRESSURE GAUGES

**STEP #1 - QUESTION**

# Question – Developing the Best Question For You



## • Websites To Spark Ideas:

- <http://www.stemnet.nf.ca/sciencefairs/>
- <http://www.scifair.org/ideas/index.shtml>
- [http://www.dwusciencefair.com/science\\_project\\_links.php3](http://www.dwusciencefair.com/science_project_links.php3)
- [http://madsci.org/MS\\_search.html](http://madsci.org/MS_search.html)
- <http://youth.net/nsrc/sci/sci.index.html>
- <http://ipl.org/div/kidspage/projectguide/projects.html>
- <http://scitoys.com/>

# Research – Get A Notebook!



- **Make A Commitment To Document Your Work**
- **Research Underlying Scientific Principles:**
  - **To Help Make Educated Guess To Answer Your Question**
  - **To Define the Test Design**
- **Internet Searches Are Great... But Don't Forget Books and People!!**
  - **More on This Later!!**



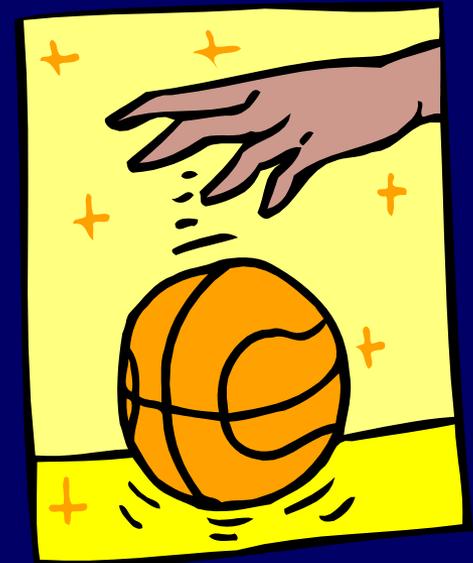
# Hypothesis

- **The Hypothesis Rewords Your Question In A Way To Help You Do Your Test**
  - **Predict the Answer, State Your Reason, If Possible**
  - **Select Projects With Well Formed Hypothesis**
- **Special Cases - Engineering Projects**
  - **Recommendation: Always Have Hypothesis Listed On Poster Board, Regardless of Its Quality**

# Hypothesis- Basketball Example:



- I'm Going to Drop My Basketball With Different Air Pressures... What Do I Think Is Going to Happen?
- My Hypothesis: I Expect That My Basketball Will Bounce Higher At Higher Air Pressure
  - A "Plus" Would Be To Speculate "WHY?"
- Then, Start To Visualize Your Graphs That Will Answer Your Question



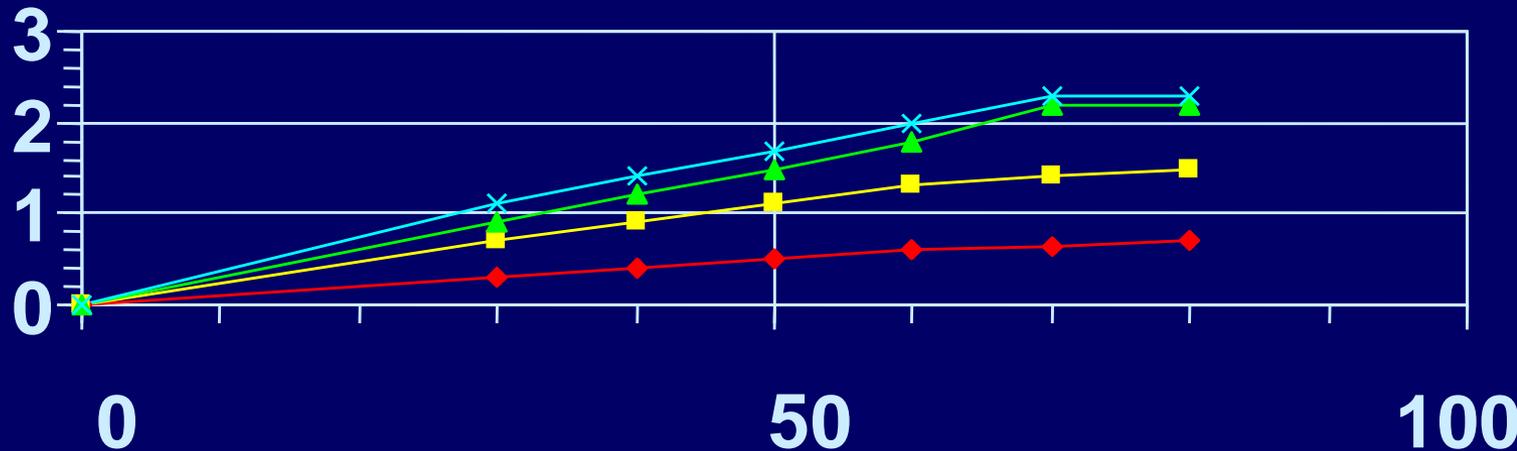
# Thinking of Your Ultimate Product, Your Graph, Focuses Your Plan



## Bounce Height for Various Basketball Pressures and Drop Heights

—◆— 1 Meter —■— 2 Meter —▲— 3 Meter —×— 4 Meter

Bounce Height in Meters



Ball Pressure in Kilopascals

# Procedure/Experiment – Design Is Critical

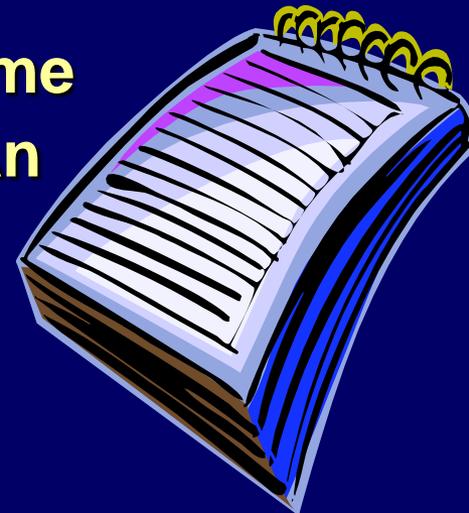


- **Experiments Should Result in Data That Can Be Displayed in a Graph**
  - **Imagine Steps to Gathering Data to Put Dots on Graph – That is Your Procedure**
  - **Remember That You Will Need To Record The Data...How Will That Data Arrive?**
  - **How Long Will Data Point Stay Valid?**
  - **What Measurement Tools Do You Need?**
    - **Video Camcorders Can Help Slow Time**

# Advice on Gathering Data:



- **Do A Control Group**
  - The 'NORM" You'll Compare Your Data To
  - Design and Use Your Own Data Sheet
  - Perform Multiple Data Runs
- **Reduce Your Variables**
  - Change Only Those That Are Under Test...Keep EVERYTHING Else The Same
  - Document Anything That Might Have An Impact (Somebody Opened The Outside Door and Let Cold Air In... The Bounce of The Ball Changed...)

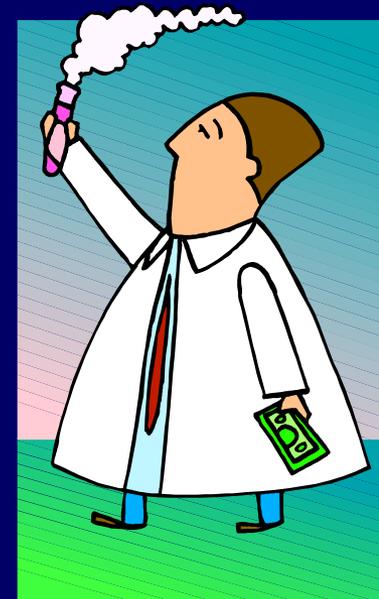




# Results – Perform The Experiment



- **The Better You Plan, The Simpler The Test!**
- **Record All Testing – Even Failures**
  - **Do A Control Group**
  - **Record All Conditions**
  - **Record Qualitative Data Like Noises/Smells**
  - **Control Your Variables Except What is Under Test**
  - **Record Measuring Tool And Units Of Data**
  - **Label Each Data Run By Time Of Day**
  - **Take Pictures Of Test Setup, If Possible**



**STEP #6 - RESULTS**

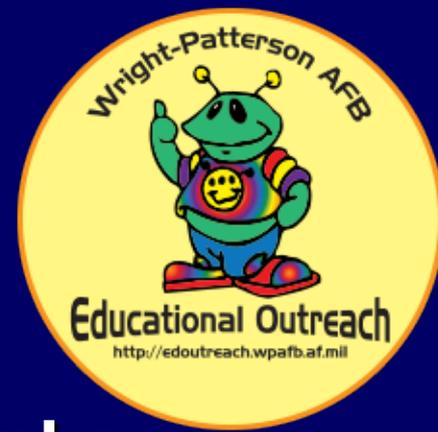
# Analysis – Have No Fear!!



- **You Analyze The Data By Putting It in the Graph**
  - **Ask Questions of the Graph...Linear? Slope? Intercept? Maximum? Minimum?**
  - **Report any Interesting Answers**
  - **Indicate Reproducibility of Data - Show Multiple Runs on Graphs...or Use Statistics**
  - **Use Different Graphs to Show Different Features**
  - **Spreadsheets Are Powerful Tools**
  - **Don't Be Afraid To change Axis Of Graph! Data Can Be Worked in a Variety of Ways**



**STEP #7 - ANALYSIS**

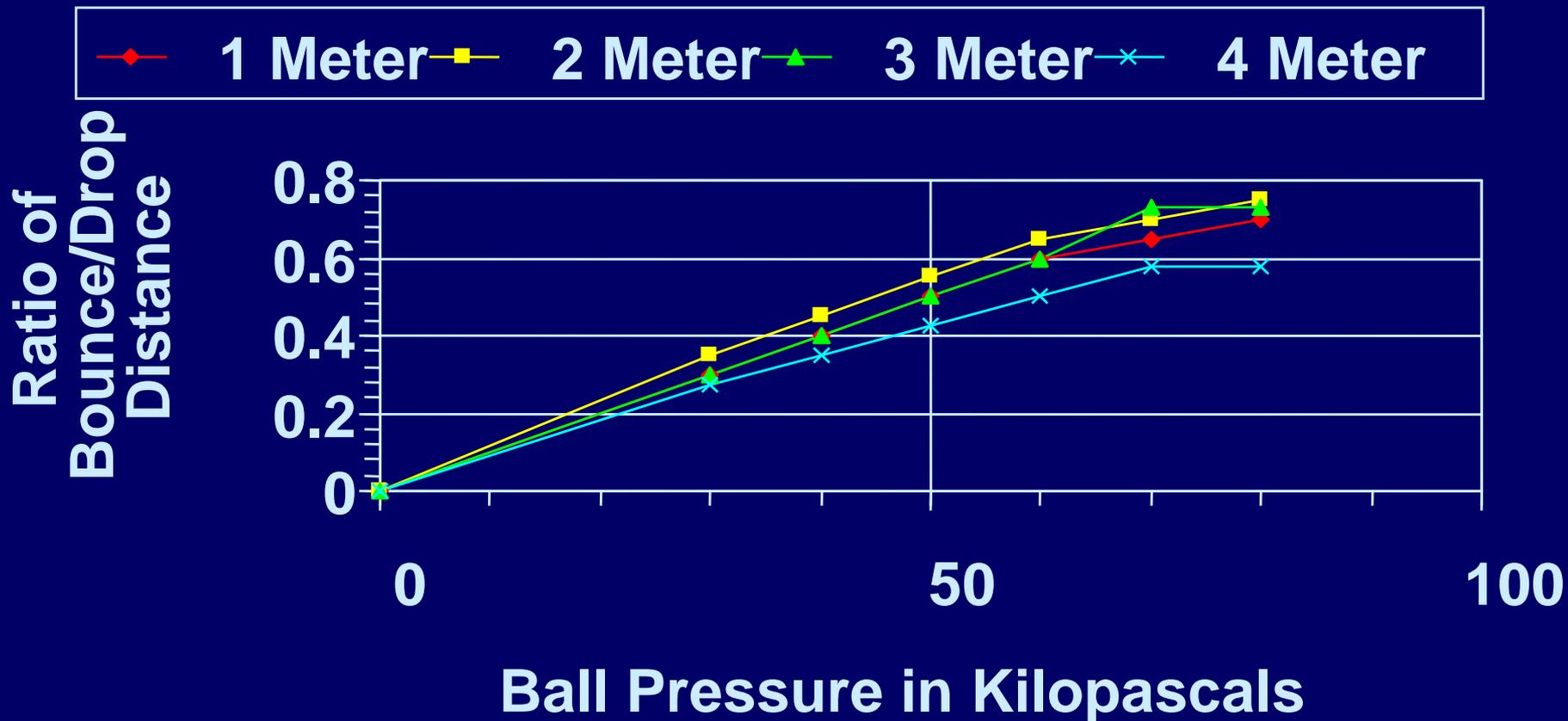


# Back To Basketball...

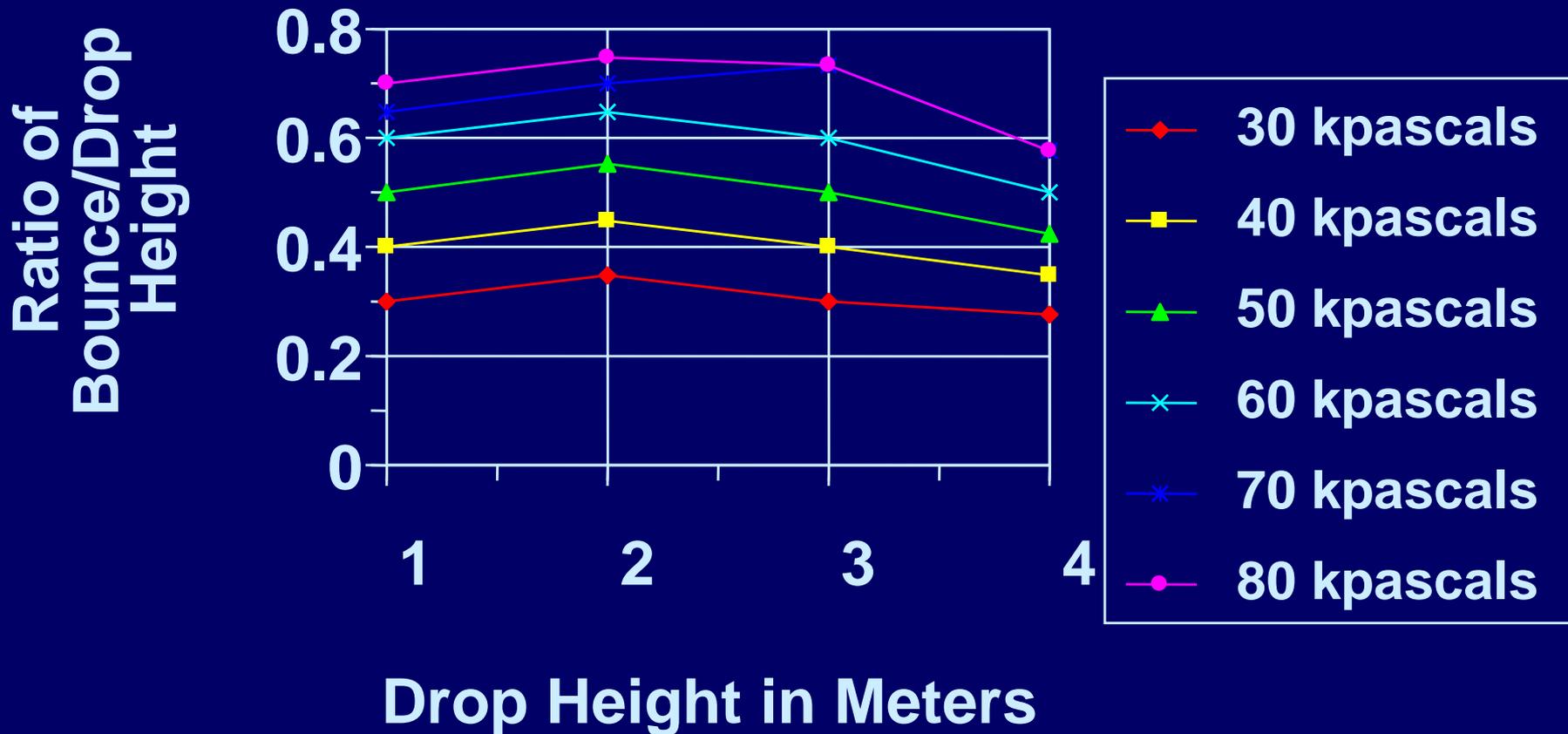
- Here Is Same Data In Two New Graphs Which Results In New Understanding
- This Is An Example Of Graphical Analysis



# Bounce Ratio Versus Ball Pressure For Various Drop Heights



# Bounce Ratio Versus Drop Height For Various Ball Pressures





# Conclusion

- **Your Conclusion is a Summary Focused On Answering Your Question/Hypothesis**
  - **If Your Hypothesis Was Incorrect or Disproved, It is NOT a Failed Experiment!**
  - **If Your Hypothesis Was Disproved, Offer An Alternative Explanation**
  - **Always Consider What More Could Be Done**
    - **Another Test**
    - **Another Project**

# How To Use “PEOPLE” In Your Research:



- You Can Have Numerous Mentors Based On Their Expertise!
- Start With Specific Questions
  - Tell Them What You're Doing and What You Think Will Work
  - Ask If You Can Ask Them More Questions
- Scientists and Engineers Love An Occasional Diversion...Like YOU!!
- Many Experts Can Be Found On the Internet
  - Make Sure Your Parents Know!

I'd Be Glad  
To Assist!!!



# Checklist – What To Ask Yourself and/or Your Mentor

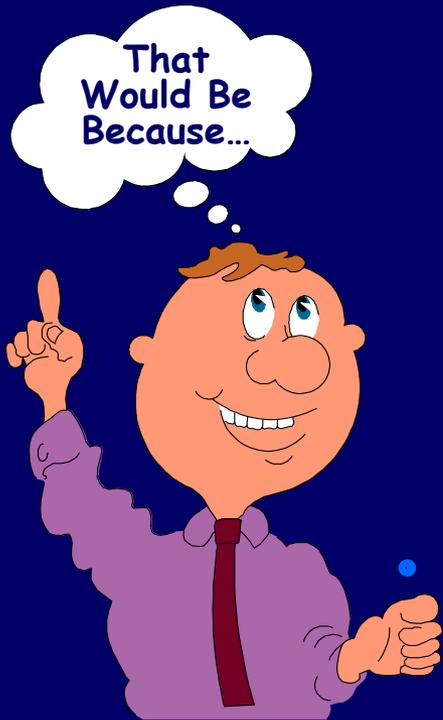


- ✓ **How Do I Analyze?**
  - ✓ **Use A Graph**
  - ✓ **Use Statistics**
- ✓ **How Much Data Should I Take?**
  - ✓ **One Run Is Not Enough!**
  - ✓ **Do At Least Three (3)**
- ✓ **How Do I Define My Experiment?**
  - ✓ **Start With Your Question**
  - ✓ **Envision Graphs That Answer Your Question**
  - ✓ **Envision Collecting Data to Put The “Dots” on the Page**
  - ✓ **Develop Data Sheet**

# Prepare For Presentation:



- The Focus Should Be Knowledge ... But In A Science Fair **IMPRESS THE JUDGES!!**
  - Anticipate Questions The Judge Will Ask
  - Research The Answer
  - Make Yourself A Note Card
  - Practice Reciting The Answer So It Sounds Natural
- Use your Poster As A Big Note Card
  - Use Topics/Key Words to Stimulate Discussion
  - Don't Forget to Explain Your Graph!!



# NO FEAR!! Practice Your Presentation



- **Use Flash Cards To Practice What You Want To Say**
  - **It Helps You With Things You Should Know Under Pressure (And Might Not Remember...)**
  - **Anticipate Questions!**
- **It Also Adds To Your Knowledge Base!**



# Preparing For The Judges:



- Expect Questions
- Have Your Answers Ready For Expected Questions
- Work Your Answers In If Not Asked
- Make Sure You Provide Information in Judging Category:
  - Knowledge Achieved
  - Originality





# Typical Questions:

- Where did the idea for this project come from?
- What did you learn from your research?
- What were the most important sources used in your research?
- How much time did you spend on the project? What took most of your time?
- Where did items used in your project come from?
- How many times did you run the experiment on each configuration?
- Did you use any statistics such as averaging?
- How constant were your conditions during experiments?
- What would you do differently? What more would you like to do?

# Selling Yourself – Use PIE!



- **Performance**
- **Image**
- **Exposure**



- **Science Fairs Are A GREAT Time To Learn How To Promote Yourself**
- **Many Successful People Use PIE Principle**
- **“Performance” Already Covered**
- **Look At Image And Exposure...**



# Image – The Impression You Give in Appearance and Actions:



- **You Want The Judges To Relate To You And See Their History In YOUR Future!**
  - **Project The Image Of Being A Budding Scientist Or Engineer**
  - **Dress Like They Would Dress**
  - **Show Them You Enjoy What You're Doing...Tell Anecdotal Stories of What Happened, Extra Stuff You Learned**
  - **Ask Questions**
  - **Play To Their Expertise...Ask How You Could Do Better In The Next Fair**

# Exposure – Make Sure The Judges See You and Remember You:



- **Use Attention Grabbing Displays and Posters**
  - **Check the Rules!!!**
- **For Maximum “Traffic”, Pick A Project Related To Today’s Public Concerns**
  - **Understand the Issue, Consider Being an Advocate**
  - **Examples: Global Warming, Acid Rain, Failed Levies, Pollution, Earthquake Protection, Water Purification, Security Devices, Genetically Altered Foods, Etc...**



# Motivation - Many Opportunities Await!



- **That Future Exceptional Science and/or Engineering Student Can Be You!!**
- **Summer Jobs, Free Training, Camps and More Are Available Through Science Fairs!**
- **Places To Check:**
  - **Ohio Academy of Science**  
<http://www.ohiosci.org/>
  - **International Science and Engineering Fair...**  
***Make Participation in this Fair Your Goal!***  
<http://www.sciserv.org/isef/>

# Motivation - Many Opportunities Await!



## More Places To Check Out:

- **Junior Science and Humanities Symposium**
- <http://www.jshs.org/>
- **ISEF, International Science and Engineering Fair**
- <https://student.societyforscience.org/intel-isef>
- **National Youth Science Camp**
- [http://www.nysf.com/w/programs/National Gallery](http://www.nysf.com/w/programs/National%20Gallery)
- **for America's Young Inventors**
- <http://www.nmoe.org/gallery/apply.htm>

**IT REALLY WORKS!!!!**

# Did We Mention “Having Fun”? :

- People Throughout History Experimented with Science and Engineering “For Fun”
- Imagine Getting Paid For Doing Something You Enjoy Doing!!
- To Avoid Stress:
  - Start Your Project Early, Be Ready... then Kick Back and Enjoy!!





# I HOPE TO SEE YOU AT A SCIENCE AND ENGINEERING FAIR





# For Additional Information:

## WPAFB Educational Outreach Office

- (937) 656-2273
- (937) 904-8033 fax
- email: [afri.wsc@us.af.mil](mailto:afri.wsc@us.af.mil)

ask for Bob Gemin

- Website – <http://edoutreach.wpafb.af.mil>



# AFRL

THE AIR FORCE RESEARCH LABORATORY  
LEAD | DISCOVER | DEVELOP | DELIVER



# Check Out Our "Scopes For Students" Program!!

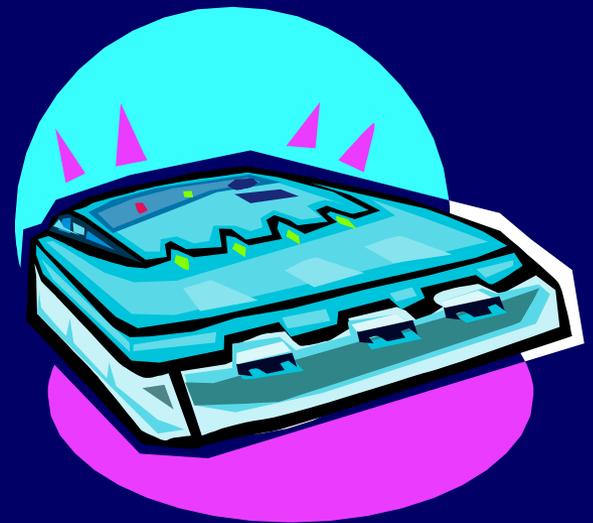
**Thanks To A Grant From  
The Armed Forces  
Communications and  
Electronics Association  
We Can Loan You  
Specialized Equipment to  
Use With Your Science  
Fair Project!!!**



**PICK UP A FLYER!!**

# "Scopes For Students"

- **Digital Oscilloscopes Help You Measure A Variety of Parameters In Your Experiment**
- **Measurements are Taken at Small Intervals so You Can Catch What Happens In An Instant!**
- **Data is Recorded in Files That Can Be Analyzed Using MS Excel**
- **Instructions on Equipment Operation Are Provided'**



# Types of Sensors:

- Accelerometers
- Barometers
- Conductivity Probe
- Current Probe
- Dual Range Force Sensor
- EKG Sensors
- Force Plate
- Gas Pressure Sensor
- Light Sensor
- Magnetic Field Sensor
- Microphone
- pH Sensor
- Relative Humidity
- Respiration Monitor Belt
- Temperature Probes
- Thermocouple
- UV Sensor
- Voltage