

Successfully Developing and Practicing Science Research Presentations

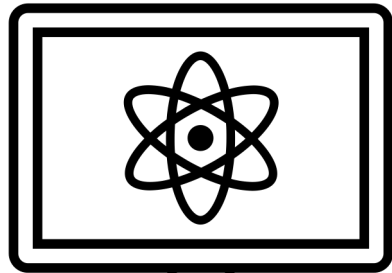
William Furiosi

Research Teacher, Oviedo High School

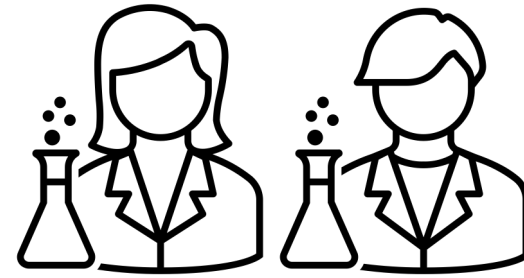
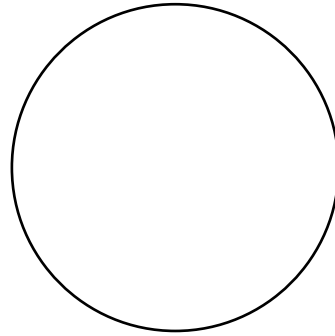
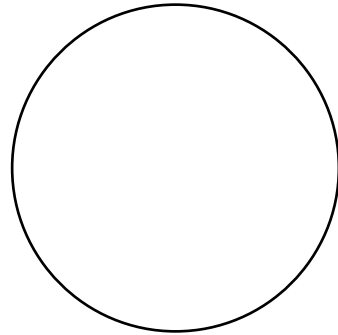
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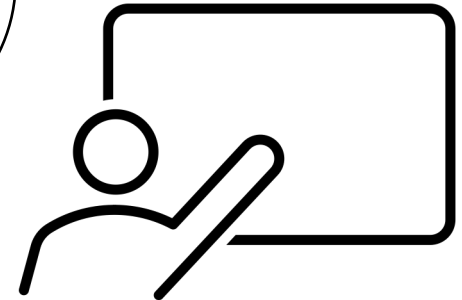
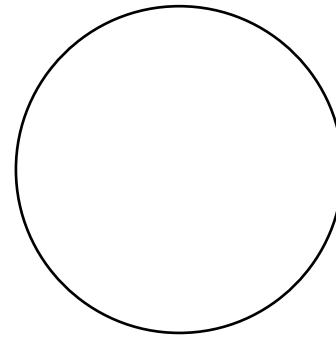
Overview



Research Posters



Judges



Research Presentations

Value of Developing Presentations

- The ISEF judging criteria establishes over **one-third (35%)** of the points to the **"Presentation"**
- **"Presentation"** includes...
 - Poster (10 points)
 - Interview (25 points)

Judging Criteria for Engineering Projects

I. Research Problem (10 pts)

- ___ description of a practical need or problem to be solved
- ___ definition of criteria for proposed solution
- ___ explanation of constraints

II. Design and Methodology (15 pts)

- ___ exploration of alternatives to answer need or problem
- ___ identification of a solution
- ___ development of a prototype/model

III. Execution: Construction and Testing(20 pts)

- ___ prototype demonstrates intended design
- ___ prototype has been tested in multiple conditions/trials
- ___ prototype demonstrates engineering skill and completeness

IV. Creativity (20 pts)

- ___ project demonstrates significant creativity in one or more of the above criteria

V. Presentation (35 pts)

a. Poster (10 pts)

- ___ logical organization of material
- ___ clarity of graphics and legends
- ___ supporting documentation displayed

b. Interview (25 pts)

- ___ clear, concise, thoughtful responses to questions
- ___ understanding of basic science relevant to project
- ___ understanding interpretation and limitations of results and conclusions
- ___ degree of independence in conducting project
- ___ recognition of potential impact in science, society and/or economics
- ___ quality of ideas for further research
- ___ for team projects, contributions to and understanding of project by all members

Judging Criteria for Science Projects

I. Research Question (10 pts)

- ___ clear and focused purpose
- ___ identifies contribution to field of study
- ___ testable using scientific methods

II. Design and Methodology (15 pts)

- ___ well designed plan and data collection methods
- ___ variables and controls defined, appropriate and complete

III. Execution: Data Collection, Analysis and Interpretation(20 pts)

- ___ systematic data collection and analysis
- ___ reproducibility of results
- ___ appropriate application of mathematical and statistical methods
- ___ sufficient data collected to support interpretation and conclusions

IV. Creativity (20 pts)

- ___ project demonstrates significant creativity in one or more of the above criteria

V. Presentation (35 pts)

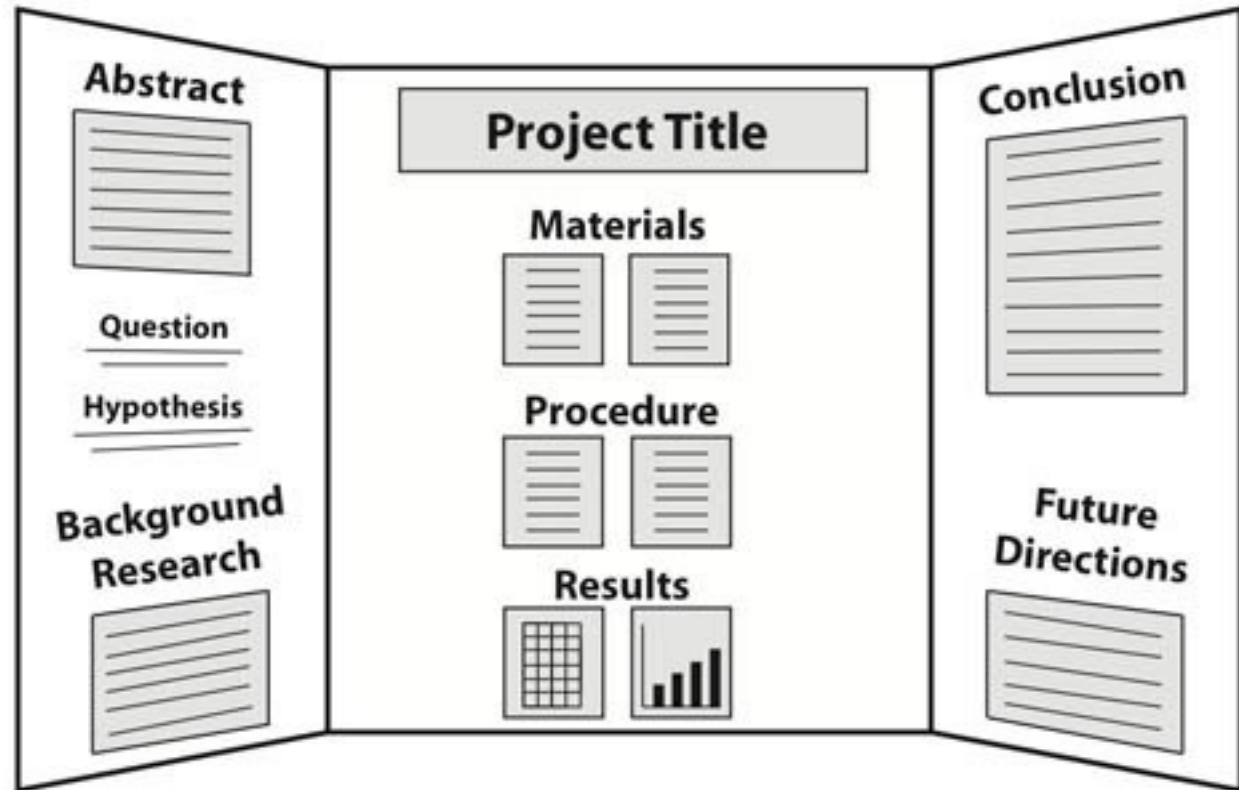
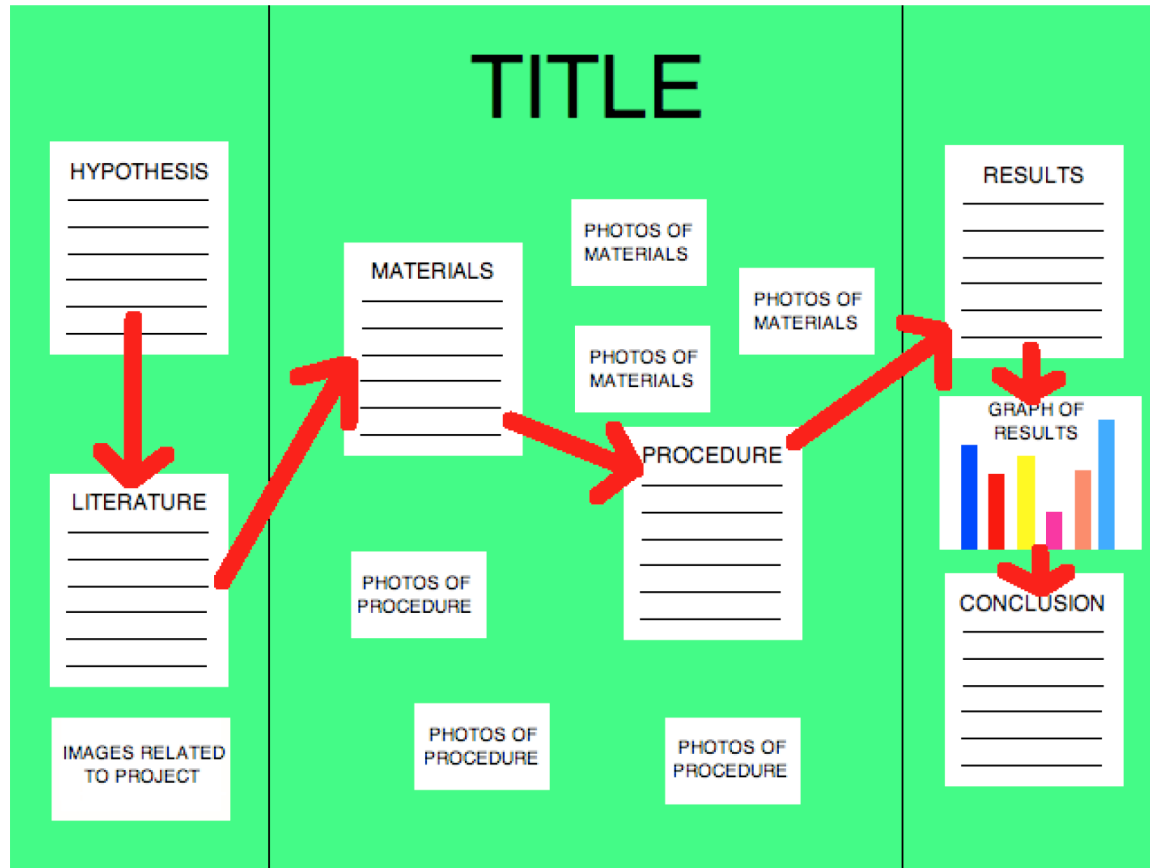
a. Poster (10 pts)

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Research Posters: The Problem



Research Posters: General Tips

- Important information should be readable from about **6-10 feet away**
- Title is **short** and draws interest
- **Word count is minimal**
- Text is clear and to the point
- **Use of bullets, numbering, and headlines** make it easy to read
- Effective use of graphics, color and fonts
- Consistent and clean layout

(NYU Libraries)

QUESTIONS TO ASK YOURSELF

What is the **most important/interesting/eye-opening** finding from my research project?

How can I **visually** share my research?

What kind of information can I convey during my talk that will **complement** my poster?

Research Posters

AREAS FOR IMPROVEMENT

Overview

Research Poster

Research Presentation

Judging

Recap



Abstract

Endocrine therapies using anti-estrogens are least toxic and very effective for breast cancers, however, tumor resistance to tamoxifen remains a stumbling block for successful therapy. Based on our recent study on the involvement of the DNA repair protein MGMT in pancreatic cancer (Clin Cancer Res. 15, 6087, 2009), here, we investigated whether MGMT overexpression mediates tamoxifen resistance. Specifically, we determined whether administration of MGMT inhibitor (O⁶-benzylguanine (BG)) at a non-toxic dose alone or in combination with the anti-estrogens (tamoxifen/fulvestrant) curtails human tamoxifen resistant breast cancer cell growth. Further, we also determined whether BG sensitizes breast cancers to tamoxifen using tamoxifen resistant cells.

MGMT expression was found to be a negative prognostic factor in breast cancer. In MCF-7 cells, MGMT levels were significantly higher in tamoxifen resistant MCF-7 compared to the parental cells. Silencing of the MGMT expression using a specific siRNA resulted in augmentation of MGMT mRNA and protein levels by 2 fold. We also observed an inverse correlation between MGMT and p53 levels in breast cancer cell lines; moreover, p53 downregulation was accompanied by increased MGMT expression. Western blot analysis showed that MGMT expression was increased in tamoxifen or fulvestrant resistant breast cancer cells. Tamoxifen or fulvestrant treatment decreased the same respectively. However, all these treatments increased the p21^{WAF1} mRNA and protein expression significantly. BG inhibited tamoxifen resistant breast cancer growth in a dose-dependent manner and it also sensitized resistant breast cancer cells to anti-estrogen therapy (TAM/ICI). These combinations also enhanced the cytochrome C release and the PARP cleavage, indicative of apoptosis. In breast cancer xenografts, BG alone or a combination of BG with tamoxifen or fulvestrant caused significant tumor growth delay and immunohistochemistry revealed that BG inhibited the expression of MGMT, ER- α , ki-67 and increased p21^{WAF1} staining. These findings suggest that MGMT inhibition may provide a novel and effective approach for overcoming tamoxifen resistance.

Introduction

Recent advances in breast cancer research have identified key pathways involved in the repair of DNA damage induced by alkylating agents and has a negative impact on therapeutic efficacy. A number of DNA-damaging alkylating agents attack the nucleophilic O⁶ position on guanine, forming mutagenic and highly cytotoxic interstrand DNA crosslinks. The DNA repair enzyme O⁶-alkylguanine DNA alkyltransferase (AGT), encoded by the gene MGMT, repairs alkylation at this site and is responsible for protecting both tumor and normal cells from alkylating agents. MGMT is expressed constitutively in normal cells and tissues. In breast tumors, MGMT gene expression is elevated and levels are up to 4-fold higher than in the normal breast. Interestingly, it has been shown that tamoxifen accelerates proteasomal degradation of MGMT in human cancer cells. In 1991, Pegg, Moschel, and Dolan observed that O⁶-benzylguanine (BG) inhibited AGT and potentiated the cytotoxicity of both chloroethylating agents and methylating agents. In a series of important observations, they showed that BG binds to the active site of AGT and its inhibition is very rapid and more potent than any other previously known AGT inhibitor. BG is not incorporated into DNA in living cells and reacts directly with both cytoplasmic and nuclear AGT. Because BG is a pseudosubstrate for MGMT which results in the covalent transfer of benzyl group to the active site of the enzyme, subsequent protein is degraded, thereby inactivating it. This stoichiometric reaction mechanism of BG with AGT has been used to study the role of AGT in DNA damage and repair. BG is currently undergoing clinical trials in various cancers to increase the efficacy of alkylating agents.

Interestingly, several observations suggest an inverse correlation between the levels of MGMT and p53 tumor suppressor proteins where wild-type p53 suppresses expression of human MGMT expression. Unfortunately, p53 function is often inactivated or suppressed in human cancers; therefore, restoration of wt-p53 activity is essential for the success of some treatments. However, whether or not this is mediated by suppression of MGMT has yet to be determined. To date, the cross-talk between MGMT and ER- α (the link to p53 expression) has not been explored in drug (i.e., tamoxifen) resistant breast tumors. The anti-estrogen tamoxifen is the most commonly used treatment for patients with estrogen receptor positive breast cancer. Although many patients benefit from tamoxifen in the adjuvant and metastatic settings, resistance to this endocrine therapeutic agent is an important clinical problem. The primary goal of present study was to investigate the mechanisms of anti-estrogen drug resistance and to design new therapeutic strategies for circumventing this resistance. The results show that MGMT expression is increased in TAM-resistant breast cancers and inhibition of MGMT by BG significantly improves TAM-sensitivity.

Results

Prolonged Treatment of Tamoxifen Increases MGMT Expression: We developed a tamoxifen resistant MCF-7 cell line by using prolonged treatment of tamoxifen on the parental ER-positive breast cancer cell line, MCF-7. Tamoxifen-resistant MCF-7 cells proliferate at rates similar to the parental MCF-7. Prolonged treatment of tamoxifen onto MCF-7 cells increased MGMT expression compared to parental MCF-7 cells 10.2 fold (Fig. 1).

Knocking Down ER α Enhances MGMT Expression in Tamoxifen Resistant Breast Cancer Cells: It is not known whether ER α and MGMT transcriptionally regulate each other in tamoxifen resistant breast cancer cells. We therefore investigated whether down regulation of ER α has any effect on endogenous MGMT expression in these cells. As expected, downregulation of ER α using specific siRNA significantly reduced ER α protein levels in these cells. Western blot analysis was performed and the results are shown in Fig. 2A. The left panel (Fig. 2A) shows that silencing of ER α increases MGMT expression. The right panel (Fig. 2A) shows that silencing of ER α increases MGMT expression. These data suggest that ER α -mediated signaling functions to repress MGMT gene expression in breast cancer cells.

Transcriptional Regulation Between MGMT and p53: Previously, it was reported that p53 negatively regulates MGMT in breast cancer cells. Therefore, we addressed whether or not silencing the p53 enhances endogenous MGMT transcription. Tamoxifen resistant MCF-7 cells were transfected with either p53 siRNA (p53-KD) (Fig. 2B) or MGMT siRNA (MGMT-KD) (Fig. 2D) along with Non-specific siRNA (NS). MGMT expression was consistently increased in p53 knock down cells, with different experiments showing a ~ fold augmentation (Fig. 2A) and as expected, knocking down MGMT decreased MGMT transcription. These results confirm that p53 can regulate MGMT at the transcriptional level.

MCF-7 cells
TAM resist. MCF-7

Figure 1. MCF-7 parental and tamoxifen resistant MCF-7 cell pellets were prepared, protein were isolated and MGMT expression was detected by western blot analysis. Tamoxifen resistant MCF-7 breast cancer cells significantly increased MGMT expression compared to MCF-7 parental cells.

O⁶-Benzylguanine Plays a Dual Role in Tamoxifen Resistant MCF-7 Cells: Contrasting with the experiments above, next, we studied whether or not knocking down MGMT has any effect on ER α transcription. As expected, knocking down MGMT decreased MGMT gene transcripts. However, it was interesting to find that ER α gene transcription was also reduced after MGMT silencing (Fig. 2E). These data demonstrate that BG has the ability to attenuate not only the MGMT, but also the ER α transcription, indicating a possible dual role for MGMT blockers in these breast cancer cells.

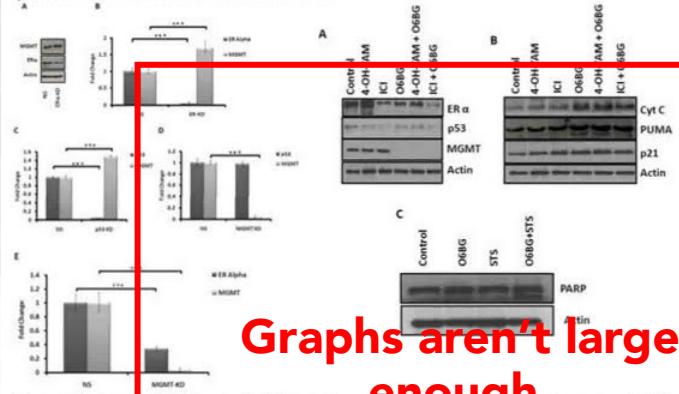


Figure 2. (A) Tamoxifen resistant MCF-7 cells were transfected with ER α siRNA (ER α -KD) and NS siRNA (NS) and cells were harvested 72h post treatment. Total proteins were isolated and ER α and MGMT expression was determined by western blot analysis. (B) Tamoxifen resistant MCF-7 cells were transfected with p53 siRNA (p53-KD) and NS siRNA (NS) and cells were harvested 72h post treatment. Total RNA was isolated and MGMT and ER α transcription was determined by qRT-PCR. (C) Total RNA was isolated from non-specific siRNA (NS) (100nM) and p53 siRNA (p53-KD) (100nM) treated MCF-7 breast cancer cells. MGMT and p21 transcription was determined by qRT-PCR. (D) Total RNA was isolated from non-specific siRNA (NS) (100nM) and MGMT siRNA (MGMT-KD) (100nM) treated MCF-7 breast cancer cells. MGMT and p53 transcription was determined by qRT-PCR. (E) Total RNA was isolated from non-specific siRNA (NS) (100nM) and p53 siRNA (p53-KD) (100nM) treated MCF-7 breast cancer cells. MGMT and p21 transcription was determined by qRT-PCR. These data suggest that MGMT expression is an inverse correlation between MGMT and p53 in tamoxifen resistant breast cancer cells (C & D).

O⁶-Benzylguanine Modulates p53 Down-Stream Targeted Protein Expressions: Encouraged by the results reported, we investigated the effect of combination therapy on endogenous MGMT, p53, and ER α protein expressions. As expected, BG decreased MGMT expression, while ER α and p53 expression were not affected. However, p21 and PUMA expression were increased and decreased respectively (Fig. 3A). We investigated the effect of BG on proteins which are involved in cell cycle regulation, apoptosis in tamoxifen resistant breast cancer cells. All these treatments significantly increased the p21^{WAF1} protein expression (Fig. 3B). PUMA expression was also increased with these treatments. Hence, PUMA may have translocated to the mitochondria, cytochrome C is released (Fig. 3C), and apoptosis was triggered in these cells in presence of combination therapy. PARP cleavage is seen in BG treated cells in presence of staurosporin as an indicator of apoptosis (Fig. 3C). Therefore, this data suggest that BG promotes cell cycle arrest and can induce apoptosis by modulating p53 function.

O⁶-Benzylguanine Modulated Transcriptional Targets in Tamoxifen Resistant Breast Cancer Cells:

The effect of combination therapy on endogenous MGMT mRNA levels was also studied. Quantitative real-time PCR (qRT-PCR) revealed that anti-estrogens (TAM/ICI) increased the MGMT expression while the combination therapy decreased it compared to control levels. ER α transcription was decreased compared to controls with all these treatments (Fig. 4A). Surprisingly, p21 and PUMA mRNA was significantly increased in the presence of combination treatments (Fig. 4B). These results suggest that MGMT expression is an inverse correlation between MGMT and p53 in tamoxifen resistant breast cancer cells (Fig. 3 & 4).

O⁶-Benzylguanine Enhances p21 Transcriptional Activity in Tamoxifen Resistant Breast Cancer Cells:

In order to investigate the effect of BG on p53 function, we performed luciferase reporter assays. Tamoxifen resistant MCF-7 breast cancer cells were transfected with p21 luc promoter construct in presence or absence of BG (target gene of p53). These results clearly demonstrate that BG significantly enhanced p21 transcriptional activity by 4.5 fold in these cells (Fig. 4D).

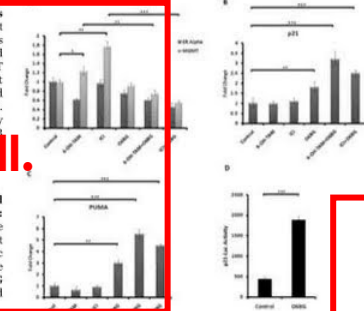


Figure 4. Tamoxifen resistant MCF-7 breast cancer cells were treated in presence or absence of BG and later 4-OH tamoxifen and ICI (100nM) was either alone or in combination with BG and cells were harvested and total RNA was isolated. (A) MGMT and ER α p21 transcription was determined by qRT-PCR. (B) 4-OH tamoxifen and ICI induces MGMT transcription in MCF-7 breast cancer cells. (C) Tamoxifen resistant MCF-7 breast cancer cells were transfected with p21-luc construct and 6h later treated with BG and 24h later cells were harvested. p21 transcription was significantly increased by BG in these cells.

O⁶-Benzylguanine Inhibits Tamoxifen Resistant Breast Cancer Cell Growth and Increase Resistant Breast Cancer Cell Sensitivity to Anti-Estrogen Therapy (TAM/ICI): Detailed necropsy revealed that all the mice had tumors in the breast. The data summarized in Table 1 show the daily BG alone or in combination with twice weekly tamoxifen/ICI significantly decreased median tumor volume and weight as compared with that seen in tamoxifen/ICI treated and control mice. The combination of BG with tamoxifen or ICI produced the greatest decrease in median tumor volume as compared with control mice (83.99 mm³, 9.33 mm³ (TAM+BG), respectively; p < 0.0001; (83.99 mm³, 31.60 mm³ (ICI+BG), respectively; p < 0.0001). Tumor weight was also significantly reduced in mice treated with combination therapy as compared with control mice (81.23 mg, 22.30 mg (TAM+BG), respectively; p < 0.0003; (81.23 mg, 51.57 mg (ICI+BG), respectively; p < 0.0003). (Table.1). Body weight was not changed among all treatment groups as compared with control mice. No visible liver metastases were present (enumerated with the aid of a dissecting microscope) in all treatment groups.

Histology and IHC Analysis: We next determined the *in vivo* effects of BG (alone or in combination) with tamoxifen/ICI. Tumors harvested from different treatment groups were processed for routine histological and IHC analysis. Tumors from mice treated with BG alone or in combination with tamoxifen/ICI exhibited a significant decrease in MGMT, ER α , ki-67 as compared with tumors treated with tamoxifen/ICI alone or control group. p53 expression was not much altered in these treatment groups. In sharp contrast, the expression of p21 was significantly increased in tumors from mice treated with BG either alone or in combination with tamoxifen/ICI. The images were analyzed by ImageJ (NIH) and MGMT, ER α , p53, p21 and ki-67 expressions were quantified by the Immunoratio plugin. (Fig. 5).

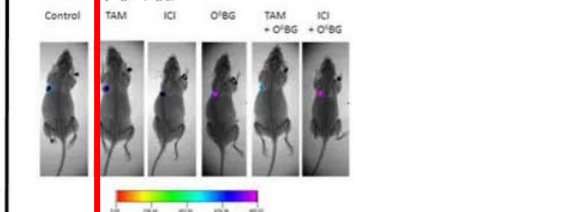
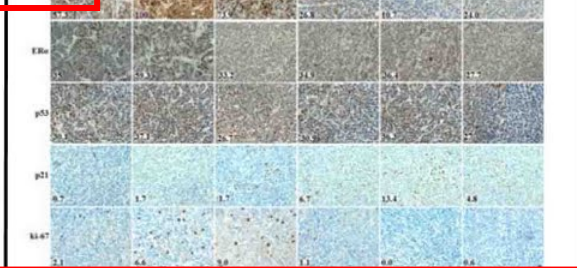
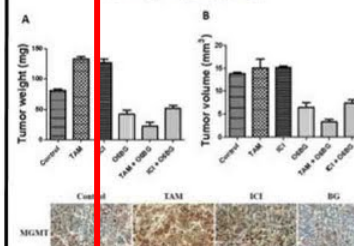


Figure 5. Tumors were harvested from control mice and mice treated with tamoxifen/ICI, BG, or both tamoxifen/ICI and BG. The sections were immunostained for expression of MGMT, ER α , p53, p21 and ki-67. Tumors from mice treated with BG either alone or in combination with tamoxifen or ICI had a significant decrease in the expression of MGMT, ER α and ki-67. p53 expression was not much altered in these treatment groups. In sharp contrast, expression of p21 was significantly increased in all these treatment groups compared to controls. Representative samples (40X) are shown.



Conclusions

1. In the present study, we observed that prolonged treatment with anti-estrogens causes drug resistance by inducing MGMT expression in breast cancer cells.
2. Inhibition of MGMT expression using O⁶-benzylguanine (BG) sensitized breast cancer cells to anti-estrogen therapy (tamoxifen and ICI 158,780).
3. We also observed that combination therapy of anti-estrogens and MGMT blockers not only overcame the MGMT derived (tamoxifen and ICI) resistance but also increased the efficacy of anti-estrogen therapy in tamoxifen resistant breast cancer cells.
4. Combination therapy inhibited tamoxifen resistant breast tumor growth *in vivo*.

Acknowledgements

We would like to thank the Florida Department of Health, Breast Cancer Research Program (2010-10) for their funding of this project.

Poor alignment of sections/headers.

Interesting background. (Potentially distracting).

Use of pictures.

Confusing flow and organization.

What is parasite spillback?

Parasite spillback is a process that describes the feedback of native parasites from new host species to native hosts.

- First, native parasites infect introduced or invasive host species.
- With a new host, parasites flourish.
- Now, parasites return to native species with increased infection and disease rates.

Salmonids Brown trout *Salmo trutta* (originating from Europe) and rainbow trout *Oncorhynchus mykiss* (North America) were first introduced to New Zealand waters in the late 19th century. Their effects on local and native stream communities as a non-indigenous species include lesser-studied effects such as parasite spillback and dilution.

Unpublished, Kelly, D.W., Paterson, R.A., Townsend, C.R., Poulin, R. & Tompkins, D.M. "Parasite spillback: a neglected concept in invasion ecology?"

Objective

1. Test whether the presence of brown trout *Salmo trutta* and their parasite abundance is correlated to increased infection rates in four native species fish.
2. Identify for native fish and brown trout seasonal variations in infection intensity.
3. Understand the impact of parasites on host's condition, survival, and reproductive potential through captivity experimentation for all five host species. Parasite transmission to, establishment in, and mortality in different host species will also be identified.
4. Use multi-host and shared-parasite stochastic simulation models.
5. Consider global implications of this model by applying it to an Argentine system and conducting a literature survey of the abundance of shared parasites in native and exotic freshwater fish.

Unpublished, Kelly, D.W., Paterson, R.A., Townsend, C.R., Poulin, R. & Tompkins, D.M. "Is parasite spillback a cause of local extinction in native communities?"

Could parasite spillback be a cause of native species loss and local level extinction?

Methods

- Analyze freshwater fish communities in lakes and streams
- Field surveys
- Host autopsies
- Infection trials
- Mathematical modeling

Fig. 2. Relative flow rates of *Colpocheilichthys* parasites in two hypothetical scenarios.

Discussion

Native species loss is a critical issue throughout the world in many different environments. This map from Conservation International shows biodiversity hotspots where over at least 70 percent of native species are already lost. The most biodiverse regions, including New Zealand, are also the ones most at risk.

Competition and predation are the traditional impacts of invasive species on native species, but disease driven impacts are becoming more widely recognized and researched. Whereas parasite spillover is already an accepted form of disease driven impact, parasite spillback can potentially be more widely used as a tool for describing and understanding impacts of invasive species and native species loss.

A parallel study with similar methods is currently being conducted by the same team of researchers in Argentina. Other areas of the world where parasite spillback has been researched include a study of competing native and invasive grasshopper populations in California. (Settle and Wilson 1990) With more awareness of this issue, more research and studies will hopefully begin and consider parasite spillback as a potential cause for native species loss, potentially helping reverse the trends in global hotspots.

Settle, W.H., and L.T. Wilson. 1990. Invasion by the variegated grasshopper and biotic interactions - parasitism, competition, and apparent competition. *Ecology* 71: 1455-1475.

Acknowledgements

Professor [redacted] of the Evolutionary and Ecological Parasitology Group.
[redacted] of Landcare Research
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Presented at the Bridging Disciplines Program Poster Session and Reception
April 16, 2009

Research Posters

THE IMPROVED

Overview

Research Poster

Research Presentation

Judging

Recap

Effects of Wildfire on Vegetation Biodiversity in Xeric Florida Scrub

Introduction

Fire Regime

- A **fire regime** is the natural combustion lifecycle of an ecosystem.
- Thousands of years ago Native Americans burned forests to clear leaf litter and make room to **cultivate their crops**.
- Lightning** is the most natural ignition for wildfires.
 - This makes summer peak wildfire season because of increased thunderstorms.
- Fire is **necessary to release** life sustaining elements from the plants into the soil.
 - Carbon rich soil is good for growing

Prescribed Burn

- Forest managers will intentionally ignite a **prescribed burn** to decrease the chances of an unpredictable wildfire.
 - They burn the easily ignited fire fuel, dry leaves and branches that scatter the ground.



Shows important pieces of a prescribed burn. Fire line/break (left), healthy (center), backfire (right).



Scrub Characteristics

- Xeric** - very dry, well drained
 - Soil** - sandy, low nutrient, acidic
 - Scrub fire interval** - 15-30 years
 - Canopy** - sparse
 - Debris** - limited; bare sand visible
- Dominant vegetation** - oaks, shrubs, palmetto
 - America's **15th most endangered ecosystem**

Geologic History of FL Scrub

- Millions of years ago, in the last Interglacial Period, Florida sea-level was much higher.
- Researchers theorize that sand from the scrub was likely the **prehistoric shoreline**.



Review of Literature

Global Trends in Wildfire and its Impacts

- Fire activity has declined with the increase of fire suppression ideologies
 - Example: Smokey Bear advertising (right).
- Fire intensity has increased with the normalization of fuel loading habitats.

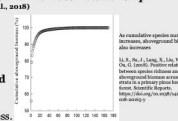


Life History Strategies of Florida Scrub Plants in Relation to Fire

- Three main recovery strategies:
 - Fire Persisters:** species that resprout immediately after fire
 - Obligate seeder:** adult plant is killed by fire, but recovers through seedling recruitment
 - Fire recruiters:** establish seed banks beforehand, but need the heat of fire to germinate
 - Gap: Species diversity and coverage after wildfire remain unknown.

Biodiversity and Aboveground Biomass Relationship

- That herbaceous species richness has a **direct, positive association** with the amount of aboveground biomass.
 - Gap: Methods of collection and measurement of aboveground biomass is still largely debated.
 - Using biomass to indicate biodiversity is a newer process.



Hypotheses

- The more recently burned plot will have a higher biodiversity index
- That plot's ground debris will have a higher change in mass after combustion

Methods

Biodiversity Index

Study Area:

- Two adjacent plots in Chuluota Wilderness Area
 - Wildfire 10 years ago
 - No fire history (NFIH)



Figure 1: Study area. Chuluota and Coon Creek was burned by wildfire in 2010. Coon Creek has no recorded fire history.

- 14 transects, 30 meters apart on fire break
- Randomly generated paces to walk
- Placed a 1m² quadrat after the last step



Figure 6: Estimating median percent coverage (John Gough, UCF Adventure). Figure 7: Plotted quadrat in plot CO2B (2010). Figure 8: Plotted quadrat in plot CO2B (NFIH).

- Additional survey deeper into the plots.
 - In order to minimize the Edge Effect.

Biomass Burn

Setup:

- Collected dead ground debris from both plots
- Separated into samples based on burn history for each plot



Figure 7: Collection from plot CO2B (NFIH). Figure 8: Collection from plot CO2B (2010).

- Natural Burn:**
 - Measure initial mass of collection
 - Under a fume hood, sample ignited on one end for 10s
 - Once fire stopped, reignited once more for 10s
 - Measured final mass of collection

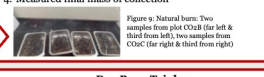


Figure 9: Natural burn. Two samples from plot CO2B (for left & right from left), two samples from CO2B (for right & left from right).

- Dry Burn Trial 2:**
 - Dried two samples of each for 30, 60, and 90 minutes
 - Initial mass of collection measured
 - Samples ignited outside for 30s, then reignited for 30s



Figure 10: Samples drying from both plots for a different interval to mitigate the effect of moisture on mass change.

Results

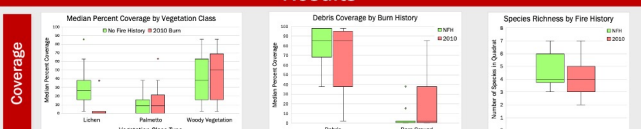


Figure 12: Box plot of the median percent coverage of Lichen, palmetto, and woody vegetation. Lichen clearly showed higher prevalence in the plot burned. The lichen is also recovered from fire.



Figure 13: Box plot of percent coverage of debris and bare ground. The bare ground coverage in the quadrats from 2010 is significantly larger than never burned. p=0.05.

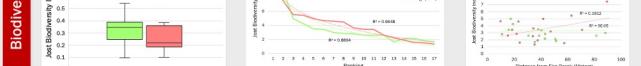


Figure 14: Box plot of number of species per quadrat. 20% of quadrats in NFIH had 2 or 4 species. Both NFIH and 2010 have the same median of 4 species. p=0.05.

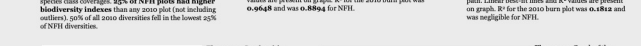


Figure 15: Line graph of biodiversity indices of each quadrat. Related from greatest to least. Logarithmic curves and R² values are present on graph. R² for the 2010 burn plot was 0.8948 and was 0.8948 for NFIH.

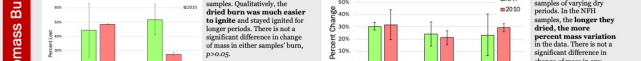


Figure 16: Box plot of Just Biodiversity Index of the 14 quadrats of different histories. The test was run on the species least coverage. 25% of NFIH plots had higher biodiversity indices than any 2010 plot (not including outliers). 50% of all 2010 diversities fell in the lowest 25% of NFIH diversities.

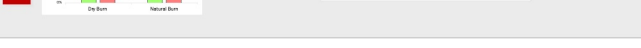


Figure 17: Line graph of biomass change and standard deviation of mass after combustion of natural and dried samples. Qualitatively, the dried burns were much easier to ignite and stayed ignited for longer periods. There is not a significant difference in change of mass in either samples' burn. p=0.05.

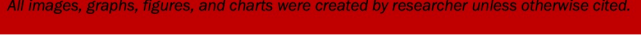


Figure 18: Box plot of biomass change and standard deviation of mass after combustion of natural and dried samples. Qualitatively, the dried burns were much easier to ignite and stayed ignited for longer periods. There is not a significant difference in change of mass in either samples' burn. p=0.05.

Discussion

Vegetation Distribution

Vegetation Class

- Lichen** - Slow to recover after any disturbance because of its shallow root system
- Palmetto** - Fire adapted- sprouts after fire from parent root system
- Woody Vegetation** - Fire adapted- quick recovery

Debris/Bare Ground

- Not directly inverse** of each other because live plants that cover ground do not count in either category
- The **bare ground** in the quadrats from 2010 are **significantly larger** than never burned, p=0.05, a=0.05

Biodiversity

Species Richness

- The highest richness came from the **NFIH plot**
- The NFIH plot was beginning to show characteristics of a **hammock habitat**
- Increased canopy** and vines
- Increased density** of brush
- The plot that has not been burned is likely transitioning into a **scrubby flatwood habitat**

Vegetation Biodiversity

Just Biodiversity Index

- 2010 plots were heavily centered around value 0.22
- >75% of NFIH quadrats had **higher biodiversity** indexes

Rank Distribution

- With an R² value of 0.9648, the quadrats of the 2010 burned plot have a **strong, negative logarithmic association**
- With an R² value of 0.894, the quadrats of the NFIH plot have a **moderately strong, negative logarithmic association**
 - The shallow gradient indicates species evenness

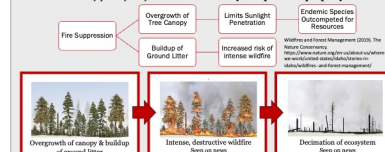
Biomass Burn

- Trial 1**
 - Natural Burn**
 - Clearly more mass change in NFIH than in 2010
 - Explained by **excess moisture** from a denser canopy
 - Dry Burn**
 - NFIH's standard deviation **increased variance** as the debris dried for longer periods
- Trial 2**
 - Interval Dry**
 - NFIH's standard deviation **increased variance** as the debris dried for longer periods
 - No significant change** in mass by burn history p>0.05 for all intervals

Applications

Fire Suppression

- Near urban centers, people fear fire.
- Fire is usually portrayed by the media as a **destroyer of personal property**.



- This project would be able to help gage a **timeline** of the health and maturity of a habitat
 - Used by **land managers** to proactively prevent catastrophic suppressed burns
 - Save personal property** from destruction
 - Save insurance companies** money on property damage

Future Considerations

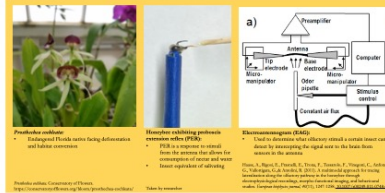
- Compare impacts of fire in **different habitats**
 - Mesic flatwoods, hammock
- Collect data on change in **acidity of soil** before and after burn to distinguish habitat maturity
- Find association between stem density and biodiversity
- Survey farther into the plot
 - Minimize the Ecotone Effect
- Sample **different burn intervals** to find correlation coefficient
- Survey public about **predisposed opinions** about fire
 - Focus on California (Western) and Florida (Eastern) views

All images, graphs, figures, and charts were created by researcher unless otherwise cited.

Associating Floral Volatiles of the Endangered Plant *Prosthechea cochleata* with Food Reward in Honeybees (*Apis mellifera*) Through Pavlovian Conditioning

Background

- Habitat fragmentation creates boundaries between populations, leading to:
 - Low genetic diversity
 - Decreased populations
 - Decreased quality and quantity of pollination, especially in pollinator dependent plants
- Honeybees evaluate the quality of food sources as a hive, optimizing foraging by visiting sources with a high nectar and pollen yield
- Honeybees are efficient, but non-native pollinators, as they originated in Europe:
 - They did not undergo co-evolution with native plants and thus are less efficient than native pollinators at foraging from these plants
 - This can make native plants low-priority food sources
- Native pollinators are often the best suited for pollinating native plants, but if their populations decline, it is important to investigate methods to encourage honeybees to aid in pollinating endangered plant species



Literature Review

- Associative Mechanosensory Conditioning of the Proboscis Extension Reflex in Honeybees**
 - Used Pavlovian conditioning to create an association between unrelated stimuli by presenting both stimuli simultaneously
 - Demonstrates that proboscis extension reflex (PER) increases with each round of Pavlovian conditioning
 - Investigated conditioning with honeybees' sense of touch, not smell
- Kiwifruit Flower Odor Perception and recognition by Honey Bees, *Apis mellifera*:**
 - Increased pollination of kiwifruit in agriculture by conditioning honeybees using volatile organic compounds (VOCs)
 - VOCs are volatile compounds that give flowers their fragrance and attract pollinators
 - Validates method of first recording EAG results, then conditioning PER

Compound showing antennal activity	Electroantennogram (EAG) response to male flowers (mV)	Response to female flowers (mV)
nonanal	1105 (1404)	-1.7 ± 0.2
3-phosphorhexanone	1115 (1407)	-3.0 ± 0.4
4-methylphenol	1144 (1708)	-1.5 ± 0.3
(3E,6E)-farnesene	1301 (1758)	-1.5 ± 0.4
(6Z)-3-oxoheptaldehyde	1669 (1765)	-1.4 ± 0.5
(6Z)-heptaldehyde	1678 (1722)	-1.4 ± 0.2

EAG data using honeybees antennae indicates VOCs show significant change in potential for olfactory response up and down intensity by smelling chemical carrier gases and recording each volatile in air flow

- Floral fragrance analysis of *Prosthechea cochleata* (Orchidaceae), an endangered native, epiphytic orchid, in Florida:**
 - Conducted combined mass spectrometry and gas chromatography analysis on *Prosthechea cochleata* headspace samples, allowing for further research

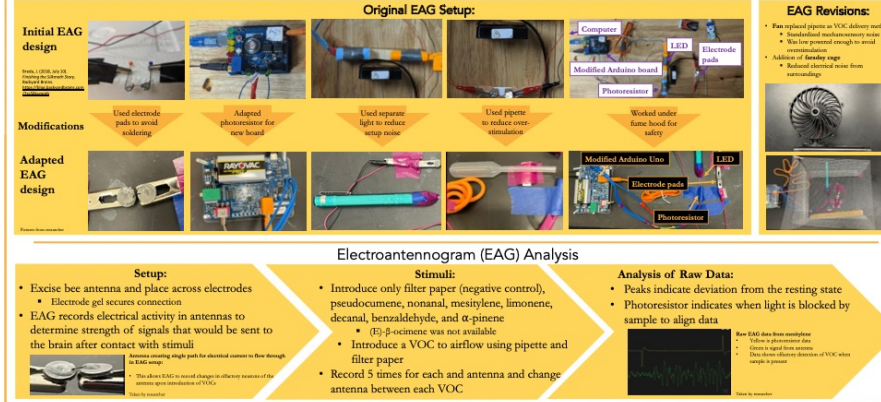
Compound	SP 1	SP 2
benzaldehyde	1.1 (1.48)	1.1 (1.48)
α-pinene	1.1 (1.48)	1.1 (1.48)
limonene	1.1 (1.48)	1.1 (1.48)
β-caryophyllene	1.1 (1.48)	1.1 (1.48)
nonanal	1.1 (1.48)	1.1 (1.48)
decanal	1.1 (1.48)	1.1 (1.48)
undecanal	1.1 (1.48)	1.1 (1.48)
linalool	1.1 (1.48)	1.1 (1.48)

Problem Statements, Goals & Hypotheses

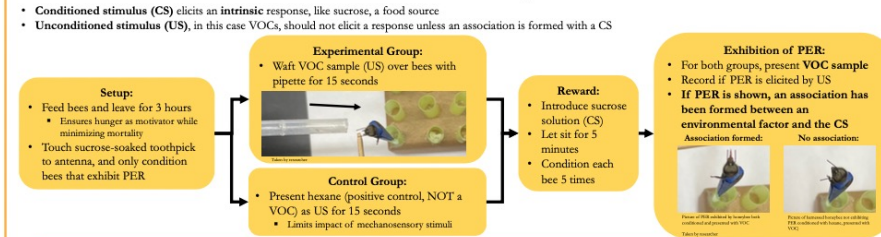
Knowledge Gaps	Goals	Hypotheses
1. Which volatile organic compounds (VOCs) from <i>Prosthechea cochleata</i> <i>Apis mellifera</i> recognize	1. Perform EAG analysis using VOCs from <i>Prosthechea cochleata</i> with a honeybee antenna	1. VOCs from <i>Prosthechea cochleata</i> will increase magnitude of electrophysiological responses of honeybee antennae during electroantennography
2. Impact of Pavlovian conditioning on exhibition of PER from <i>Apis mellifera</i> using VOCs from <i>Prosthechea cochleata</i>	2. Condition honeybees to elicit PER in response to the VOCs of <i>Prosthechea cochleata</i>	2. More conditioned honeybees will exhibit PER in response to VOCs from <i>Prosthechea cochleata</i> than control bees

Methods

Electroantennogram (EAG) Construction

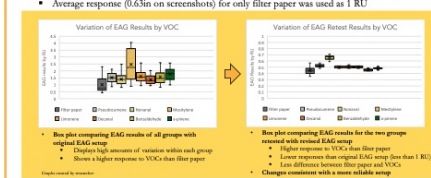
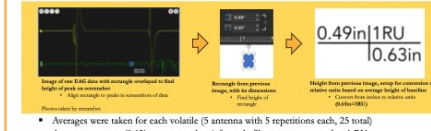


Pavlovian Conditioning



EAG Results

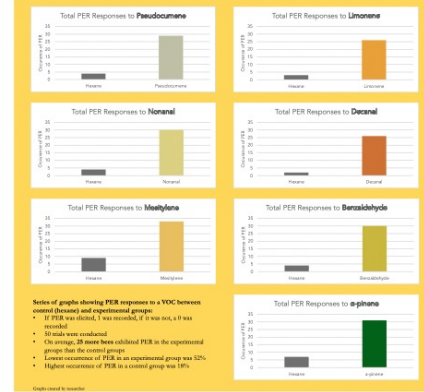
- Screenshots of visual data had to be used as there was no other way to save recordings in software used for EAG recording
- No measurement tool was available in software used for EAG recording, so relative units (RU) were used to quantify results
- Results were quantified by measuring the length from one peak to its corresponding trough



- Original EAG setup was revised as a Gage R&R test found a 75.45% R&R value
 - Acceptable R&R values are <20%, so original EAG setup was not reliable
- Revised EAG setup resulted in more reliable data with an R&R value of 16.78%
- A one-way ANOVA showed a difference between at least two groups ($p < 0.001$)
- Tukey-Kramer tests found 5 VOCs yielded higher results than filter paper ($p < 0.01$)
 - α-pinene and benzaldehyde results were not significantly different from filter paper ($p > 0.10$)

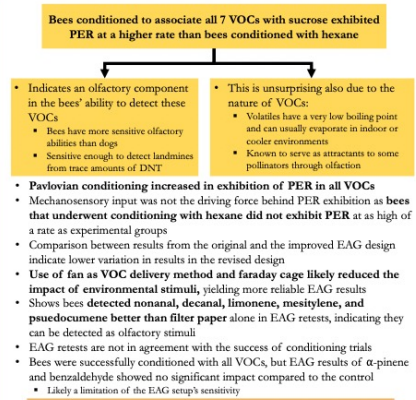
Conditioning Results

- Both the VOC group and the hexane group were presented the same VOC following conditioning, making PER exhibition specific to the olfactory conditioning



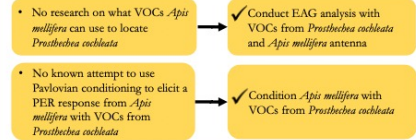
- 7 chi squared tests were performed, comparing PER exhibition between each VOC's control and experimental groups
 - All experimental groups exhibited PER at a significantly higher rate than their controls ($p < 0.001$)
 - Conditioning with any of the 7 VOCs tested effectively increases exhibition of PER

Discussion

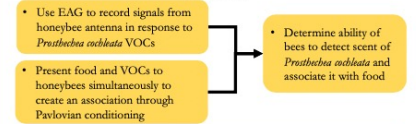


Conclusions

Problems and Goals



Methods:

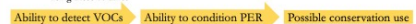


Results

- In order of decreasing strength of original EAG response the groups were:
 - Mesitylene
 - α-pinene
 - limonene
 - benzaldehyde
 - None (control)
- Five volatiles from *Prosthechea cochleata* were shown to be detected by honeybees in revised EAG analysis
 - Indicates that the improved EAG setup yields more reliable results and may be a useful and more cost-effective substitute for EAGs
- Conditioning data shows a significant increase in PER exhibition after conditioning with pseudocumene, nonanal, mesitylene, limonene, decanal, benzaldehyde, and α-pinene
 - Indicates Pavlovian conditioning is successful in forming an association between primary VOCs from *Prosthechea cochleata* and a food reward

Applications

- Provides baseline research on feasibility of incorporating Pavlovian conditioning of honeybees in conservation of native plants
 - Before field tests to improve pollination, Pavlovian conditioning had to be proven effective using these volatiles



- Contributes to the information available on honeybees' olfactory capabilities
 - Reduces groundwork necessary for other bee research using these VOCs

Future Research

- Long term goal:
 - Continue testing applications of Pavlovian conditioning in conservation
- Next steps:
 - Develop synthetic *Prosthechea cochleata* scent for Pavlovian conditioning and observe impact on recognition of natural scent
 - Test impact of conditioning with synthetic scent on visitation and pollination of *Prosthechea cochleata* by honeybees

Research Posters: Specialized Tips

- Recommendations for the following font sizes:
 - **Headers:** 50 - 70 pt
 - **Subheaders:** 30 - 40 pt
 - **Body:** 24 pt
 - **Captions:** 12-18 pt
- Use a complementary color scheme to the theme/topic of your project.
- Utilize **sans-serif** fonts rather than **serif** fonts
- Don't fear white or negative space.
 - American Journal Experts recommend up to 40% of your poster being white space.
- Adjust paragraph/line spacing and have smaller font sizes for subbullets.
- Avoid runts (words that hang all by their lonesome on a line).

Research Posters: ISEF-Specific Tips

- Do **NOT** include brand names or logos on your poster.
 - Anything on your abstract is allowable, such as your name and school.
 - There are exceptions regarding personal logo use for your poster.
- ALL graphs, images, and figures *should* be captioned.
- ALL graphs, images, and figures **must** be cited.
 - If all visual elements are produced by the researcher, then use the disclaimer, *"All graphs, images, and figures were produced by the researcher."*
 - If some elements are from other sources, cite them appropriately. Then use the disclaimer, *"All graphs, images, and figures were produced by the researcher unless otherwise stated."*

Research Posters: Development

• Background Mini-Posters

• Intermediate Poster Checkpoints

- Background / Overview
- Literature Review
- Problems
- Goals
- Hypotheses
- Methods
- Results
- Discussion
- Conclusion

Complete after research plan pre-app

Complete during experimentation

Complete immediately following exp

Complete following creation of the re

Environmental Factors' Effects on Bisphenol A and Styrene Chemical Leaching into Lakes, Soil, and Absorption into *Spirogyra* sp.

What is plastic leaching?

- Chemicals that are transferred or released from plastics into...
 - Waterways
 - Soil
 - Plants
 - Prepared food and beverages
- Different types of chemicals leak depending on plastic and how it is made
- Released chemicals have negative effects on the human body

Plastic Pollution

- Increased use of plastic made by fossil fuels in past century
 - 1950 - 2.3 million tons vs. 2015 - 448 million tons
- Extremely durable, hard to decompose
- Carried into water and soil by littering
 - Waterways → Plastics carried down streams, rivers, or sewers into larger bodies of water
 - Soil → Plastics may be dropped onto ground then sit there
- All plastic pollution disrupts ecosystems
- Plastic bits carry chemicals into the ecosystems

Freshwater Biomes

- Bodies of water that consist of less than 1% of salt
- Covers about 1/5 of the world
- Freshwater body types include...
 - Lakes/ponds
 - Rivers/streams
 - Some wetlands
- Two types of lakes...
 - Oligotrophic lakes → Low nutrient lakes with high amounts of dissolved oxygen
 - Eutrophic lakes → High nutrient lakes with low amounts of dissolved oxygen

Purpose

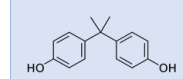
1. Exploring how environmental factors of freshwater biomes like lakes or rivers affect BPA and styrene leaching
2. Exploring how environmental factors of eutrophic lakes affect BPA and styrene leaching into *Spirogyra* sp.
3. Exploring how environmental factors affect BPA and styrene leaching into soil

Knowledge Gap

- Best model for rivers and lakes
- How to show chemicals are being absorbed by *Spirogyra* sp.
- How to show that chemicals are being absorbed into soil
- With stagnant water, other than sunlight, other environmental factors to measure
 - Stagnant water has little currents

Bisphenol-A

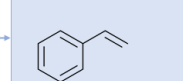
- Found in epoxy resins and polycarbonates
 - Epoxy resin → Food cans, bottle tops, and water supply lines
 - Polycarbonates → water bottles and food storage containers
- Known for their durability and resistant to abrasions



- Health concerns include...
 - Negative effects on fetus, infant, and childhood development
 - Increased cardiovascular disease
 - Endocrine disruptor → emulates estrogen

Styrene

- Found in polystyrene
 - Polystyrene → trays and containers, disposable eating utensils, insulation and packaging
- Known for its light weight and good insulation



- Acute exposure has low to moderate toxicity
- Neuron disruptor → Depression, reaction time, memory
- Genotoxic → Damages genetic information
- Carcinogenic → Ability to cause cancer
- Disrupts reproductive system

Spirogyra sp. Algae

- Filamentous, unbranched green algae
- Called pond scum or pond silk
- Found in stagnant, fresh water
 - Ponds or at the rim of lakes
- Two cell walls → inner cellulose wall and outer peptidoglycan
 - Peptidoglycan is hydrophilic
 - Slightly dissolves, creating a mucilage
- Central vacuum with nucleus suspended in the middle (primordial utricle)
- Chloroplasts spiral around central



Fig. 3 - Singular *Spirogyra* sp. cell. Shows primordial utricle with nucleus being held by cytoplasmic strands.

- Sexual reproduction
 - Vegetative reproduction (fragmentation)
 - Asexual reproduction
 - Sexual reproduction: Conjugation (most common)
- Sexual reproduction → Scalariform (2 filaments) or lateral (1 filament)

Methods

- Have 9 groups with different concentrations/duration/intensity of different factors
 - Ammonia (0.25 mg/L, 0.5 mg/L, 1.0 mg/L)
 - Sunlight (shaded, 2-hour interval, full light)
 - Currents (stagnant, low, high)
- Have 3 groups with different concentrations of phosphorus and nitrogen with *Spirogyra* sp.
 - Group 1 (0.03 mg/L P, 1.5 mg/L N)
 - Group 2 (0.05 mg/L P, 1.0 mg/L N)
 - Control group 3 (0.03 mg/L P, 1.0 mg/L N)
- Have 4 groups with different concentrations of different factors
 - Water (dry, moist, saturated)
 - Sunlight (shaded, 2-hour interval, full light)
 - Movement (stirred every 3 days, every 7 days, every 11 days)
 - Negative control
- Collect lake samples to show model accuracy

Keywords

Bisphenol A (BPA) - A chemical used to make epoxy resins and polycarbonate

Styrene - A chemical used to make polystyrene

***Spirogyra* sp.** - A nonbranching green algae found in stagnant freshwater

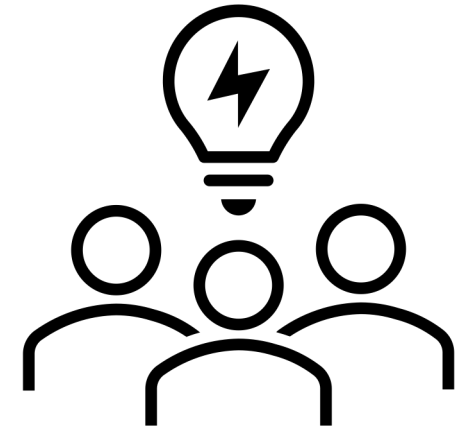
Epoxy resin - A polymer made with BPA, used as a thermoplastic and liner

Polystyrene - A polymer made with styrene, used for packaging and insulation

Polycarbonate - A polymer made from BPA, used for food storage

Research Posters: Reflection

- Take a moment to reflect to yourself or network with peers near you about the following questions:
 - What do you do that **facilitate** poster design?
 - What are your greatest **strengths** with poster design and content? **Weaknesses**?
 - What new **insights** did you gain thus far?
 - What **improvements** do you wish to make to your poster design this upcoming year?



Research Presentations: The Formats

1 MINUTE

0:00 – 0:10	Problem
0:11 – 0:20	Goals Hypothesis
0:21 – 0:30	Methods
0:31 – 0:45	Results
0:46 – 1:00	Conclusion Applications

3 MINUTE

0:00 – 0:45	Review of Literature Problem
0:46 – 1:00	Goals Hypothesis
1:01 – 1:30	Methods
1:31 – 2:00	Results
2:01 – 2:30	Discussion
2:31 – 3:00	Applications Future Directions Conclusions

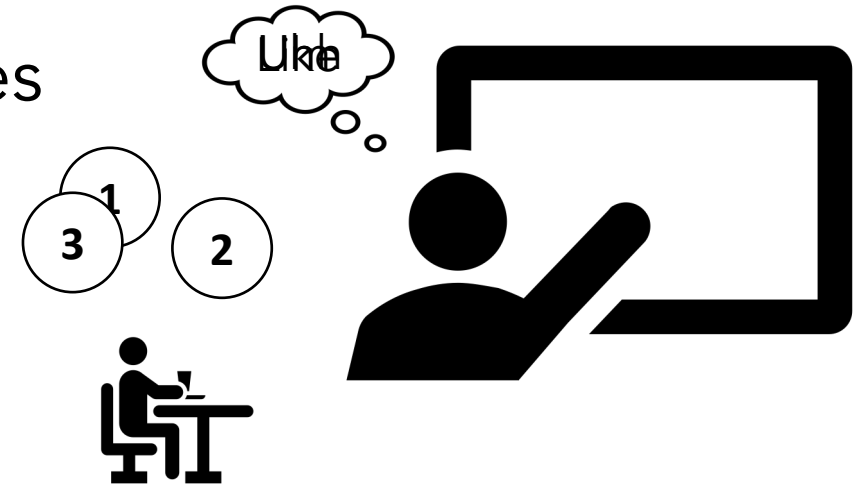
5 MINUTE

0:00 – 1:15	Review of Literature Problem
1:16 – 1:30	Goals Hypothesis
1:31 – 2:00	Methods
2:01 – 3:00	Results
3:01 – 4:00	Discussion
4:01 – 4:30	Applications Future Directions
4:31 – 5:00	Conclusions

DO NOT COME WITH A MEMORIZED PRESENTATION

Research Presentations: Making it a Game

- Encourage students to cater to their audience
 - Get as many people to understand as possible
 - Speak as fluently and seamlessly as possible
- *Example:* Counting Umms, Uhhs, & Likes

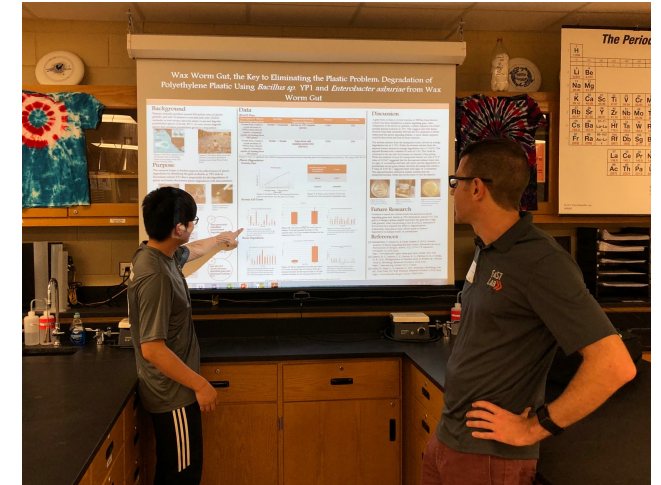


Research Presentations: Supporting Claims

- Support your claims with sources
 - Use your **Review of Literature!**
- Avoid the most cited reference of all-time: **"they"**
(Purcell, personal communication, 2019)
- Validates your research is...
 - Current and applicable
 - Builds off prior research
 - Shows whether it's scientifically supported

Research Presentations: Development

- Presentation Practice Modes
 - Round Robins
 - Whole Class
 - Expert Guidance
- Alternative Presentations
 - Mock Data
 - Lab Summary
 - Pecha Kucha
 - Promotional Videos



STRONGER SYNTACTIC ALIGNMENT IN THE PRESENCE OF AN INTERLOCUTOR
PUBLISHED JUNE 25TH, 2007 / JOURNAL OF NEUROSCIENCE METHODS 166 (2007) 41–52
KNOWLEDGE GAP : **HYPOTHESIS / GOAL**

Discourse between explanations of cognitive mechanisms influencing syntactic priming.
Current studies focus on how *linguistic context* influences syntactic choice.

Is the degree of syntactic alignment influenced by conversational context?
Conclude if top-down influences affect the degree of syntactic priming.

METHODOLOGY :

- Dutch native speakers
- No colorblindness or speech disorders
- Sixty-nine participants
- Confederate Interlocuter was female
- Additional measure to avoid suspicion ; both were instructed to detect mismatches.

FIGURE 1 Study design: participants completed a syntactic priming experiment in one of 4 conditions: Adaptive Interlocutor, Non-Adaptive Interlocutor, Adaptive Recording, Non-Adaptive Recording. The experiment set-up for the Interlocutor versus No Interlocutor conditions are illustrated on the left versus right, respectively. The experiment was in Dutch, we use English translations in the figure to help the reader.

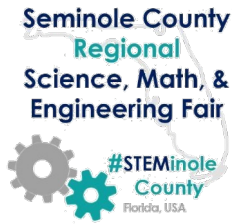
Research Presentations: Development

- Additional Practice
 - Competitions
 - Symposium Showcase
- Miscellaneous
 - Project-Killing Questions

January



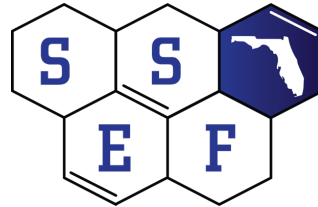
February



Early March



Late March



April



Early May



Mid-May



Overview

Research Poster

Research Presentation

Judging

Recap

Research Presentations: Reflection

- Take a moment to reflect to yourself or network with peers near you about the following questions:
 - What do you do that **facilitate** presentations?
 - What are your greatest **strengths** with presentations? **Weaknesses**?
 - What new **insights** did you gain thus far?
 - What **improvements** do you wish to make to your presentations this upcoming year?

FUTURE IMPROVEMENTS

Add opportunities to present to our School Board

Create a video recorded presentation assignment requiring self- and peer-evaluation

Present 60s research summaries to discipline-specific science classes

Judging: Strategies

- Adapting to the competitions
 - Find the rubrics specific to the competition
 - Determine your judges' expertise
- Understanding judging personalities

Junior Science, Engineering, and Humanities Symposium Judging Worksheet for Evaluating Student Speaker Competition

Speaker Name: _____

Project Title: _____

Judging Criteria		Below Average	Average	Above Average
Originality	Identified an original research question			
	Project shows creativity in question asked, approach to problem-solving, data analysis and interpretation, and/or use of equipment			
	Student selected the research topic and devised the project			
	Student was primarily responsible for the work done on the project			

Total Points Awarded for Originality, where 0 is low and 10 is superior: _____

Quality of Research	Project involved experimental work done by the student			
	Research question was clearly stated and sufficiently limited			
	Procedural plan for achieving a solution was presented			
	Variables and controls (as needed) were clearly recognized and defined.			
	Readily available facilities were utilized for the research			
	Data are adequate to support the conclusions			

Total Points Awarded for Quality of Research, where 0 is low and 10 is superior: _____

Depth of Understanding	Student shows an understanding of other research in the general area of the project			
	Student references scientific literature			
	Student gives adequate details of work done. Adequate time was spent on the project.			
	Project carries out the purpose to completion. Project covers the problem thoroughly.			
	Limitations of the data are recognized			
	Conclusions are based on adequate experimentation			
	References further work that may be warranted on the project			

Total Points Awarded for Depth of Understanding, where 0 is low and 10 is superior: _____

Quality of Presentation	Presentation was completed in time allotted			
	Presentation was effective: information clearly shared in a logical order, appropriate use of audio visuals, speaker was well spoken			
	Student fielded questions well			

Total Points Awarded for Quality of Presentation, where 0 is low and 10 is superior: _____

Overview

Research Poster

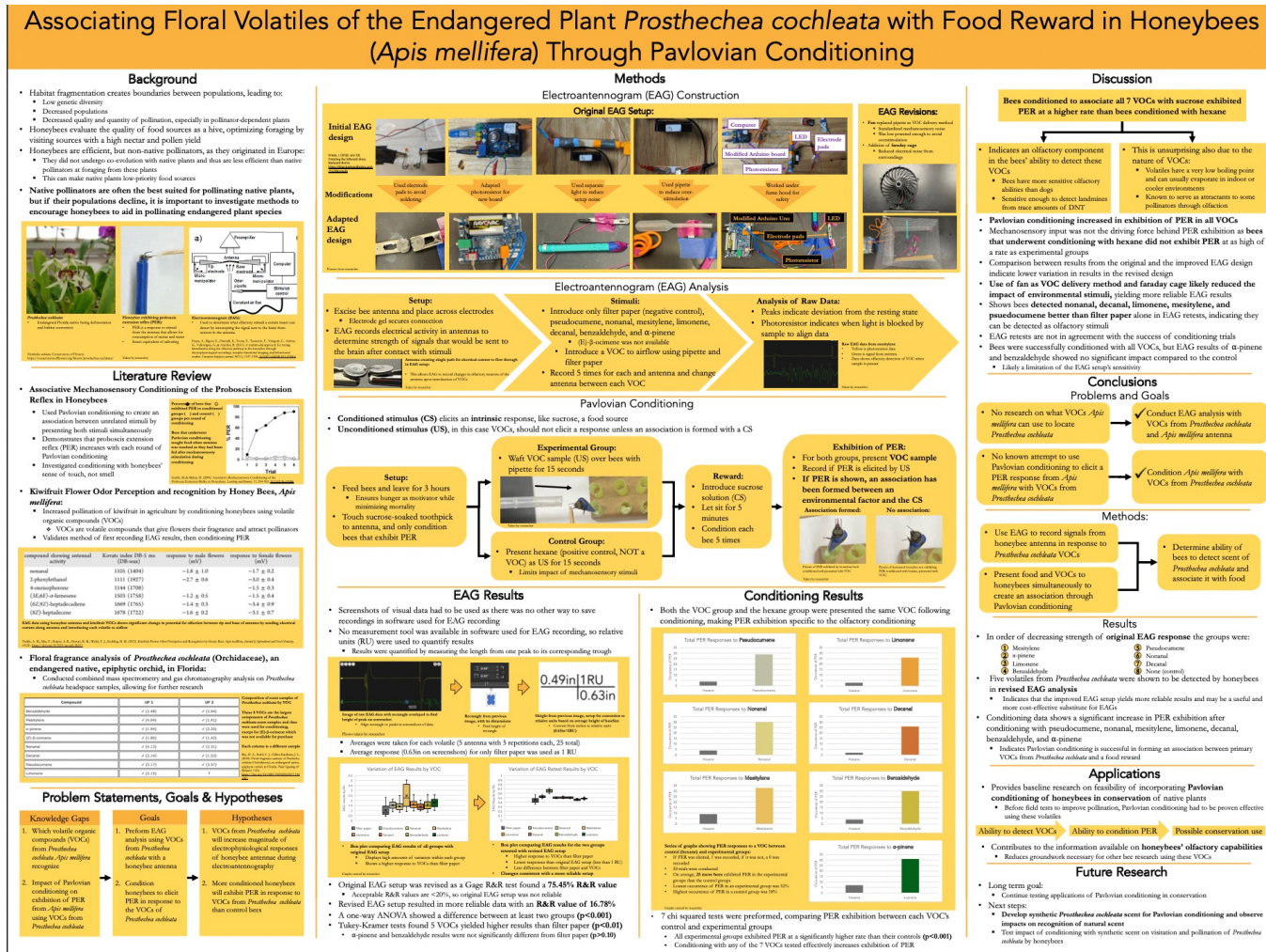
Research Presentation

Judging

Recap

Judging: Development

- Parallelism of poster and presentation design aligned with the rubric
- Experiencing judging personalities using round-robin presentations



INTERJECTOR

DESCRIPTION

Your role is to interject in inopportune times during the presenter's presentation.

TASK

Aim to interrupt with a statement or question the presenter's presentation at least **three** times.

GET-TO-THE-POINT

DESCRIPTION

Your role is to ask the presenter to get to the point in the middle of their introduction/background/hook.

TASK

Interrupt the person's introduction/background/hook **within the first 15 s** by asking them to go directly to their results or by asking a project-specific question.

THAT'S ALL THANKS

DESCRIPTION

Your role is to, without emotion, listen to the entirety of the project's presentation and then leave at the end.

TASK

Show no emotion, no confirmation, and ask no questions throughout the researcher's presentation.

TRADITIONALIST

DESCRIPTION

Your role is to allow the presenter to run through their entire speech and ask questions at the end.

TASK

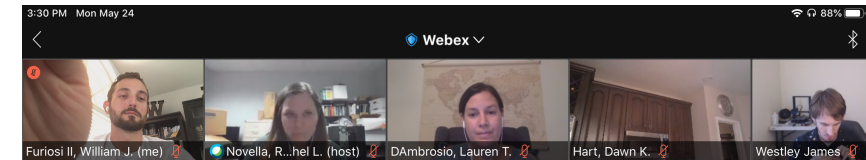
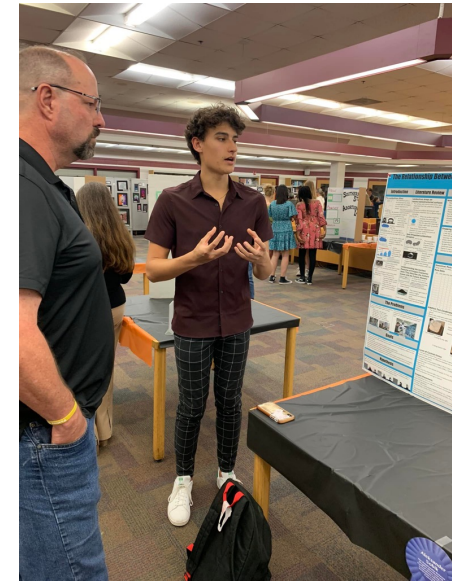
Only ask questions at the end and provide no input otherwise throughout the presentation.

Judging: Reflection

- Take a moment to reflect to yourself or network with peers near you about the following questions:
 - What do you do that **facilitates** the understanding of judges?
 - What are your greatest **strengths** with adapting your presentation?
Weaknesses?
 - What new **insights** did you gain thus far?
 - What **improvements** do you wish to make to your presentations this upcoming year?

Recap

- Research Posters
 - Follow design principles and practice parallelism
 - Allow it to speak for itself without also serving as a research paper (ie. **less words!**)
- Oral Presentations
 - A better presenter will win more.
 - The way you get better at presenting is to present more.
- Judging
 - Evaluate your judges' personalities
 - Adapt your presentation to fit their needs



Successfully Developing and Practicing Science Research Presentations

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