The Effect of Climate on Mosquito Populations

L2R Cohort – The GLOBE Program

Sarasota School of Arts and Sciences

Teachers:
Carlos Hernandez, 8th Grade Science
Julia Calderon, 7th Grade Science
Lauren Watson, 6th Grade Science
Sara Kuhar, 7th Grade Science

Table of Contents

Abstract

The purpose of this study was to see if there is a link between global climate change and an increase in mosquito populations and mosquito borne disease. Students came up with two research questions: 1) How does climate change affect mosquito populations? and, 2) How do changes in precipitation affect mosquito populations? The three hypotheses tested were: populations of mosquito larvae increase as rainfall amounts increase, the heavier the rainfall, the more likely mosquito larvae will be found in sitting water within a few days, and one effect of climate change is heavier precipitation events, which leads to increased mosquito populations because of more sitting water. Students collected water samples and looked for mosquito larvae around our school's campus as well as recorded rainfall amounts at our school's weather station. Students also collected atmospheric data using the one-day integrated weather data sheet and followed GLOBE protocols. The data collected showed that mosquito larvae increased as rainfall increased. The data also showed that the heavier the rainfall, the more likely mosquito larvae will be found in sitting water within a few days. Historical data seemed to show that mosquito larvae increased when there was a heavy precipitation event following a dry period. For the most part, students' hypotheses were supported by the data. Further research needs to be conducted in order to see if global climate change has an effect on mosquito populations and an increase in mosquito borne diseases.

Research Questions

- How does climate change affect mosquito populations?
- How do changes in precipitation affect mosquito populations?

Research

Worldwide, there are approximately 3,450 mosquito species. There are currently about 300 species of mosquitoes in Florida and 40 in Sarasota County. Mosquitoes breed in shallow water; however mosquitoes don't fly too far from where they breed. When mosquitoes “bite”, they are not actually using it for food, but instead for the development of eggs. Only female mosquitoes take blood meal in order to lay several hundred eggs. The mosquitoes breathe using a thing on their back called a trumpet. Mosquitoes only live for two weeks to a month. Mosquitoes lay their eggs in stagnant water because larvae require air at the surface to survive. Any water holding container has the potential to breed mosquitoes and, in fact, one tablespoon of water can be enough to produce 100 mosquitoes (Sarasota County Mosquito Management, 2012). Places with at least some seasonal warm weather are where mosquitoes typically call home since they cannot survive in year-round cold climates.

Some mosquitoes can transmit diseases and these types are called vectors. Examples of diseases that vector mosquitoes transmit include malaria, dengue fever, West Nile virus, and yellow fever. The disease is transmitted when the mosquito lands on you and injects its saliva into your blood before siphoning blood. This causes an allergic reaction. If the mosquito is carrying blood meal from another person or animal, it can transfer the disease to the new “host”. Currently, there are no cases of malaria in the United States, but scientists believe that a changing climate could eventually bring malaria to the U.S. (Sarasota County Mosquito Management, 2012).

According to the Florida Climate Center (2008), “’Climate Change’ refers to the variation in the Earth’s global or regional climates over time.” Since 1985, the southeast U.S. has experienced a 10% increase in rainfall and an increase in the frequency of large rainfall events that produce at least 2 inches of rain (Florida Climate Center, 2008). In addition, most rural areas in Florida have been on a warming trend over the

past century. Increased rainfall leads to an increased amount of sitting water. This is especially true for larger than normal rainfall events because the rainwater comes down in large quantities in a short period of time and so it cannot infiltrate the soil and instead sits at the surface.

Climate change can also lead to more extreme weather events, such as flooding, drought, and hurricanes. "They [mosquitoes] breed in standing water, but these can actually become more prevalent during a drought than in rainier times" (Lemonick, 2012). Mosquitoes are able to reproduce more quickly than most insects and if they are in warmer weather, they can reach maturation earlier, thereby spreading diseases more quickly (Lemonick, 2012). Another factor is the changing of the seasons where spring is coming earlier and winters are shorter and milder with fewer frost days. These conditions are ideal for the survival of mosquitoes and many other insects. With changes in regional climates, mosquitoes are able to expand their range and reach new areas and potentially spread new diseases.

Hypotheses

- Populations of mosquito larvae will increase as rainfall amounts increase.
- The heavier the rainfall, the more likely mosquito larvae will be found in sitting water within a few days.
- One effect of climate change is heavier precipitation events, which leads to increased mosquito populations because of more sitting water.

Methods & Materials

Collecting Mosquito Larval Data:

- Materials: Turkey baster, mosquito larvae containers with lids, rain gauge, water sampling location (bird bath), stereoscopes, Petri dishes, pipettes
- Methods: Students went every school day at approximately 10:00am to check the rain gauge and the bird bath. They recorded the rainfall in centimeters. When checking the bird bath, the students used a turkey baster to siphon any sitting water to put in the mosquito larvae container. When

back in the classroom, the students examined the water sample more closely for larvae. If larvae were present, they removed them with the pipette and observed them under the stereoscope in order to try and identify them.

Collecting Atmospheric Data:

- Materials: 1-day integrated weather data sheet (GLOBE), GLOBE cloud charts, weather station that includes a digital thermometer/hygrometer, rain gauge, and barometer
- Methods: Students went every school day at approximately 12:00pm to collect atmospheric data according to the 1-day integrated weather data collection protocols. Students then entered their data on GLOBE's website.

Results

Table 1: Florida's Average Precipitation (in inches) by Month for 2007-2011
(Source: Florida Climate Center)

Month	Average Precipitation
January	30.99
February	30.94
March	31.07
April	25.43
May	31.09
June	31.24
July	33.12
August	33.17
September	33.97
October	33.87
November	33.93
December	34.21

Table 2: Florida's Total Annual Precipitation (in inches) for 2007-2011
(Source: Florida Climate Center)

Year	Total precipitation
2007	29.57
2008	29.00
2009	45.01
2010	46.85
2011	48.77

Table 3: Sarasota County's Total and Average Mosquito Larval Counts by Month for 2007-2012
(Source: Sarasota County Mosquito Management)

Month	Total Count	Avg. count per year
January	6740	1123
February	10256	1709
March	13612	2269
April	26830	4472
May	18218	3036
June	28942	4824
July	46374	7729
August	39854	6642
September	38750	6458
October	26212	4369
November	7556	1259
December	5654	942

Table 4: Sarasota County's Total Annual Mosquito Larval Counts for 2007-2012
(Source: Sarasota County Mosquito Management)

Year	Total Count
2007	44218
2008	54670
2009	45771
2010	37642
2011	48195
2012	38502

Table 5: SSA+S Total Rainfall and Mosquito Larval Counts for January – April 2013
(Source: Sarasota School of Arts and Sciences)

Date	Rainfall	Number of Larvae
28-Jan	0	0
29-Jan	0	0
30-Jan	0	0
31-Jan	2.4	0
1-Feb	0	0
4-Feb	0	0
5-Feb	0	0
6-Feb	0	0
7-Feb	0	0
8-Feb	2.3	2
12-Feb	1.8	0
13-Feb	0	0
14-Feb	0	0
22-Feb	0	0
4-Mar	0	0
5-Mar	0	0
20-Mar	2.5	0
25-Mar	8	0
5-Apr	3	2
9-Apr	1	-
10-Apr	0	1

Figure 1: Florida's Average Precipitation (in inches) by Month for 2007-2011
(Source: Florida Climate Center)

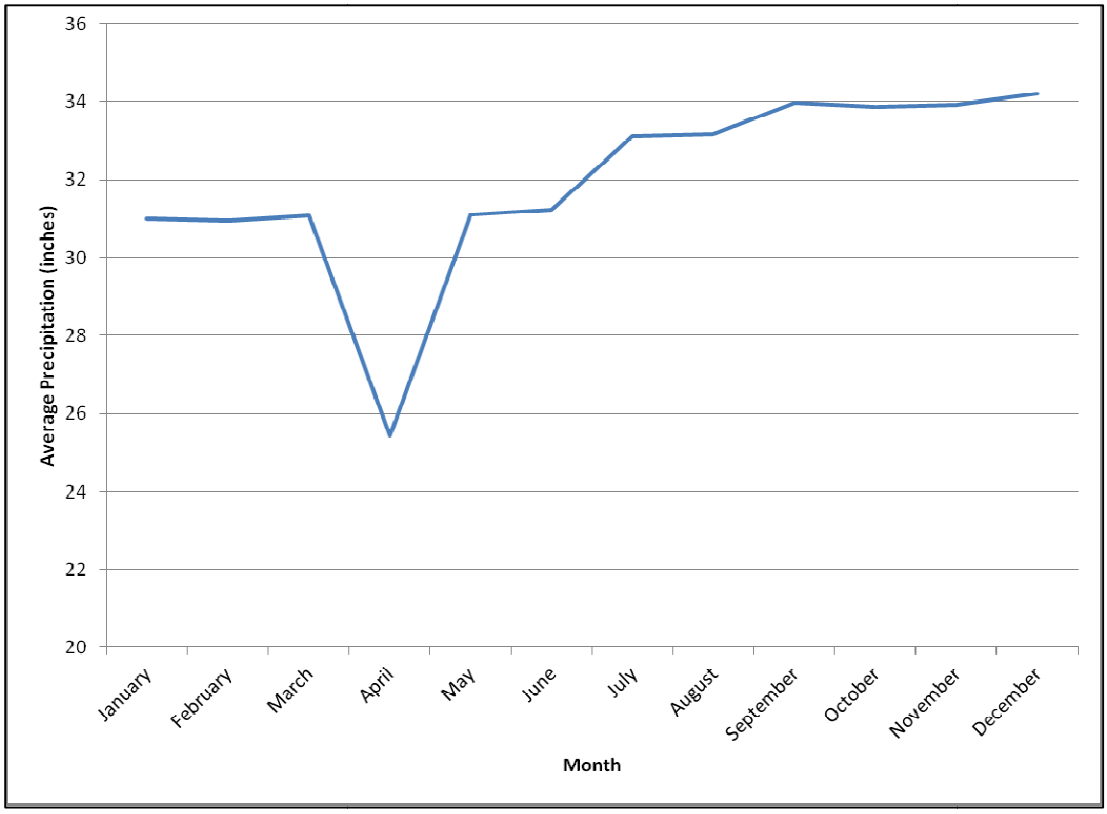


Figure 2: Florida's Total Annual Precipitation (in inches) for 2007-2011
(Source: Florida Climate Center)

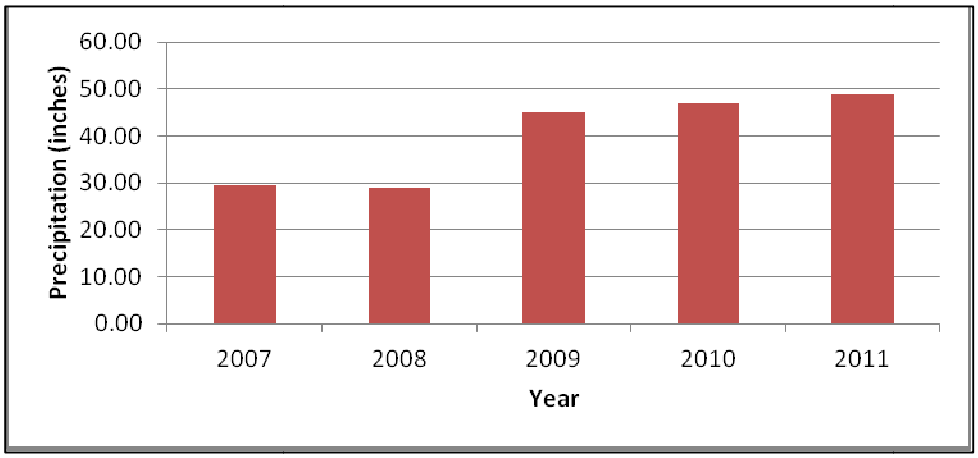


Figure 3: Sarasota County's Total and Average Mosquito Larval Counts by Month for 2007-2012
(Source: Sarasota County Mosquito Management)

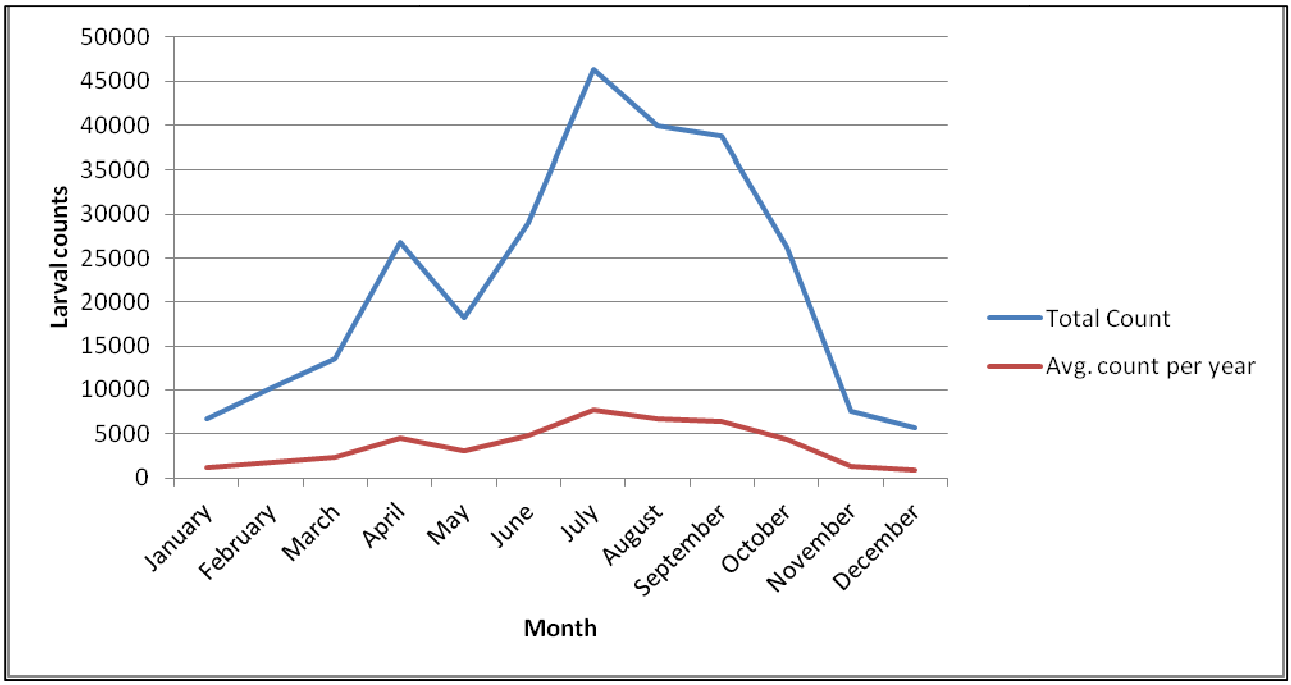


Figure 4: Sarasota County's Total Annual Mosquito Larval Counts for 2007-2012
(Source: Sarasota County Mosquito Management)

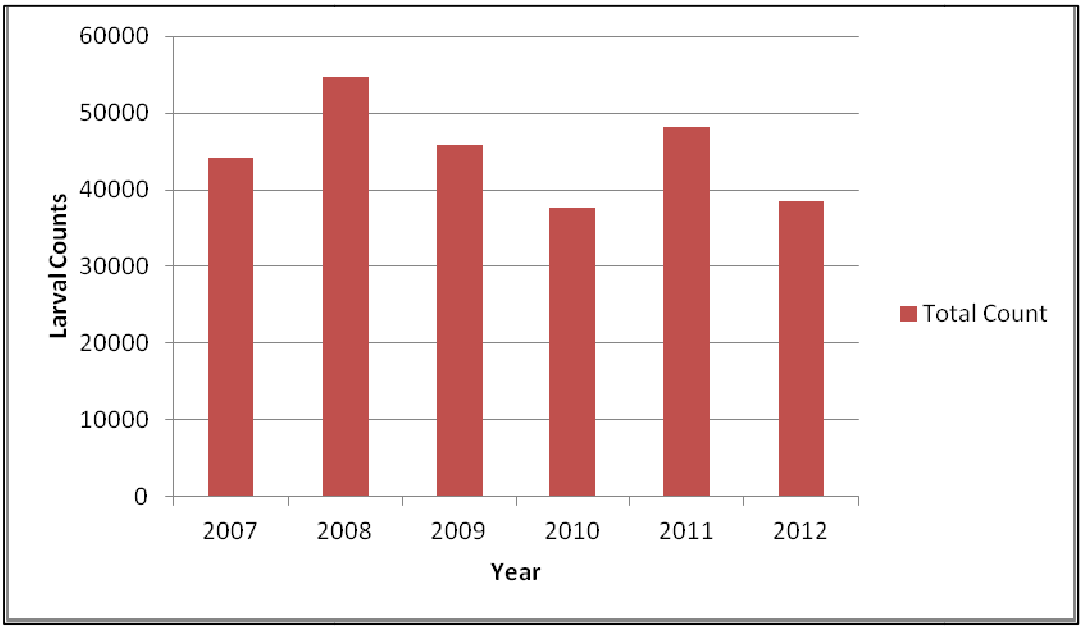


Figure 5: SSA+S Monthly Total Rainfall and Mosquito Larval Counts for January – April 2013
(Source: Sarasota School of Arts and Sciences)

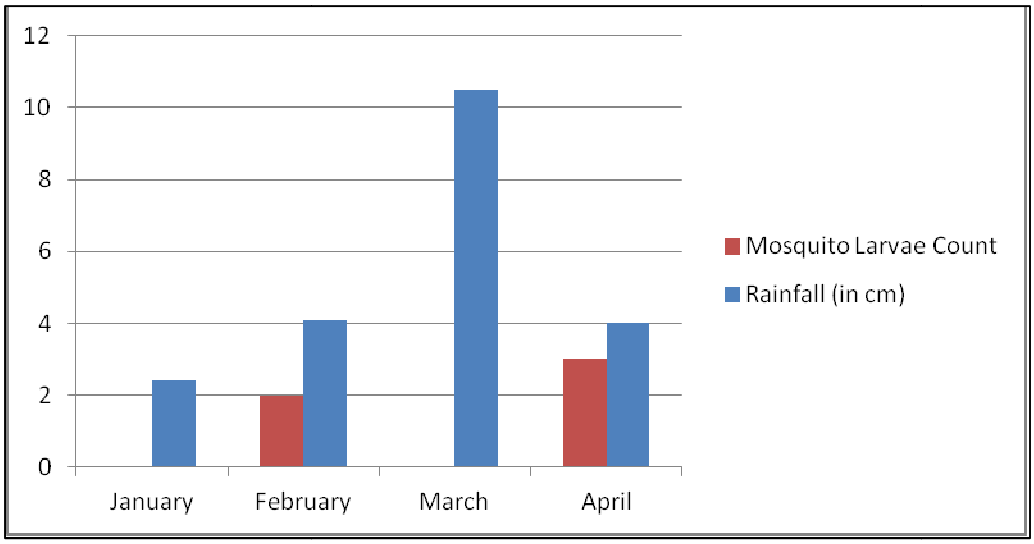
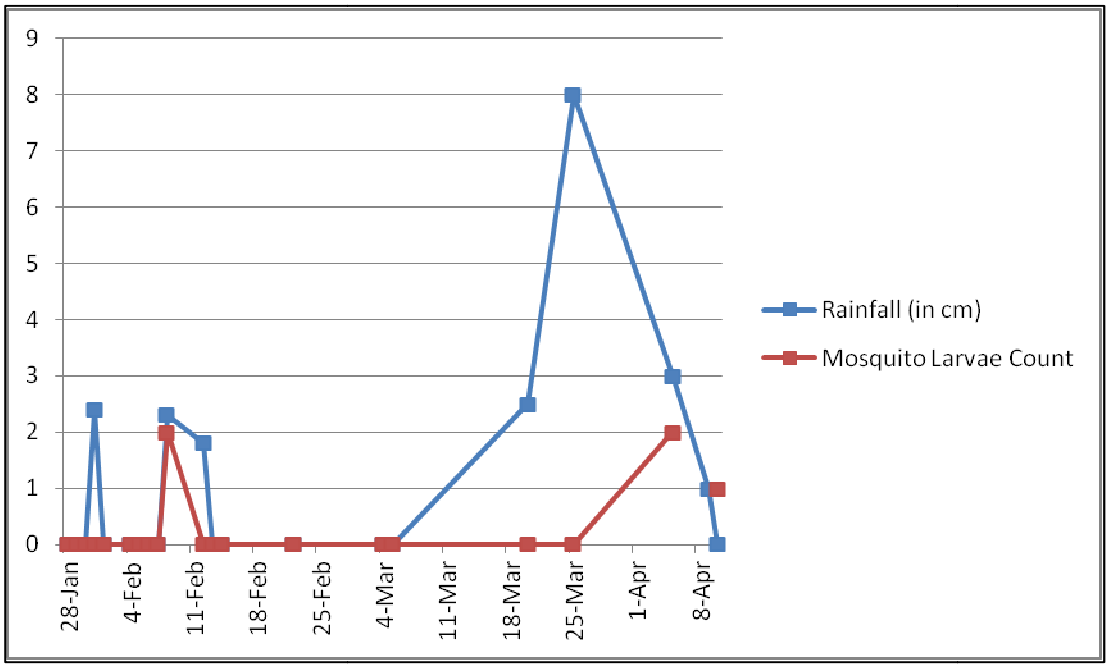


Figure 6: SSA+S Total Rainfall and Mosquito Larval Counts for January – April 2013
(Source: Sarasota School of Arts and Sciences)



Conclusions

The original hypothesis stated that populations of mosquito larvae increase as rainfall amounts increase. Based on our own data collected (Figures 5 and 6), the hypothesis was partially supported. We only had a few days of rainfall, but mosquito larvae only appeared on two of those occasions. On the day with the heaviest rainfall (8 cm), mosquito larvae were found within the next few days in the sitting water. However, mosquito larvae were not found every time it rained. It seemed as though the mosquito larvae did not appear until the water had been sitting for a couple of days, which seems to provide some support for the second hypothesis that the heavier the rainfall, the more likely mosquito larvae will be found in sitting water within a few days.

The third hypothesis stated that one effect of climate change is heavier precipitation events, which leads to increased mosquito populations because of more sitting water. Based on historical data (Figures 1-4), mosquito larval counts are highest during summer months when the temperatures are warmer. This is supported by the research that shows that warmer temperatures are ideal for the growth of mosquito and other insect populations. Heavy rainfall is a necessary factor for mosquito larvae as well because mosquitoes need sitting, stagnant water to lay their eggs. However, the historical data seems to instead show that mosquito larvae increase when there is heavy precipitation following a dry period. It is clear that more research needs to be done to determine the relationship between rainfall amounts, duration, and time of year with the rise and fall of mosquito populations.

Discussion

At this point, we do not think the data is enough to draw a solid conclusion because we only started collecting data in January, which means there wasn't much rain and there weren't many mosquitoes laying eggs. In March, the beginning of spring, there was a lot of rain which seemed to lead to more mosquito larvae. Data was not collected every day and perhaps not all of the water was properly collected in order to look for larvae. Data needs to be collected year-round on a daily basis in order to draw conclusions.

In the future, we will do more observations and experiments involving mosquitoes and rainfall amounts. We can see what type of larvae is most common in Florida, and we could also learn more about their life cycle and the effect of other climate variables on their populations. Another idea includes monitoring migratory bird populations in our area as birds can be carriers of mosquito born diseases.

Acknowledgments

- Laurie Tarleton, Sarasota County Mosquito Management
- Melissa Griffin, Assistant State Climatologist
- Hayden Wachob, Sarasota High School MAST student

Works Cited

Lemonick, M. (2012, August 17). *Climate is ripe for deadly west nile virus attack on Texas*. Retrieved from http://www.climatecentral.org/news/climate-is-ripe-for-deadly-west-nile-virus-attack-on-texas-14826/

Sarasota County Mosquito Management. (2012). *Mosquitoes and Diseases*.

Southeast Climate Consortium. (2008, June). *Agroclimate change facts*. Retrieved from http://climatecenter.fsu.edu/images/docs/ClimateChange-factsheet.pdf

Contact Information

Sarasota School of Arts and Sciences
645 Central Avenue
Sarasota, Florida 34236
(941) 330-1855

Teachers:
Carlos Hernandez, 8th Grade Science, carloshernandez@ssas.org
Julia Calderon, 7th Grade Science, juliacalderon@ssas.org
Lauren Watson, 6th Grade Science, laurenwatson@ssas.org
Sara Kuhar, 7th Grade Science, sarakuhar@ssas.org

Students:

Ms. Watson's 6th Grade Students:	Mrs. Calderon's 7th Grade Students:	Mrs. Kuhar's 7th Grade Students:	Mr. Hernandez's 8th Grade Students:
Allison Anderson	Erin Boudreau	Xavier Alexander	Roman Zaccone
Carson Anderson	Devon Chiodo	Heather Dowd	Molli Walsleben
Logan Baumgardner	Ashlyn Downey-Hayes	Jayson Garcia	Andrew Toale
Martha Berber-Umana	Bryce Elfers	Michael Gowan	Summer Strickland
Sean Carroll	Daniel Erb	Mackenzie Grace	Jocelyn Starcher
Tristin Clarke	Mark-Elliot Finley	Derek Hering	Lazer Simon-Williams
Maxfield Curran	Kaitlyn Ganner	Max Kunkel	Matas Savickas
Garrett Gruttadauria	Kyle Guay	Nicholas Latsko	Ruben Nava
Emily Haywood	Anton Kernohan	Madilyn Lay	Alexander Mead
Lindsey Jennings	Joshua Kohler	Lauren Lobeck	Nicholas Levy
Tiffany Lam	Jason Korwin	Luke Massa	Pamela Kurpiewski
Brian Lane	Montserrat Leon	Riley McDonnell	Olivia Kracht
Nicole McKenna	Hannah Lucas	Laura McKenna	Joseph Kirschner
Kayleen Noonan	Anna Millbourn	Jayden Myers	Earle Kelly
Victoria Pabon	Anton Petrov	Wyatt Nowling	Tyler Hunt
Christopher Petrovich	Adrianna Pryor	Miles Perkins	Matthew Ginquitti
Aaron Prokupets	Harvey Sellers	James Reardon	Giulia Gardini
Christopher Rendle	Hannah Shiffner	Rachel Rice	Samantha Fonder
Kathryn Savage	Nathaniel Silverthorne	Anna Sand-Lambert	Taylor Destasio
Cinthya Suarez	Cameron Wright	Benjamin Simon	Kersten Damosh
Maya Torres	Olivia Wright	Ian VanArsdall	Arianna D'Angelo
Sune Venter	Brian Zimmerman		Emily Crump
			Bailey Casteel
			Raymond Bell