

Building Sustainable Physics Education Communities: Network Analysis of the STEP UP Program's First Cohort



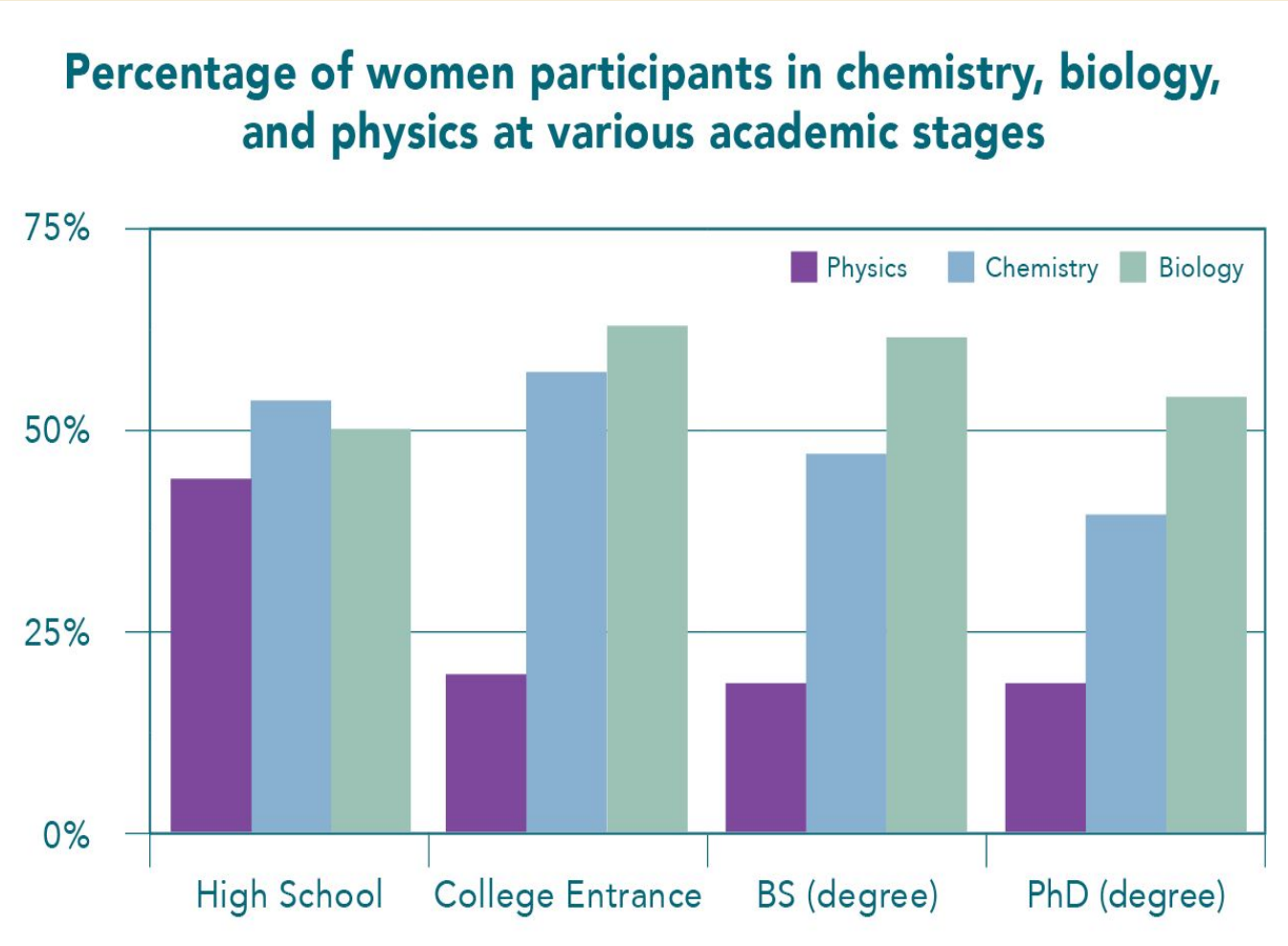
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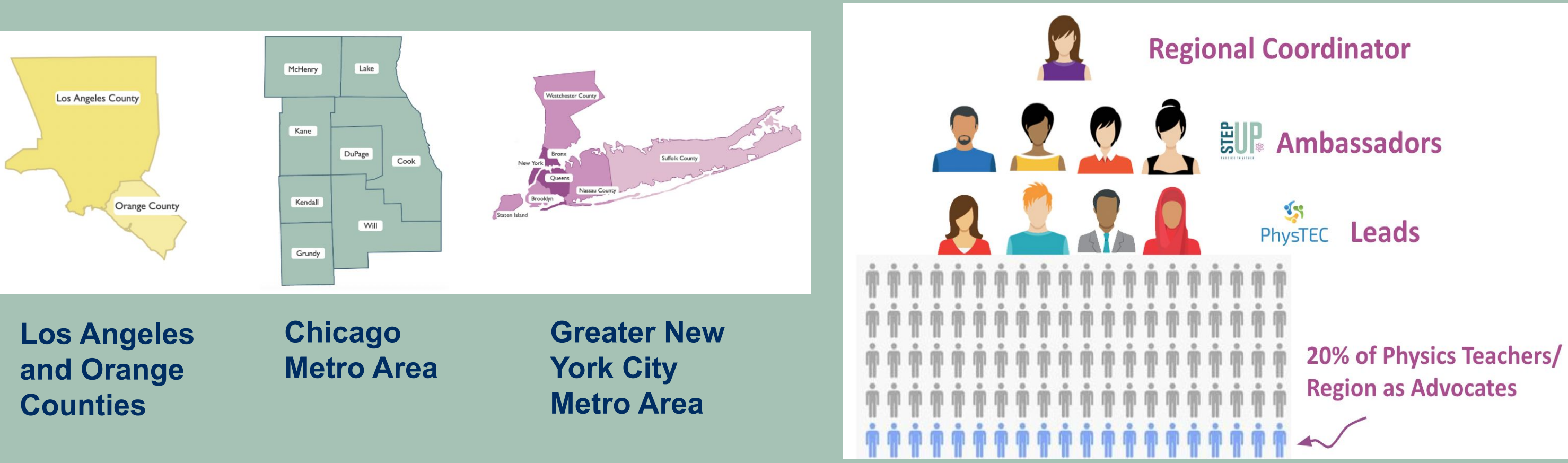
Introduction

- **47%** of the students taking at least one high school (HS) physics class identify as female, **only 20%** of physics majors in the first year of college are female [1,2].
- The largest proportions of **female students** who **continue** to undergraduate **physics programs** became **interested** in a physics career in **HS** [3].
- If we can recruit 20% of physics teachers to inspire one young woman to major in physics, we can approach parity [2,4].



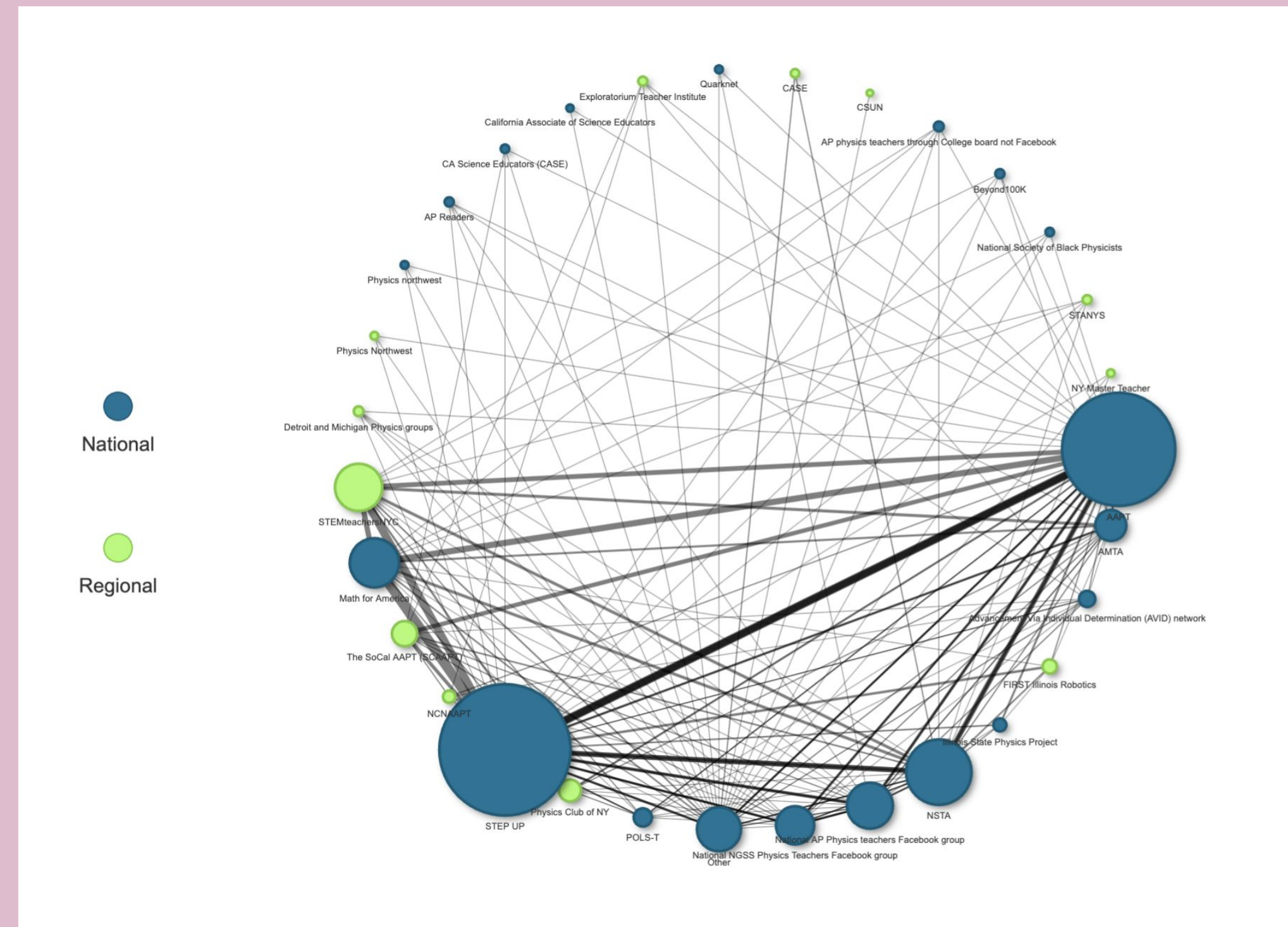
Community Model

Through a Moore Foundation Grant, the STEP UP team is implementing a community model in the three regions shown below. The purpose is to test a sustainable community model and recruit 20% of physics teachers in each region to teach the STEP UP curriculum, affect cultural change in classrooms, and inspire young women to pursue physics as an undergraduate.



Research Results

Communities that STEP UP Advocates are connected with:



- The most influential national community among STEP UP Advocates was found to be AAPT.
- Regional networks while having smaller nodes had strong connections with STEP UP

Hypotheses

- By analyzing teacher networks, we will learn how to **strengthen relationships and connectivity** between teachers to create **sustainability and longevity** for the STEP UP community.
- Teacher social network analysis can be used in physics education research to better understand **growth, sustainability, and utilization of teacher networks**.

Theoretical Framework

- Social network analysis has **primarily been used** in physics education research to study **student dynamics and attitudes** [5, 6].
- We found a **lack of studies** being conducted on **science teachers and the use of social networks**, as well as studies calling specifically to address this gap in literature [7].
- We believe that creating a **community of practice** will incentivize teachers to **continue implementing STEP UP lessons**, based on the **positive impact of strong teacher networks** on implementation of schoolwide reforms [8].

Methods

Survey Data Collection:

- Pre-survey distributed September 2023/ Post-survey in April 2024. For 3 different regions: Chicago, Los Angeles and New York City.
- Questions analyzed:
 - Q1: Which National and local teacher networks are you connected with?
 - Q2: With whom you have connected or communicated with BEFORE/AFTER the 2023-24 cohort activities began.

Region	Pre-survey count		Post-survey count	
	counts	counts *	counts *	counts
Chicago	28	11	11	13
LA	34	9	10	14
NYC	56	39	39	40
Total	118	59	60	67
no. of blank responses	33	13	10	11

* counts after filtering names from both surveys.

Data Processing

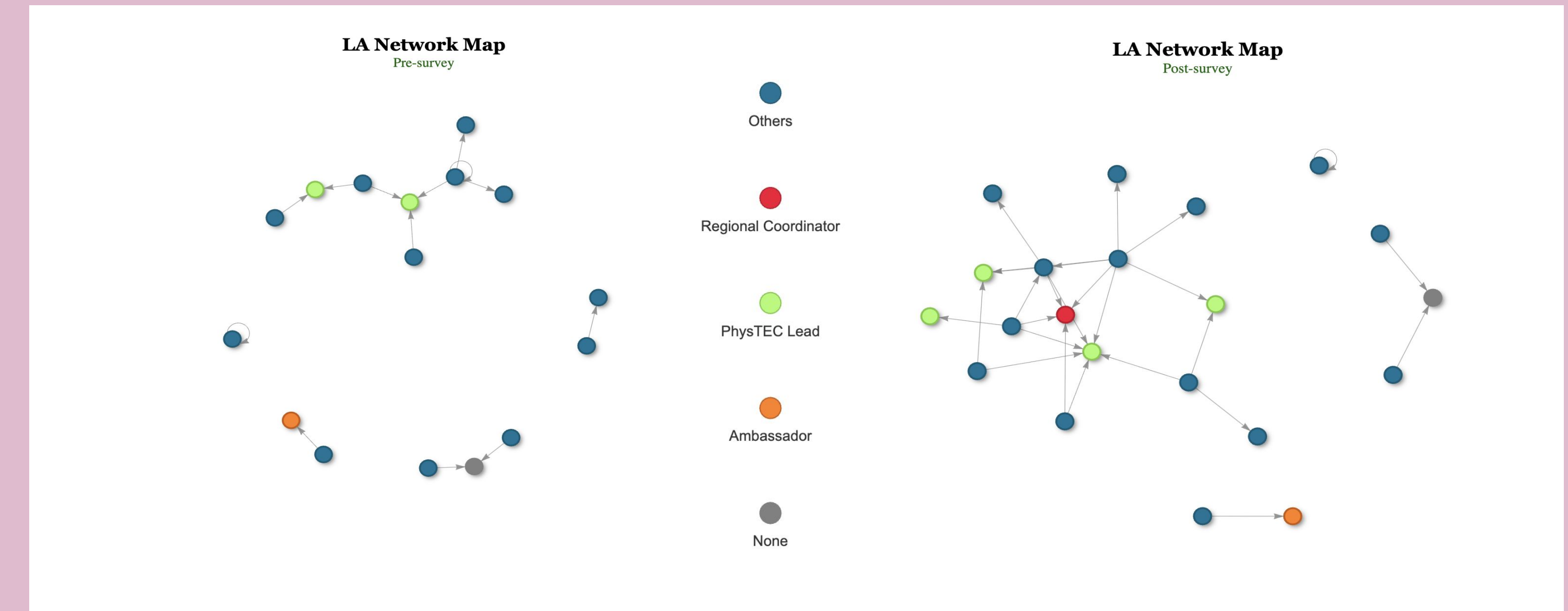
Q1:

- Regions were filtered, unique counts of 2 or more communities were created for each row.
- Size of nodes was assigned according to the frequency of the community's occurrence.
- Colors were assigned to distinguished National or Local Networks.
- Links between each pair were thicker according to the frequency with which they were selected by each individual.

Q2:

- Selected teachers were split into individual name-role pairs.
- Regions were filtered, names and their roles were extracted.
- For each node, colors were assigned according to their unique roles.
- Quantitative analysis: betweenness, closeness and degree of centralities were calculated for each node [9].
- 'visNetwork' library was used to visualize an interactive network for users, with a circular layout for Q1.

Los Angeles region pre/post map:



- Except for NY, all regions saw increased importance and connectivity over time.
- Teachers made more connections across the network over time.
- Among the coordinating team, the **Regional Coordinator** influence was significantly greater for LA and Chicago.
- NY **Ambassadors** became more connected and influential across the network, which is absent in Chicago and LA.



Other Network Maps

Ideas for Future

Next, we would like to continue to evaluate to following questions:

- Are networks sustainable? And how do we strengthen the networks?
- Does building teacher networks help with building teacher identity as a physics teacher?
- What are the most effective ways to partner with teacher networks to help STEP UP fulfill our mission?



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[4] White, S., & Tesfaye, C. L. (2011). Female students in high school physics. American Institute of Physics, College Park, MD
[5] D.Z. Grunspan, B.L. Wiggins, and S.M. Goodreau, "Understanding Classrooms through Social Network Analysis: A Primer for Social Network Analysis in Education Research," *Cell Biol. Educ.*
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[7] Polizzi, Samuel J., et al. "Exploratory Social Network Analysis of Science Teacher Leaders' Communities of Practice." *Proceedings of the National Association for Research in Science Teaching, Baltimore, MD, USA* (2016).
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