Systems Thinking in Communities:

Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in Philadelphia, Pennsylvania

This community storybook was developed by Transtria LLC.

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Acknowledgments

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Introduction

Healthy Kids, Healthy Communities: Out-of-School Time (OST) Partnership is one of 49 community partnerships participating in the national *Healthy Kids, Healthy Communities* program of the Robert Wood Johnson Foundation (www.healthykidshealthycommunities.org). The purpose of this *Healthy Kids, Healthy Communities: OST Partnership* project was to introduce systems thinking at the community level by identifying the essential parts of the Philadelphia, Pennsylvania system and how the system influences policy and environmental changes to promote healthy eating and active living as well as to prevent childhood obesity. To accomplish this goal, community partners participated in a group model building session and discussions. The group model building exercises were designed by staff from Transtria LLC and the Social System Design Lab at Washington University in St. Louis, Missouri as part of the *Evaluation of Healthy Kids, Healthy Communities* funded by the Robert Wood Johnson Foundation. These exercises actively involved a wide range of participants in modeling complex systems and provided a way for different representatives (e.g., schools, after-school centers, government agencies, research/evaluation organizations) to better understand the systems (i.e., dynamics and structures) in the community (see the *Healthy Kids, Healthy Communities Group Model Building Facilitation Handbook*, www.transtria.com/hkhc). Overall, the evaluation was designed to assess policy, system, and environmental changes as a result of the community partnerships' efforts to increase healthy eating and active living in order to reduce childhood obesity.

Philadelphia, Pennsylvania: Background and Local Participation

Philadelphia, Pennsylvania is the nation's fifth largest city, with a population of 1,526,006. Residents of the city are mainly black (43.4%) and white (43.4%), although other racial and ethnic groups are represented (Asian 6.3%; American Indian and Alaska Native 0.5%; Hispanic or Latino 12.3%). Twenty-one percent of residents speak a language other than English at home. The median household income is $37,000 and about 30% of persons are living below the poverty level.

The Health Promotion Council (HPC) of Southeastern Pennsylvania, Inc. was the lead agency for the Healthy Kids, Healthy Communities: Out-of-School Time (OST) Partnership. HPC is a non-profit agency, founded in 1981, governed by a board of directors. The OST Partnership focused on implementing Healthy Living Guidelines in over 200 sites funded by the Philadelphia's Department of Human Services and managed by the Public Health Management Corporation. Reaching over 20,000 low-income Philadelphia youth from kindergarten to twelfth grade, the program provides after-school and summer opportunities.

The OST Partnership began as a result of HKHC funding; however many partners worked together on the Philadelphia Urban Food Fitness Alliance for several years beforehand. HKHC HPC and OST staff and partners formed a Leadership Team to provide strategic direction for the project. Over 80 individuals participated in meetings to provide expertise on OST systems, nutrition, and physical activity.

HPC and OST staff, along with HKHC Partners, formed a leadership team to provide strategic direction for the project. Approximately 80 individuals from 38 different organizations were invited to participate and provide expertise on OST systems, nutrition, physical activity, obesity, government, community, and policy. Individuals on the leadership team had diverse backgrounds and experiences.

Over the duration of the initiative, partners have been supportive and dedicated to the OST work. The partnership has allowed partner organizations to improve collaborative skills and glean useful resources from other groups without competition.

Healthy Kids, Healthy Communities: OST Partnership's Priorities and Strategies

The partnership and capacity building strategies of *Healthy Kids, Healthy Communities: OST Partnership* included:

- **Parent Involvement:** A parent leadership team was created to better understand parents' perspectives and to glean recommendations on nutrition and physical activity standards in the OST programs.
- **Youth Involvement:** Leadership teams were formed at the middle and high schools levels. The purpose of the teams was to engage youth in discussions and to obtain feedback on nutrition and physical activity standards.
- **Healthy Living Guidelines for Out-of-School Time Programs Toolkit:** The OST Partnership created a Healthy Living Guidelines for Out-of-School Time Programs Toolkit for OST staff and parents. The toolkit contained OST resources and information on how to implement the guidelines. The City of Philadelphia approved the toolkit, and it was distributed to over 180 programs throughout Philadelphia.
- **Training and Technical Assistance:** OST partners and HPC HKHC staff provided trainings and technical assistance to OST staff on implementation of the Healthy Living Guidelines.

The healthy eating and active living strategies of *Healthy Kids, Healthy Communities: OST Partnership* included:

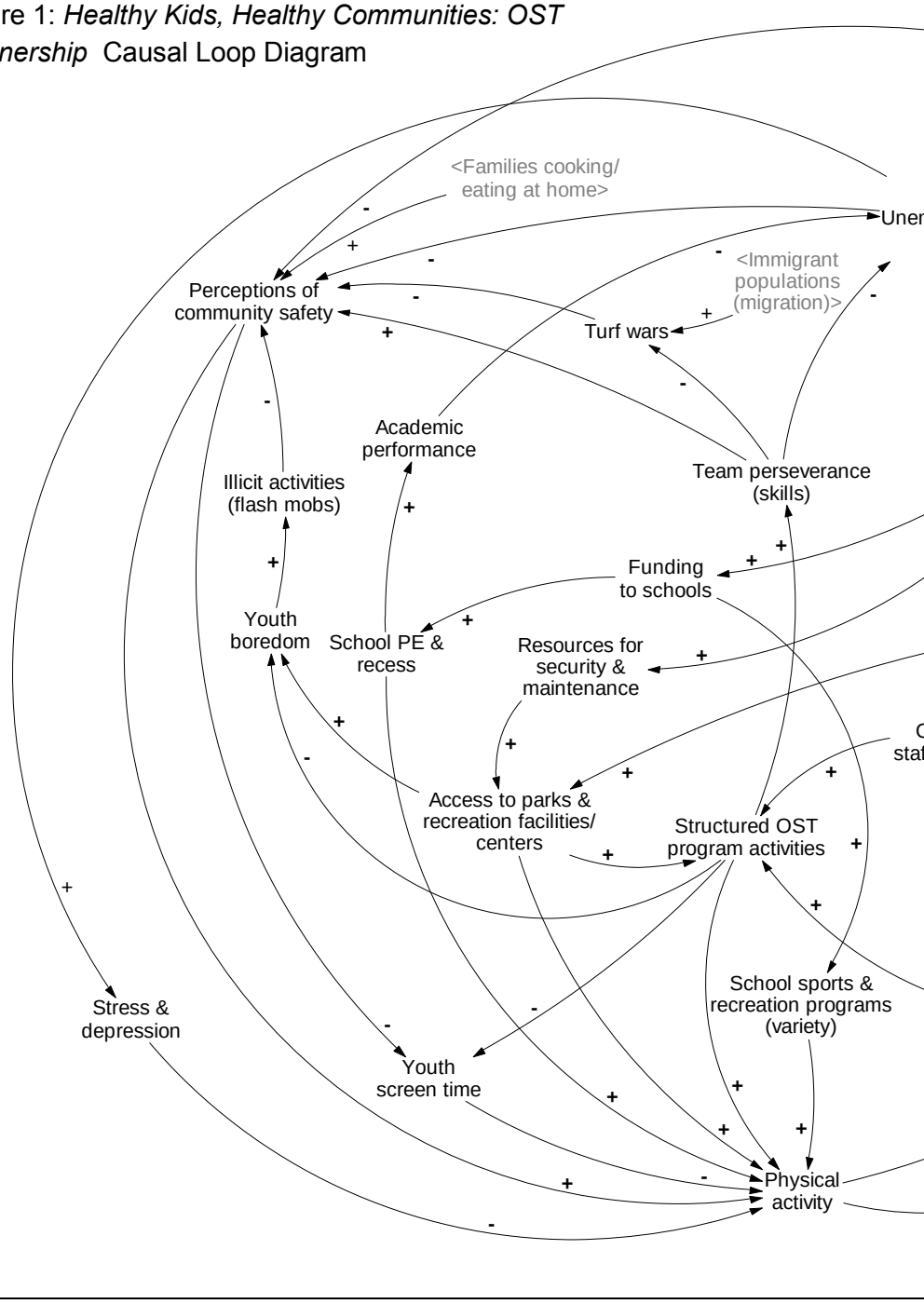
- **Childcare Nutrition and Physical Activity Standards:** HPC partnered with Philadelphia's Department of Human Services, Philadelphia Department of Public Health, and Public Health Management Corporation to implement Healthy Living Guidelines in over 200 OST sites. The guidelines focused on improving nutrition and physical activity of youth attending OST programs.

For more information on the partnership, please refer to the Philadelphia case report (www.transtria.com/hkhc).

Systems Thinking in Communities: Philadelphia, Pennsylvania

"Systems thinking" represents a range of methods, tools, and approaches for observing the behaviors of a system (e.g., family, community, organization) and how these behaviors change over time; changes may occur in the past, present, or future. Figure 1 illustrates a system of policies, environments, local collaborations, and social determinants in Philadelphia, Pennsylvania that influence healthy eating, active living, and, ultimately, childhood obesity. This system and the dynamics within the system are complicated with many different elements interacting.

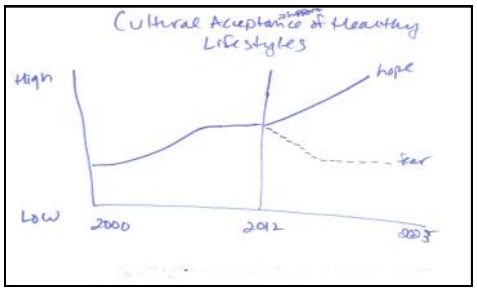
Figure 1: *Healthy Kids, Healthy Communities: OST Partnership* Causal Loop Diagram



Models, such as Figure 1, provide a way to visualize all the elements of the system and their interactions, with a focus on causal relationships as opposed to associations. Through the model, specific types of causal relationships, or feedback loops, underlying the behavior of the dynamic system, can be identified to provide insights into what is working or not working in the system to support the intended outcomes (in this case, increases in healthy eating and active living, and decreases in childhood overweight and obesity). In system dynamics, the goal is to identify and understand the system feedback loops, or the cause-effect relationships that form a circuit where the effects "feed back" to influence the causes.

Group Model Building

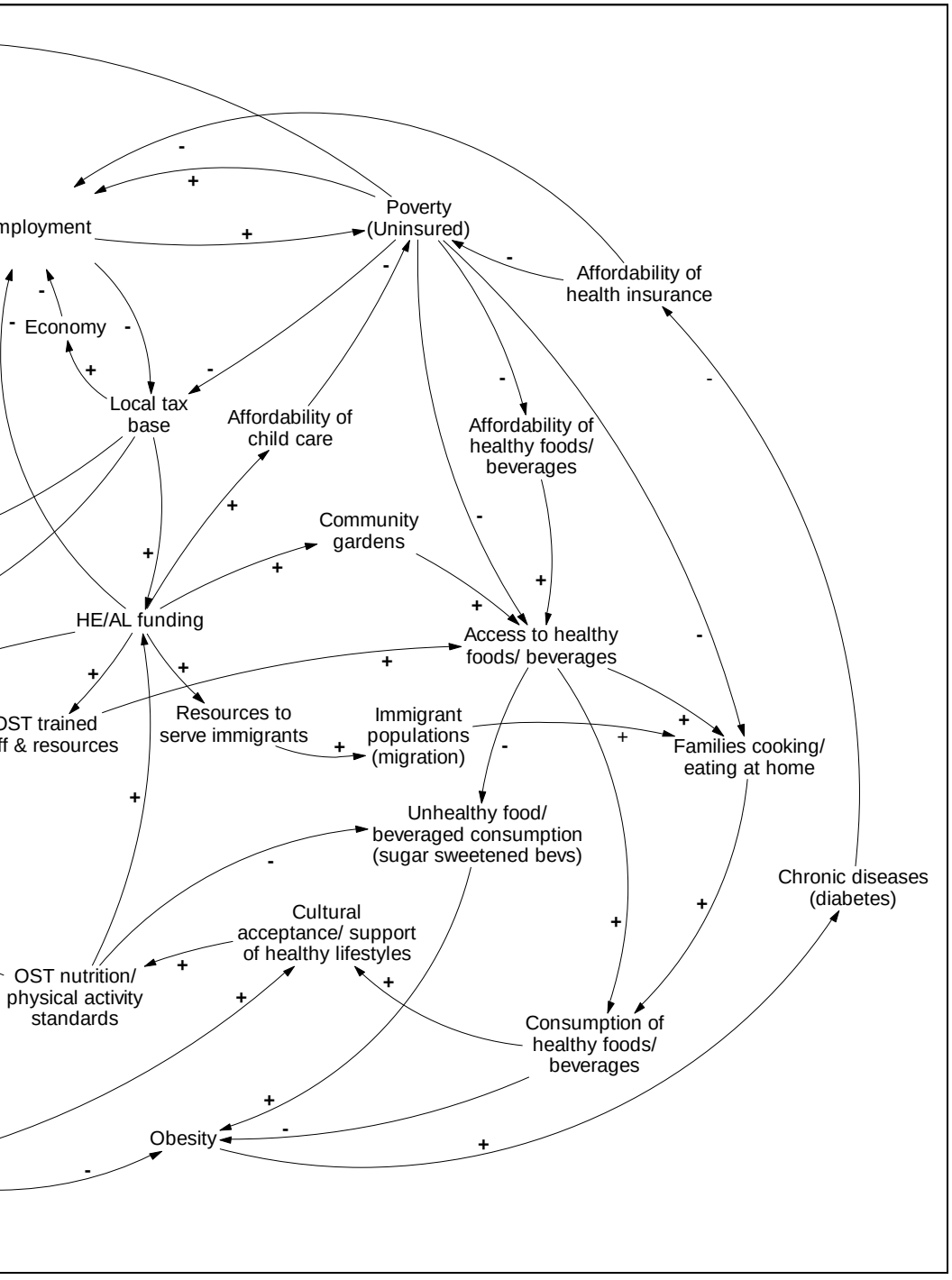
Members of the *Healthy Kids, Healthy Communities: OST Partnership* partnership participated in a group model building session in February, 2012 and generated this system. also referred to as a causal loop diagram (Figure 1). Participants in the group model building session included representatives from schools, after-school centers, government agencies, and research/evaluation organizations. The group model building session had two primary activities: 1) a Behavior Over Time Graph exercise; and 2) a Causal Loop Diagram (or structural elicitation) exercise.



<u>Behavior Over Time Graphs</u>

To identify the range of things that affect or are affected by policy, system, and environmental changes in Philadelphia related to healthy eating, active living, and childhood obesity, participants designed graphs to name the influences and to illustrate how the influences have changed over time (past, present, and

future). In this illustration for cultural acceptance of healthy lifestyles, the amount of acceptance has increased since 2000 and the participant hopes that this increase will continue into the future. Each graph is a tool to increase the use of common, specific language to describe *what* is changing in the community as well as *when*, *where*, and *how* it is changing. The graphs capture participants' perceptions of the influence, or variable, and through the graph, the participant tells their story. These perceptions are based on actual data or evidence, or they are part of the participants' lived experience.



Causal Loop Diagram

To examine the relationships among the variables from the behavior over time graphs, participants worked together and with facilitators to develop a causal loop diagram. In Figure 1, the words represent variables of quantities that can increase and decrease over time (i.e., the behavior over time graphs). These variables are influenced by other variables as indicated by the lines with arrows. The lines with arrows represent causal relationships - this is what is known about the system and how it behaves.

One feedback loop is: local tax base → economy → unemployment → local tax base.

What is important to notice is that there are other feedback loops interacting simultaneously to influence or to be influenced by local tax base. Some variables may increase local tax base while other variables limit it. Determining the feedback loop or loops that dominate the system's behavior at any given time is a more challenging problem to figure out, and ultimately, requires the use of computer simulations.

Based on this preliminary work by the *Healthy Kids, Healthy Communities: OST Partnership* partnership, this "storybook" ties together the behavior over time graphs, the participants' stories and dialogue, and feedback loops from the causal loop diagram to understand the behavior of the system affecting health in Philadelphia, Pennsylvania and to stimulate greater conversation related to Philadelphia's theory of change, including places to intervene in the system and opportunities to reinforce what is working. Each section builds on the previous sections by introducing concepts and notation from systems science.

Causal Loop Diagram for the Childhood Obesity System

The causal loop diagram (CLD) represents a holistic system and several subsystems interacting in Philadelphia, Pennsylvania. In order to digest the depth and complexity of the diagram, it is helpful to examine the CLD in terms of the subsystems of influence. Because of this project's focus on healthy eating, active living, and childhood obesity, this system draws attention to a number of corresponding subsystems, including: healthy eating policies and environments (red), active living policies and environments (blue), health and health behaviors (orange), partnership and community capacity (purple), and social determinants (green).

From the group model building exercises, several variables and causal relationships illustrated in Figure 2 were identified within and across subsystems. This section describes the subsystems in the CLD.

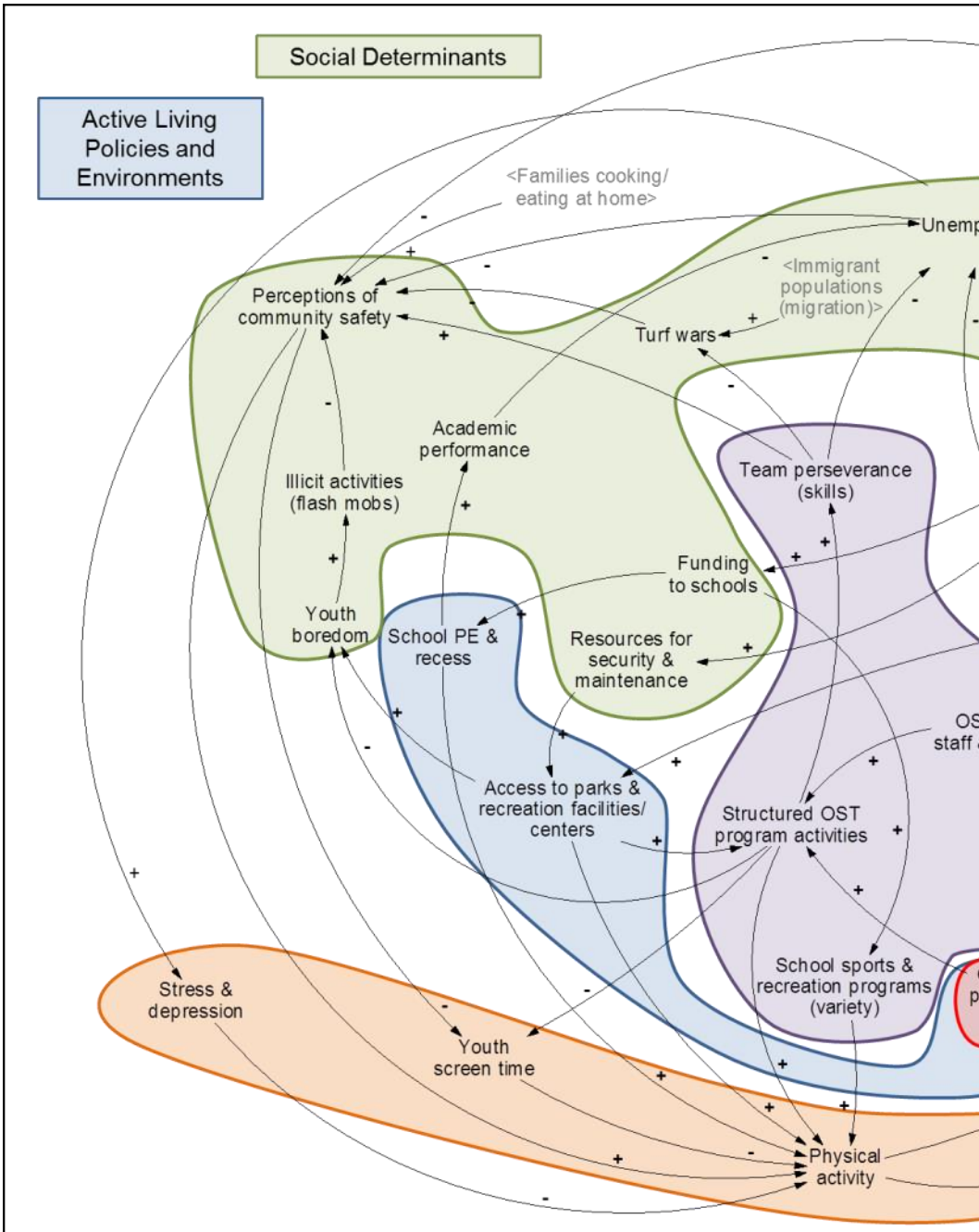


Figure 2: Subsystems in the *Healthy Kids, Healthy Communities: OST Partnership* Causal Loop Diagram

Healthy Eating Policies and Environments (Red)

The healthy eating policy and environmental subsystem includes food production, food distribution and procurement, and food retail. During the behavior over time graphs exercise, the participants generated twelve graphs related to policy or environmental strategies (e.g., out-of-school time nutrition standards) or contexts (e.g., affordability of healthy foods and beverages) that affected or were affected by the work of *Healthy Kids, Healthy Communities: OST Partnership*. The variables represent participants' conversations from the behavior over time graph and causal loop diagram exercises.

Active Living Policies and Environments (Blue)

The active living policy and environmental subsystem includes design, planning, construction, and enforcement or maintenance related to access to opportunities for active transportation and recreation. For this topic, the group model building participants developed seven graphs related to policy or environmental strategies (e.g., access to parks and recreation facilities or centers) or contexts (e.g., physical education and recess in schools) that affected or were affected by the partnership's work.

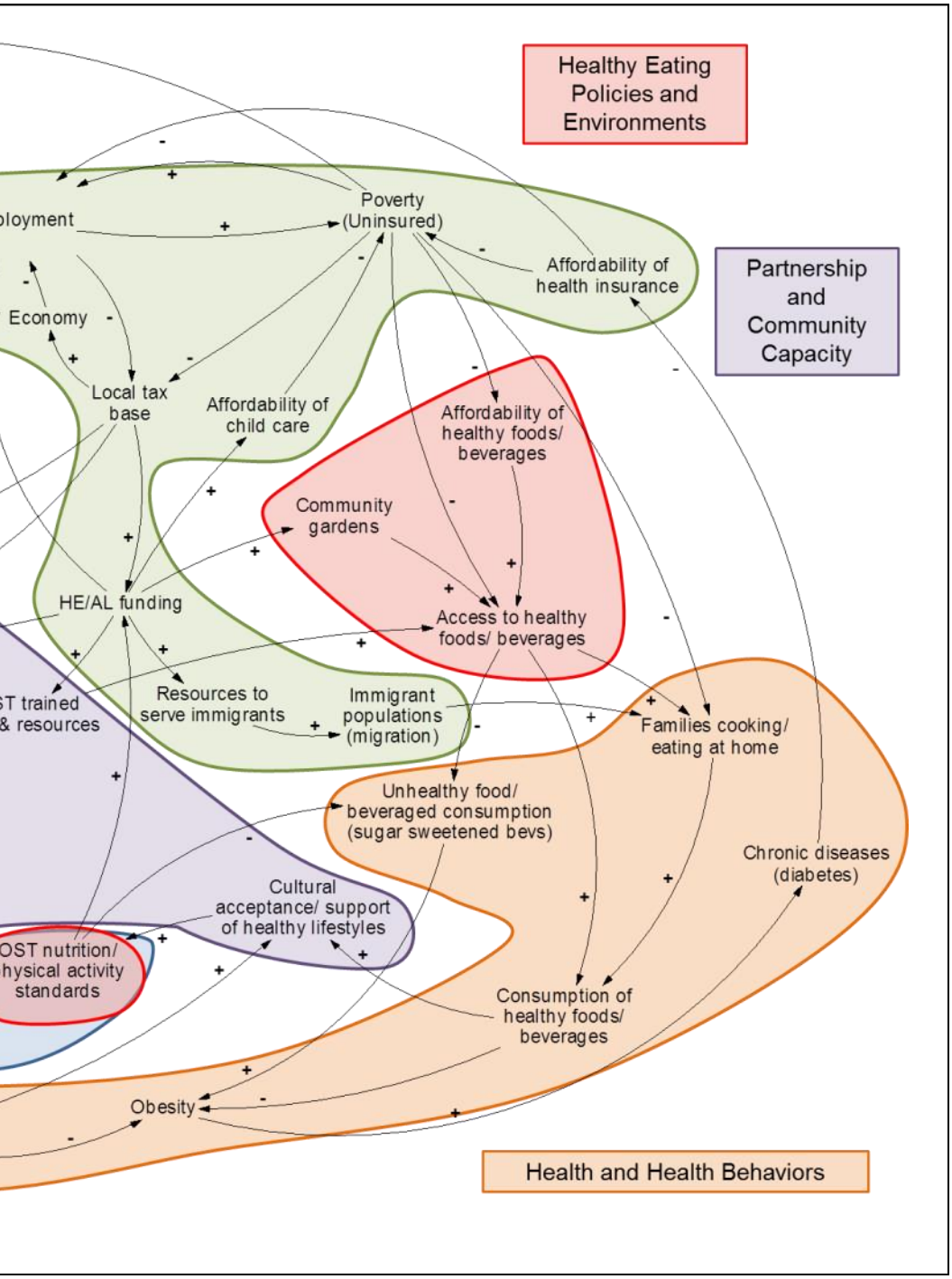
Health and Health Behaviors (Orange)

The subsystem for health and health behaviors includes health outcomes (e.g., obesity), health behaviors

(e.g., healthy eating, physical activity), and behavioral proxies or context-specific behaviors (e.g., families cooking and eating at home).

Partnership and Community Capacity

The partnership and community capacity subsystem refers to the ways communities organized and rallied for changes to the healthy eating and active living subsystems. For instance, *Healthy Kids, Healthy Communities: OST Partnership* trained staff and provided them with a toolkit. This subsystem also includes community factors outside the partnership that may influence or be influenced by their efforts, such as cultural acceptance and support of healthy lifestyles.



Social Determinants

Finally, the social determinants subsystem denotes societal conditions (e.g., poverty) and psychosocial influences (e.g., youth boredom) in the community that impact health beyond the healthy eating and active living subsystems. In order to achieve health equity, populations and subgroups within the community must have equitable access to these resources and services.

Each one of these subsystems has many more variables, causal relationships (arrows), and feedback loops that can be explored in greater depth by the *Healthy Kids, Healthy Communities: OST Partnership* partners or by other representatives in Philadelphia, Pennsylvania . Using this CLD as a starting place, community conversations about different theories of change within subsystems may continue to take place.

The next sections begin to examine the feedback loops central to the work of *Healthy Kids, Healthy Communities: OST Partnership*. In these sections, causal relationships and notations (i.e., arrows, "+" signs, "-" signs) from Figure 2 will be described to increase understanding about how systems thinking and modeling tools can work in communities to increase understanding of complex problems that are continuously changing over time, such as childhood obesity. At the end of this CLD storybook, references to other resources will be provided for those interested in more advanced systems science methods and analytic approaches.

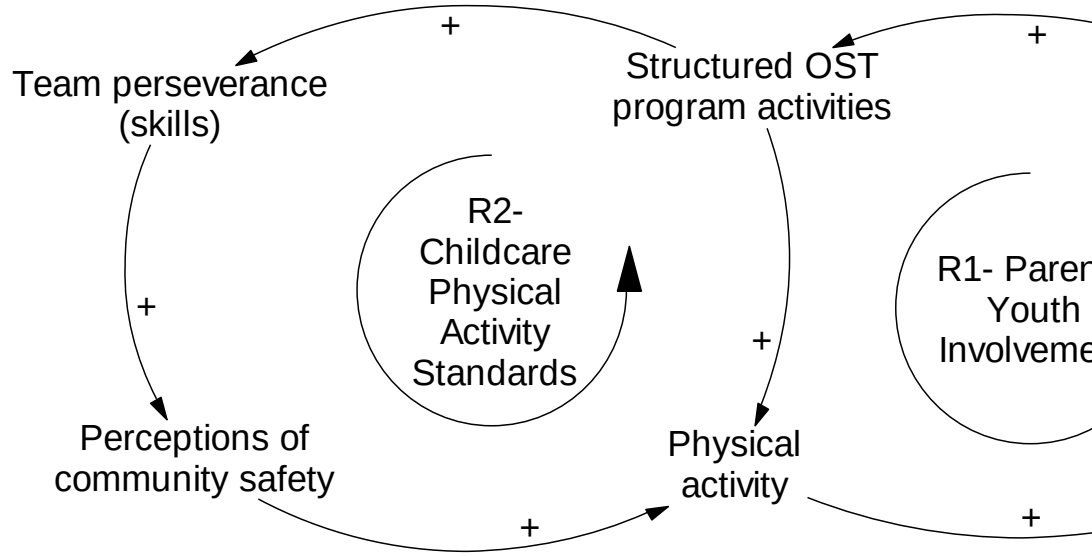
Child Care Nutrition Standards Feedback Loop

To simplify the discussion about feedback loops, several loops drawn from the *Healthy Kids, Healthy Communities: OST Partnership* CLD (see Figures 1 and 2) are shown in Figure 3. While the CLD provides a theory of change for the childhood obesity prevention movement in Philadelphia, Pennsylvania, each feedback loop tells a story about a more specific change process.

Causal Story for Feedback Loop

Story A: In this case , the story is about child care nutrition standards (blue highlighted loop in Figure 3). Philadelphia, Pennsylvania partners developed Healthy Living Guidelines in over 200 OST sites, focusing on improving nutrition and physical activity of youth attending OST programs. Participants described how OST nutrition standards increased funding for healthy eating initiatives that, in turn, paid for trained staff and resources to implement the guidelines. As a result, youth in the OST programs had greater access to healthy foods and beverages that increased their consumption of these foods and beverages. With a larger number of kids eating (and drinking) healthy, there is greater overall cultural acceptance and support of healthy lifestyles. This shift in norms increases the likelihood of adoption of these standards in other settings.

Figure 3: Child Care Nutrition Standards Feedback Loop



Story B: While the preceding story reflected a positive scenario for Philadelphia, Pennsylvania, the same feedback loop also tells the opposite story. Without nutrition standards, funds are not allocated to support nutrition training and resources to increase access to healthy foods and beverages in OST sites. Consequently, youth in the programs are less likely to consume healthier foods and beverages, making cultural acceptance and support of healthy eating less prevalent and, in turn, nutrition standards less popular.

Reinforcing Loop and Notation

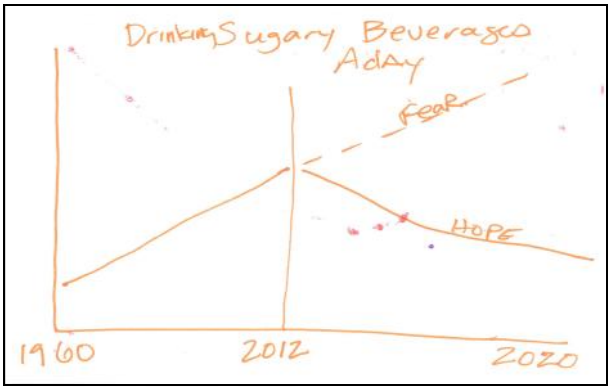
These stories represent a reinforcing loop, and the notation in the feedback loop identifies it as a reinforcing loop (see "R3 — Childcare nutrition standards" and blue highlighted loop in Figure 3). The words represent variables of quantities that increase and decrease as illustrated in the stories above. These variables change over time and are influenced by other variables as indicated by the arrows. Each arrow represents a causal relationship, and the plus and minus signs on the arrows indicate whether or not the influence of one variable on another variable (1) increases/adds to (plus or "+" sign), or (2) decreases/removes from the other variable (minus or "-" sign). These signs are referred to as polarities.

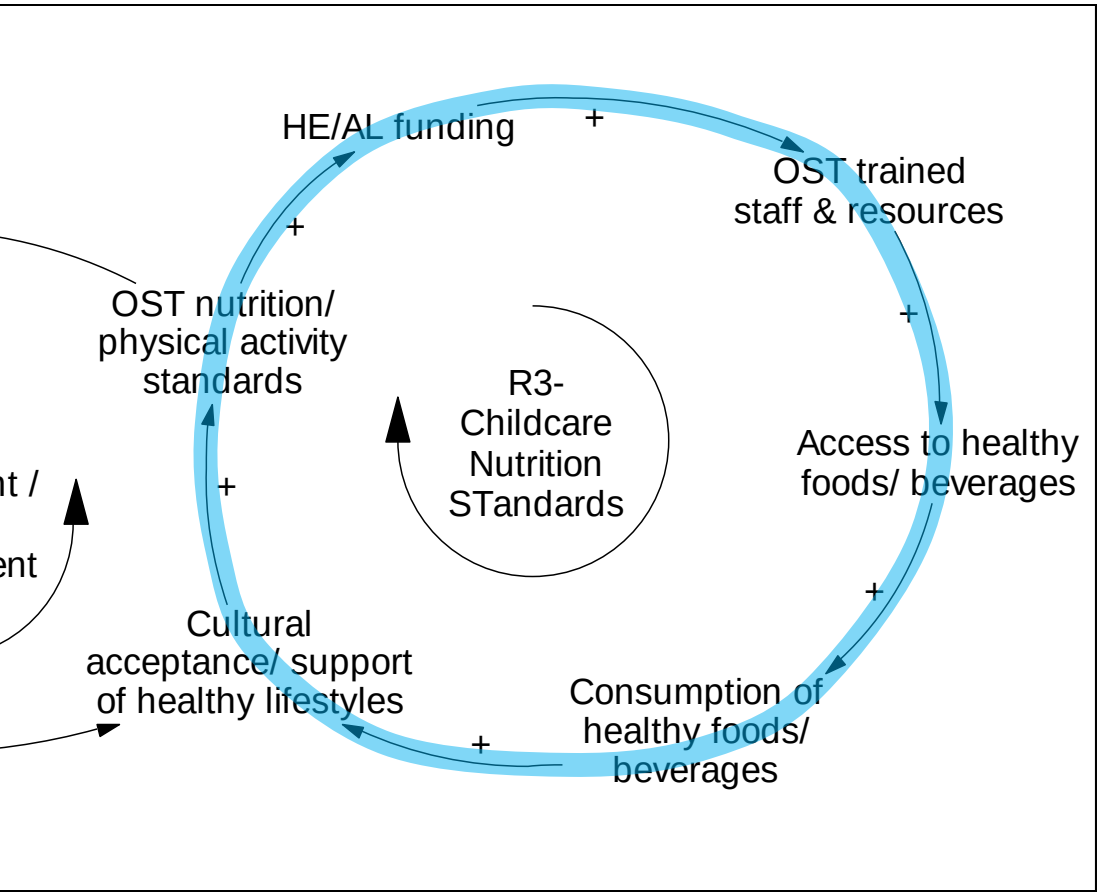
"And you could also say that OST standards could have a decrease on sugar-sweetened beverages, because there's also that standard in this initiative that says take those out of your programs. No more Capri Suns." (Participant)

In a reinforcing loop, the effect of an increase or decrease in a variable continues through the cycle and returns an increase or decrease to the same variable, respectively.

Looking specifically at the "+" or "-" notation, a feedback loop that has zero or an even number of "-" signs, or polarities, is considered a reinforcing loop. Balancing loops, with an odd number of "-" signs in the loop, are another type of feedback loop.

In isolation, this reinforcing loop represents the influence of child care nutrition standards on consumption of healthy foods and beverages. To understand other influences on these variables, it is important to remember that this reinforcing loop is only one part of the larger CLD (see Figures 1 and 2), and the other loops and causal relationships can have an impact on the variables in this loop.



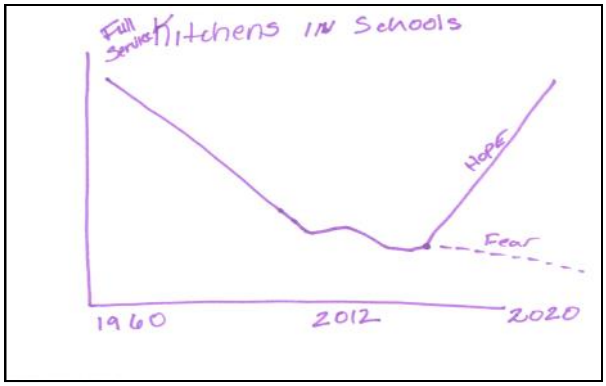


<u>System Insights for *Healthy Kids, Healthy Communities: OST Partnership*</u>

Since 1960, participants identified a fairly steady decline in the number of full-service kitchens in schools as well as a continuous increase in the number of kids drinking sugary beverages in Philadelphia, Pennsylvania (see behavior over time graphs).

From the systems thinking exercises, several insights can inform partners' child care nutrition standards strategy. For instance, nutrition standards can help to reinstate full-service kitchens in schools and other OST settings to ensure these settings are equipped to store and prepare healthy foods and beverages, or the standards can limit the amount of sugar in beverages served in OST programs.

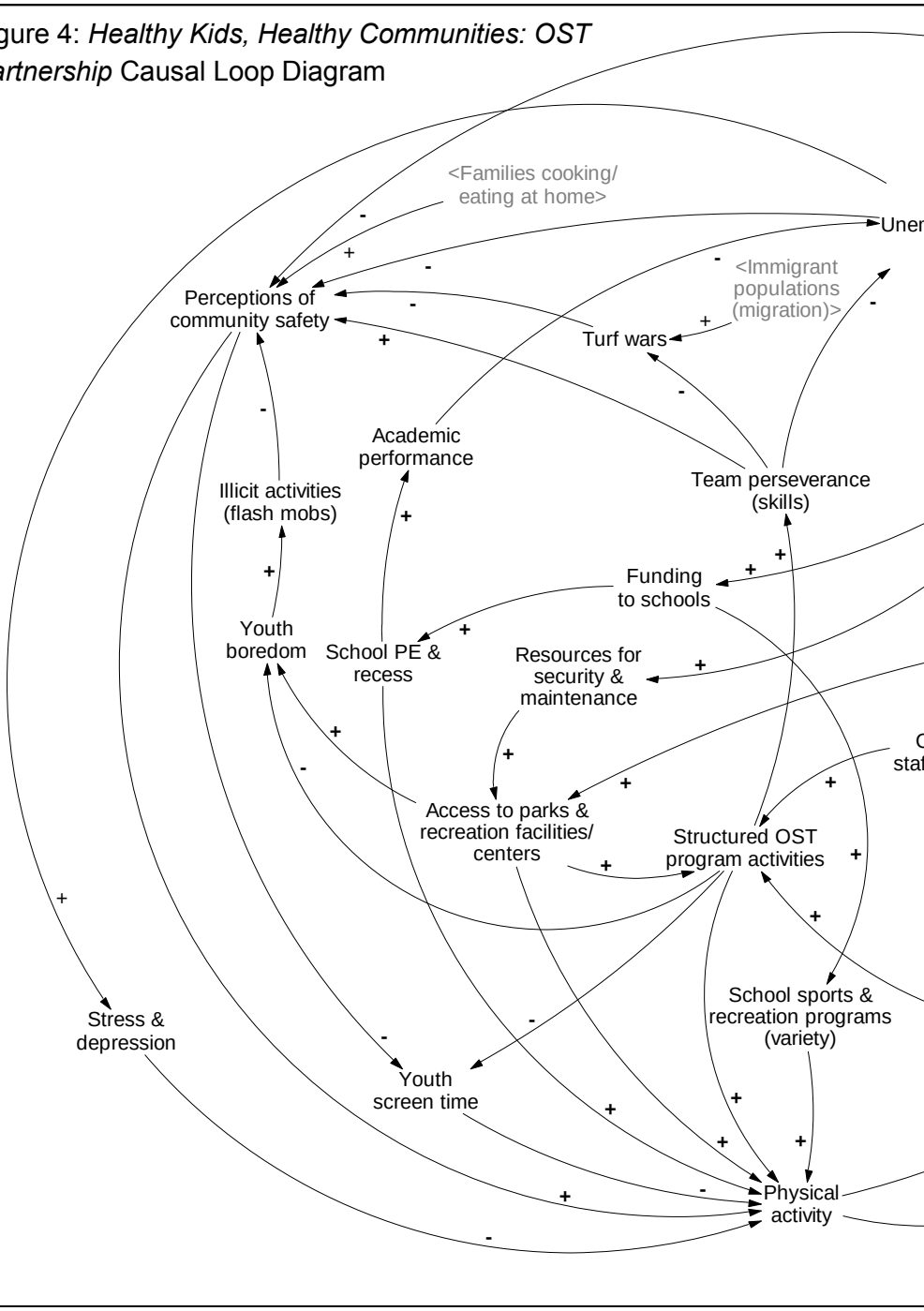
In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including development of assessment tools and protocols to measure cultural acceptance and support of healthy lifestyles, evaluation of standards most effective in increasing consumption of healthy foods and beverages, and assessing the return on investment from funds spent on healthy eating initiatives in OST programs.



Opportunities for Systems Thinking in Philadelphia, Pennsylvania

This storybook provided an introduction to some basic concepts and methods for systems thinking at the community level, including: causal loop diagrams, variables, causal relationships and polarities, reinforcing feedback loops, and balancing feedback loops, among others. For the *Healthy Kids, Healthy Communities: OST Partnership* partners, this storybook also summarized the healthy eating, active living, partnership and community capacity, social determinants, and health and health behaviors subsystems in the Philadelphia causal loop diagram as well as an example feedback loop corresponding to the partnership's primary strategies.

Figure 4: *Healthy Kids, Healthy Communities: OST Partnership* Causal Loop Diagram



This causal loop diagram reflects a series of conversations among partners and residents from 2011 to 2013. Some discussions probed more deeply into different variables through the behavior over time graphs exercise, or causal relationships through the causal loop diagram exercise.

This represented a first attempt to collectively examine the range of things that affect or are affected by policy, system, and environmental changes in Philadelphia, Pennsylvania to promote healthy eating and active living as well as preventing childhood overweight and obesity.

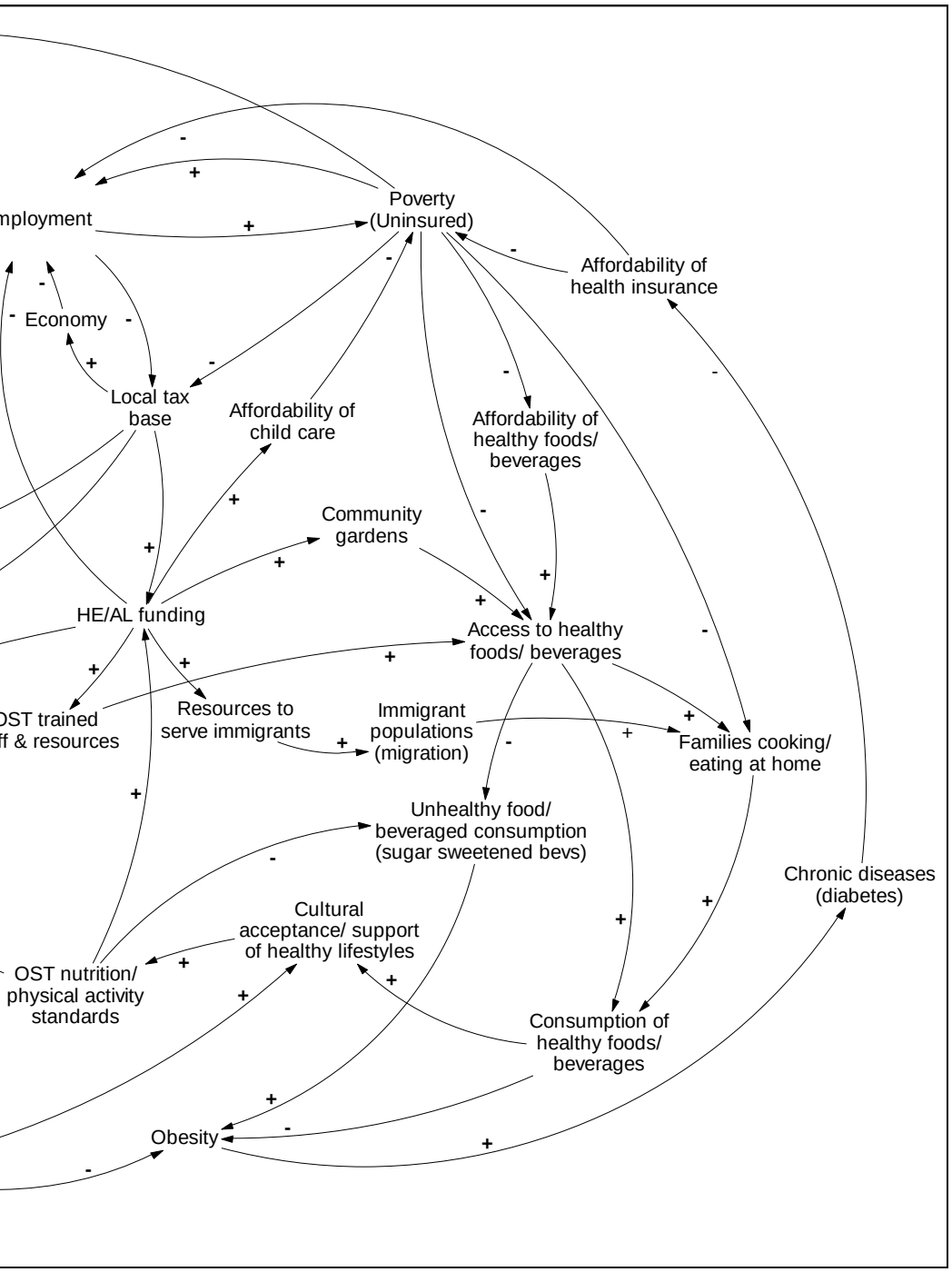
Yet, there are several limitations to this storybook, including:

- the participants represent a sample of the *Healthy Kids, Healthy Communities: OST Partnership* partners (organizations and residents) as opposed to a representative snapshot of government agencies, community organizations, businesses, and community residents;
- the behavior over time graphs and the causal loop diagram represent perceptions of the participants in these exercises (similar to a survey or an interview representing perceptions of the respondents);
- the exercises and associated dialogue took place in brief one- to two-hour sessions, compromising the group's capacity to spend too much time on any one variable, relationship, or feedback loop; and
- the responses represent a moment in time so the underlying structure of the diagram and the types of feedback represented may reflect "hot button" issues of the time.

Much work is yet to be done to ensure that this causal loop diagram is accurate and comprehensive, for

example:

- having conversations to discuss existing feedback loops to ensure that the appropriate variables and relationships are represented accurately;
- reviewing the behavior over time graphs (see also Appendix D) to confirm that the trends reflect common perceptions among residents and compare these trends to actual data;
- revisiting variables removed because they were not part of feedback loops, including grocery stores, farmers' markets, healthy options in corner stores, fast food restaurants, full-service kitchens in schools, access to ped/bike facilities, active transportation (biking, walking), city council support, zoning land for local food production, academic programs; and
- starting new conversations about other variables (behavior over time graphs exercise) or relationships (causal loop diagram exercise) to add to this diagram.



In addition, different subgroups in Philadelphia may use this causal loop diagram to delve in deeper into some of the subsectors (e.g., healthy eating, active living) or feedback loops, creating new, more focused causal loop diagrams with more specific variables and causal relationships.

Use of more advanced systems science methods and analytic approaches to create computer simulation models is another way to take this early work to the next level. The references section includes citations for resources on these methods and analytic approaches, and it is necessary to engage professional systems scientists in these activities.

Please refer to the Appendices for more information, including:

- Appendix A: Behavior over time graphs generated during site visit
- Appendix B: Original translation of the causal loop diagram into Vensim PLE
- Appendix C: Transcript translation of the causal loop diagram into Vensim PLE
- Appendix D: Behavior over time graphs not represented in the storybook

References for Systems Thinking in Communities:

Group model building handbook:
Hovmand, P., Brennan L., & Kemner, A. (2013). Healthy Kids, Healthy Communities Group Model Building Facilitation Handbook. Retrieved from http://www.transtria.com/hkhc.

Vensim PLE software for causal loop diagram creation and modification:
Ventana Systems. (2010). Vensim Personal Learning Edition (Version 5.11A) [Software]. Available from http://vensim.com/vensim-personal-learning-edition/

System dynamics modeling resources and support:
Andersen, D. F. and G. P. Richardson (1997). "Scripts for group model building." System Dynamics Review 13(2): 107-129.

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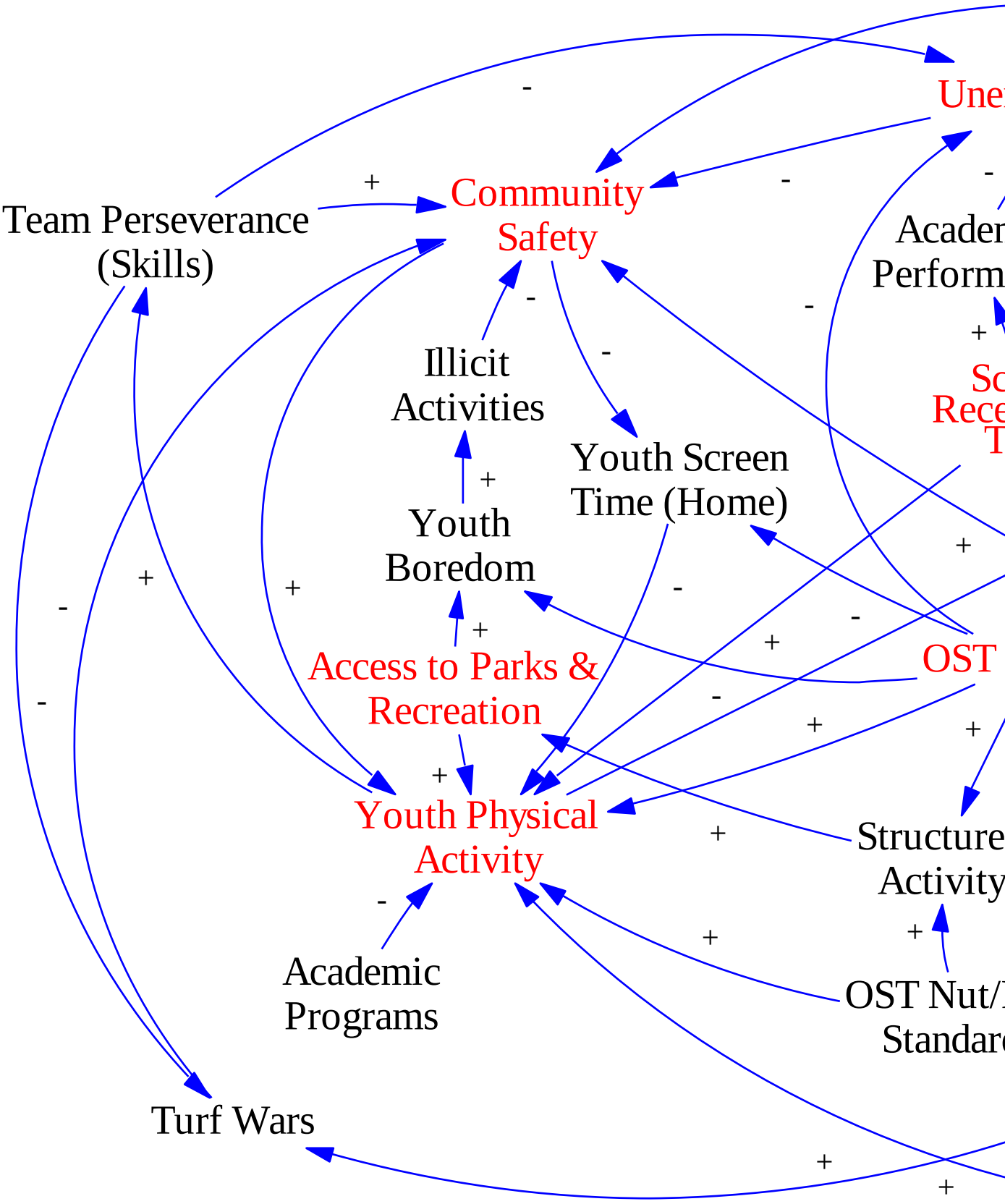
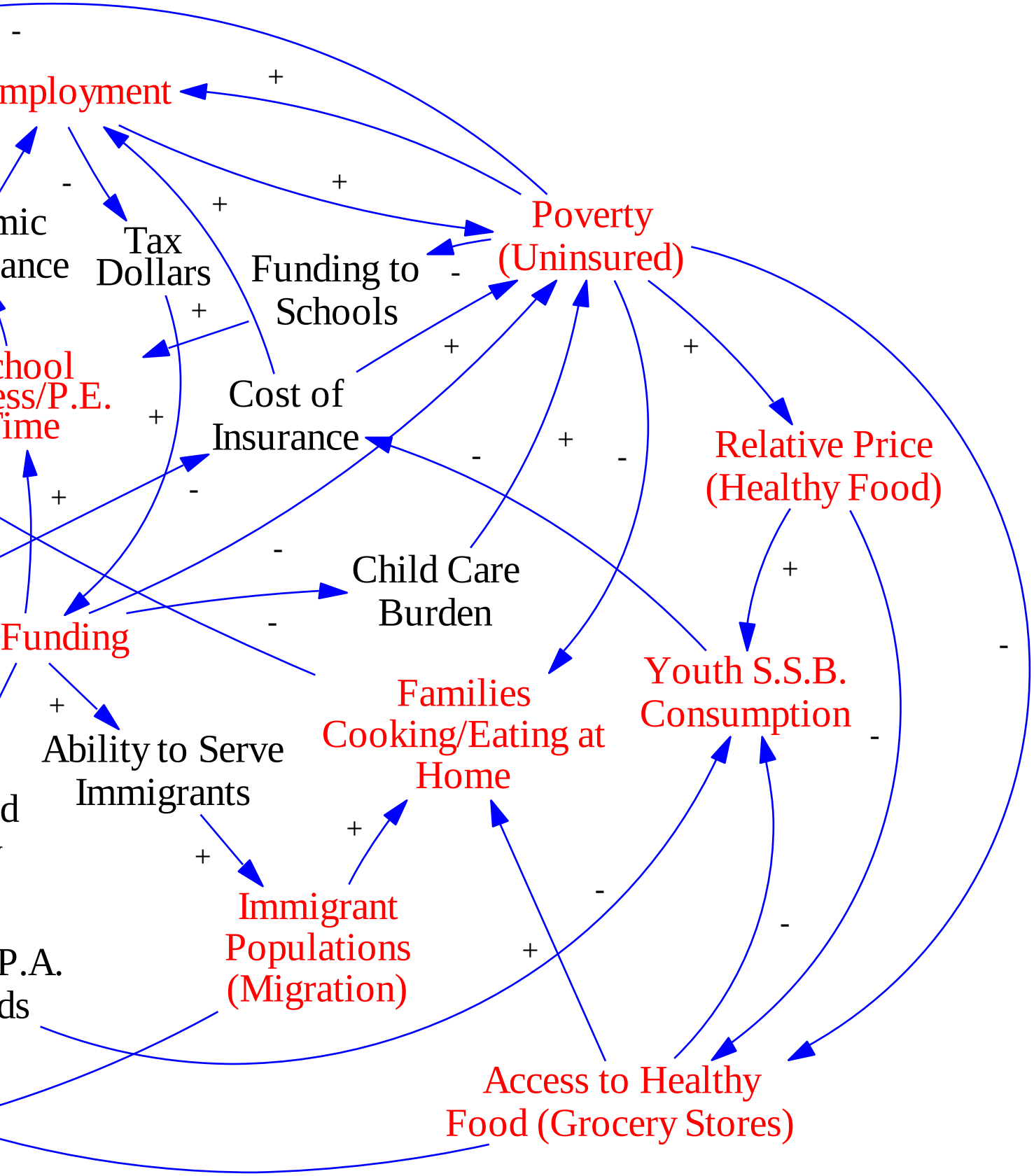
Appendix A: Behavior Over Time Graphs Generated during Site Visit

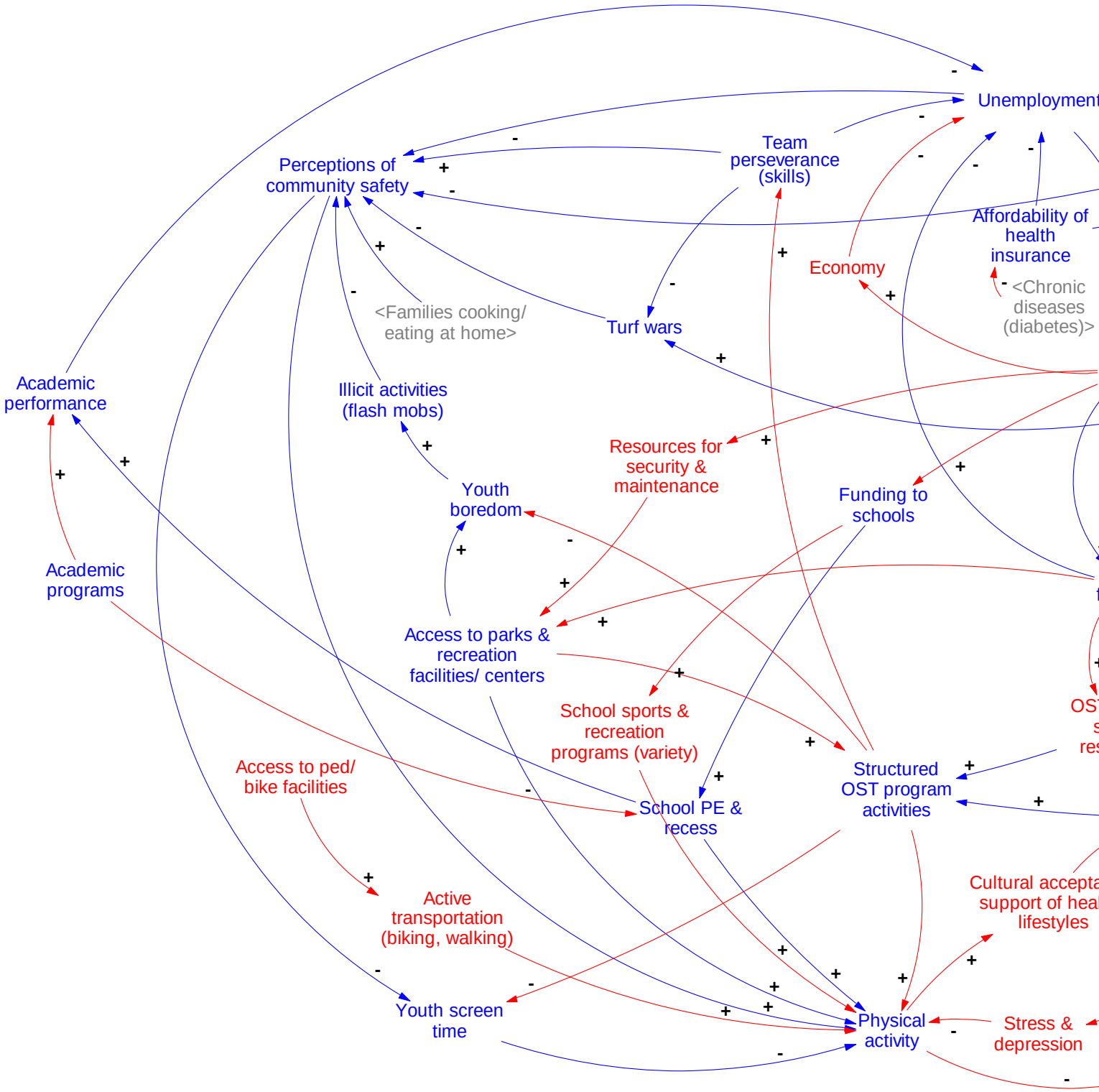
Philadelphia, Pennsylvania: *Healthy Kids, Healthy Communities: OST Partnership*	
Categories	**Number of Graphs**
Active Living Behavior	2
Active Living Environments	5
Funding	1
Healthy Eating Behavior	5
Healthy Eating Environments	7
Marketing and Media Coverage	0
Obesity and Long Term Outcomes	0
Partnership & Community Capacity	0
Policies	3
Programs & Promotions (Education and Awareness)	3
Social Determinants of Health	3
Total Graphs	**29**

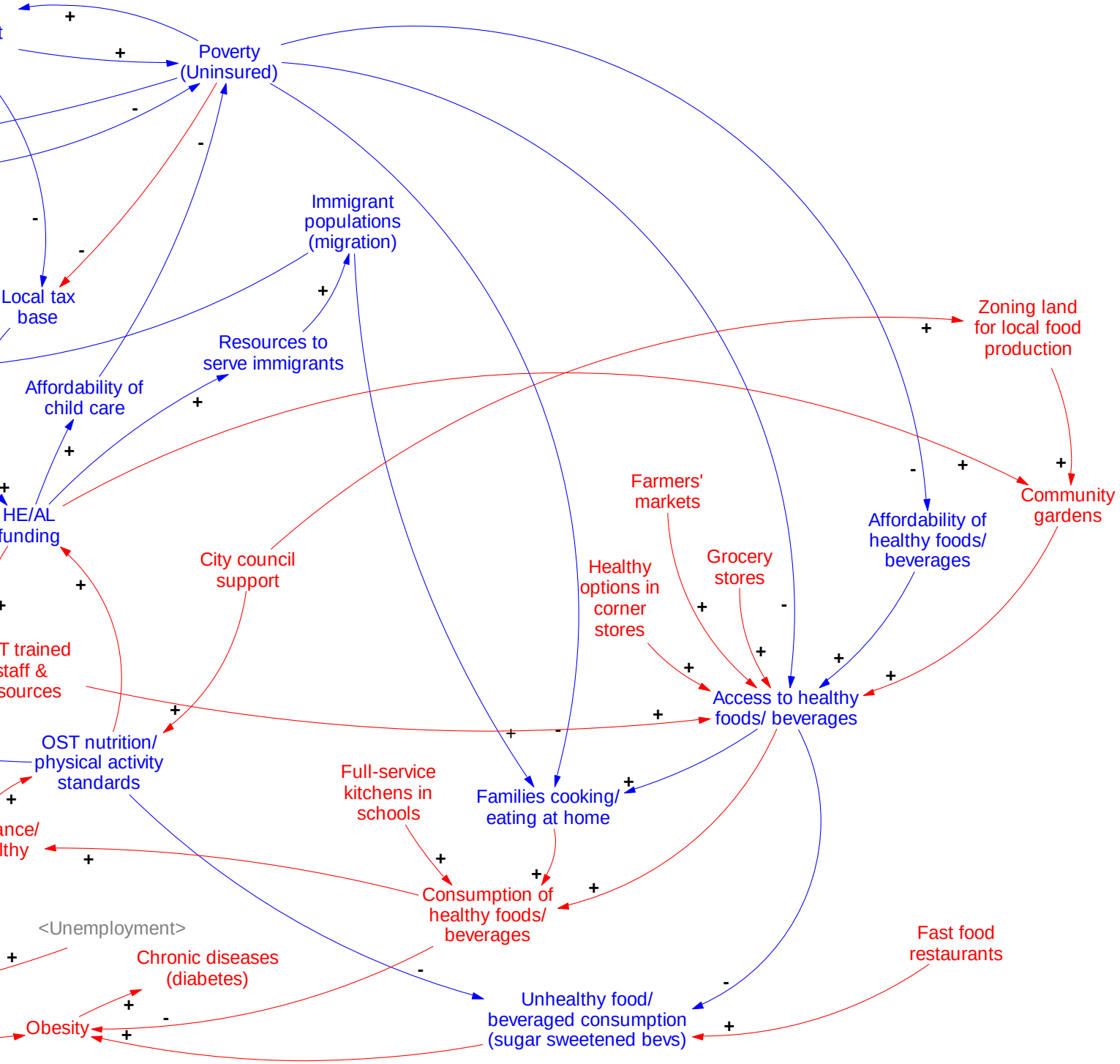
Appendix B: Original Translation of the Causal Loop Diagram into Vensim PLE



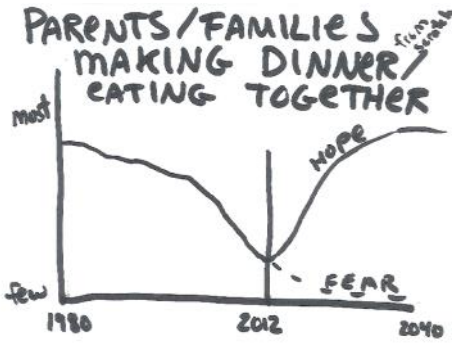

mployment
Poverty
(Uninsured)
Tax
Dollars
Funding to
Schools
Cost of
Insurance
Relative Price
(Healthy Food)
Child Care
Burden
Funding
Youth S.S.B.
Consumption
Families
Cooking/Eating at
Home
Ability to Serve
Immigrants
Immigrant
Populations
(Migration)
Access to Healthy
Food (Grocery Stores)

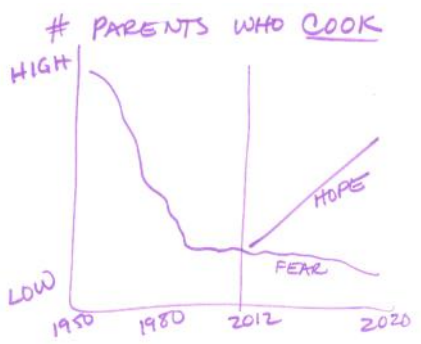
Appendix C: Transcript Translation of the Causal Loop Diagram into Vensim PLE

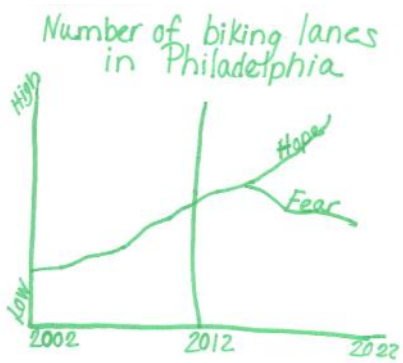


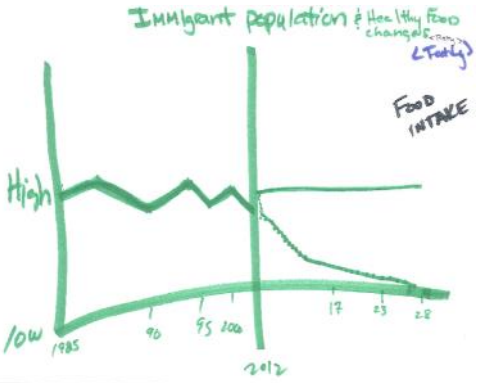

Poverty
(Uninsured)
Immigrant
populations
(migration)
Local tax
base
Resources to
serve immigrants
Affordability of
child care
Zoning land
for local food
production
Community
gardens
HE/AL
funding
City council
support
Farmers'
markets
Grocery
stores
Healthy
options in
corner
stores
Affordability of
healthy foods/
beverages
Access to healthy
foods/ beverages
OST nutrition/
physical activity
standards
Full-service
kitchens in
schools
Families cooking/
eating at home
Consumption of
healthy foods/
beverages
<Unemployment>
Chronic diseases
(diabetes)
Obesity
Unhealthy food/
beveraged consumption
(sugar sweetened bevs)
Fast food
restaurants

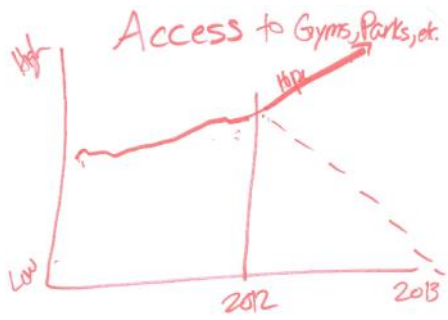
Appendix D: Behavior Over Time Graphs not Represented in the Storybook

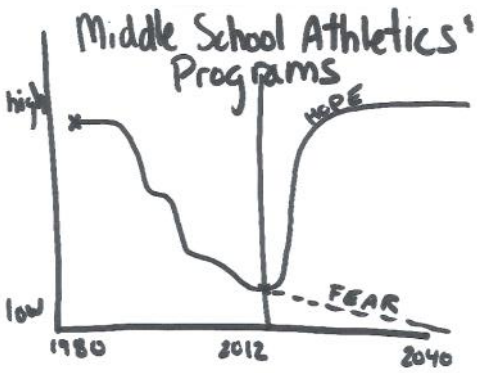


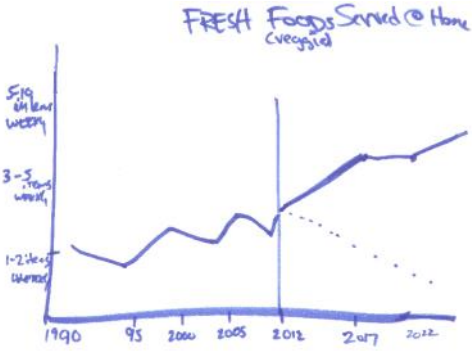


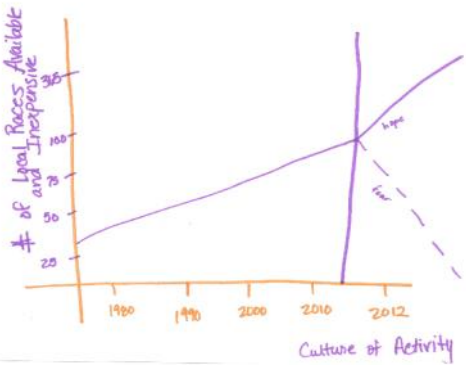


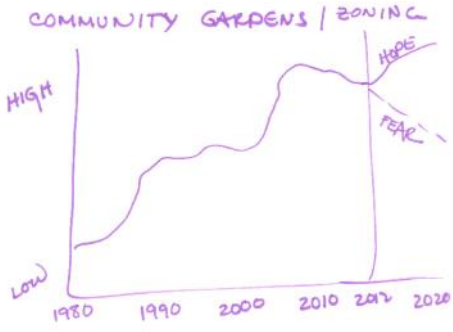


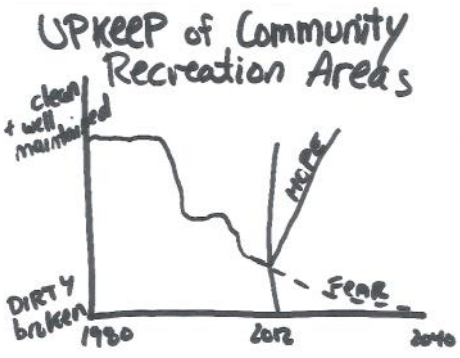


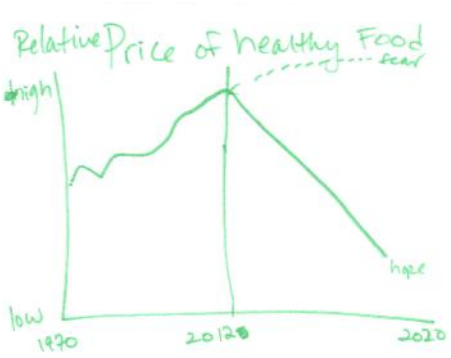


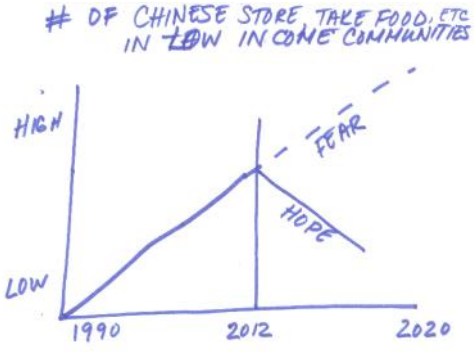


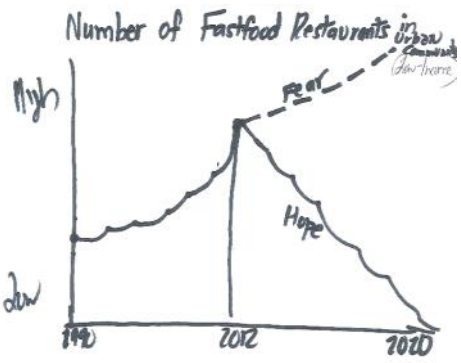


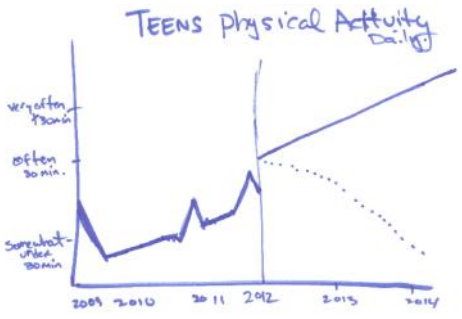


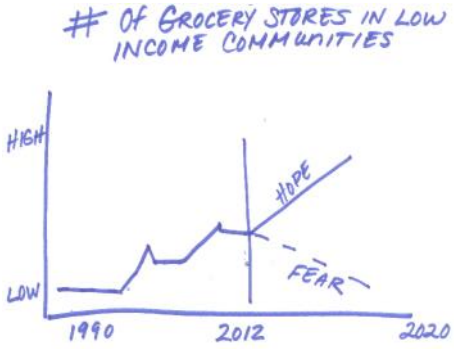


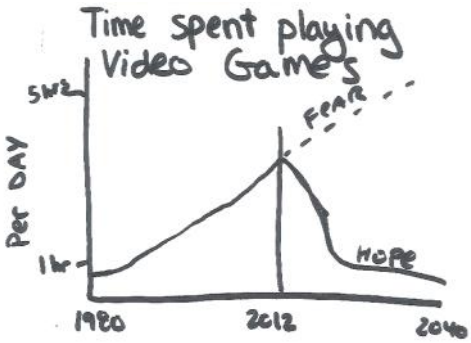


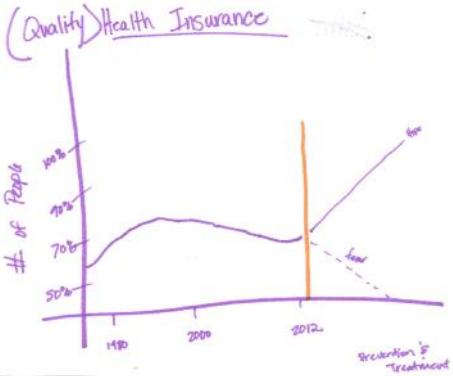


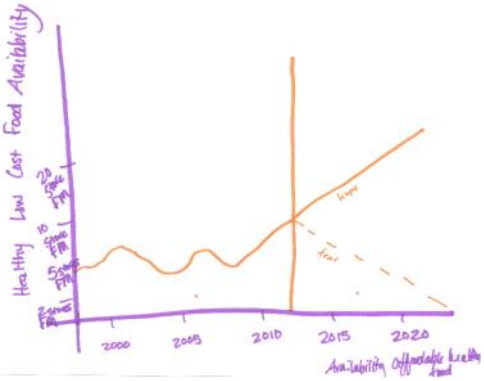

Number of Fastfood Restaurants in Urban Communities
High
Low
Fear
Hope
1990
2012
2020

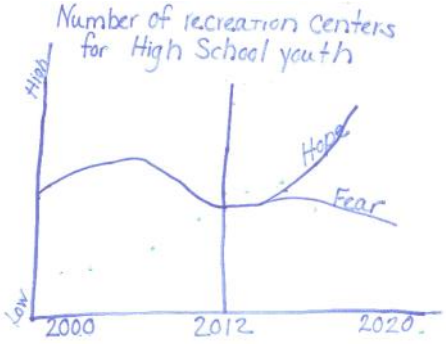

TEENS physical Activity Daily
very often 30 min.
often 30 min.
somewhat often 30 min.
2009 2010 2011 2012 2013 2014

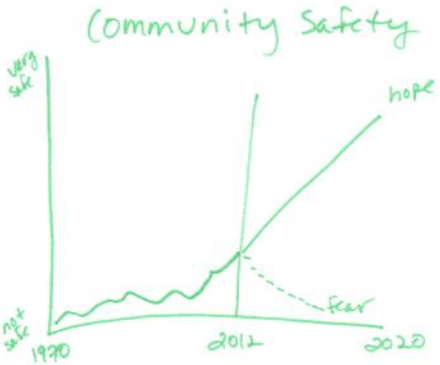

Of GROCERY STORES IN LOW INCOME COMMUNITIES
HIGH
LOW
HOPE
FEAR
1990
2012
2020

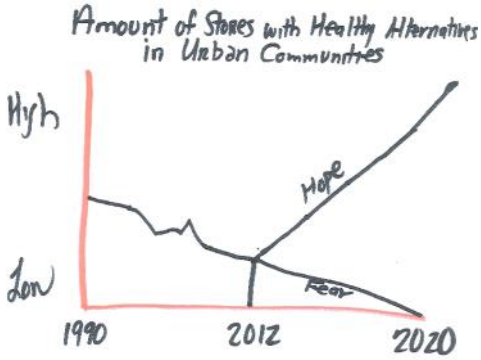

Time spent playing Video Games
Per DAY
5hr
1hr
FEAR
HOPE
1980
2012
2040

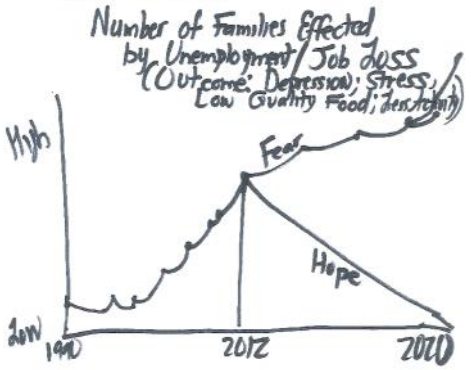

(Quality) Health Insurance
# of People
100%
70%
50%
1980
2000
2012
Prevention & Treatment


Healthy Low Cost Food Availability
2000
2005
2010
2015
2020
Availability Affordable Healthy Food


Number of recreation centers for High School youth
High
Low
Hope
Fear
2000
2012
2020


Community Safety
very safe
not safe
hope
fear
1970
2012
2020


Amount of Stores with Healthy Alternatives in Urban Communities
High
Low
Hope
Fear
1990
2012
2020


Number of Families Effected by Unemployment/Job Loss
(Outcome: Depression; Stress; Low Quality Food; Homelessness)
High
Low
Fear
Hope
1990
2012
2020