# Systems Thinking in Communities:

# Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in Portland and Multnomah County, Oregon

This community storybook was developed by Transtria LLC.

Support was provided by the Robert Wood Johnson Foundation.

**Acknowledgments**

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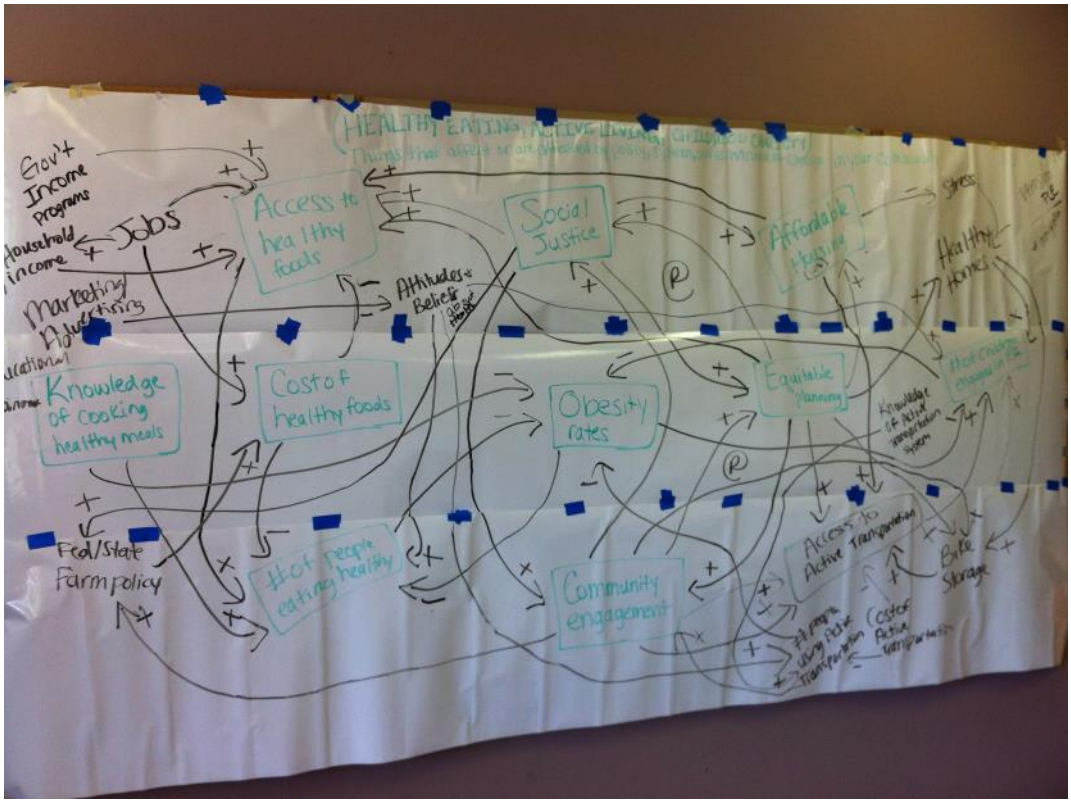

Gov't Income Programs
Household income
Jobs
Access to healthy foods
Social Justice
Affordable Housing
Stress
Healthy Homes
Marketing Advertising
Attitudes + Beliefs
Knowledge of cooking healthy meals
Cost of healthy foods
Obesity rates
Equitable planning
Real/State Farm policy
Ppl eating healthy
Community engagement
Access to Active Transportation
Bike Storage

## Introduction

*Portland Healthy Kids, Healthy Communities (HKHC)* 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 *Portland HKHC* project was to introduce systems thinking at the community level by identifying the essential parts of the Portland and Multnomah County 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 and 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., policy/advocacy organizations, government agencies, businesses, community-based 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.

## Portland and Multnomah County, Oregon: Background and Local Participation

Although Portland is known for its progressive efforts around healthy living, underserved areas in East Portland do not see the same advantages as the rest of the population. Rezoned in the past 40 years to accommodate multi-family housing, East Portland residents have high rates of poverty, crime, and unsafe housing conditions compared to the rest of Portland. The partnership targeted multi-family housing developments specifically in East Portland. Their efforts, especially around housing policy, additionally impacted multi-family housing throughout Portland.

The purpose of Portland HKHC's Healthy Active Communities for Portland's Affordable Housing Youth and Families project was to improve the healthy eating and active living opportunities in both affordable housing and private market housing development in Portland. The partnership focused on developing policy and incentives to encourage developers and property owners to include HEAL features. Oregon Public Health Institute (OPHI) was the lead agency for Portland HKHC.

### *Portland HKHC's* Priorities and Strategies

The partnership and capacity building strategies of *Portland HKHC* included:

- **Capacity Building/Healthy Housing:** In partnership with the City of Portland Bureau of Planning and Sustainability and various other partners, Portland HKHC worked to create healthier living environments for resident housing throughout Portland. Partners published policy recommendations for multi-housing developments, developed healthy eating and active living best practices and standards for multi-housing developments, and published a Portland Healthy Housing Handbook to guide property owners and landlords to make housing healthier for residents.

The healthy eating and active living strategies of *Portland HKHC* included:

- **Portland Plan/Healthy Housing:** The City of Portland completed a comprehensive strategic plan, Portland Plan. The Portland Plan was adopted in 2012. Portland HKHC advocacy efforts resulted in the inclusion of many healthy eating and active living related policies in the plan. Additionally, the development of the healthy eating and active living best practices and standards for multi-housing developments was incorporated into the Portland Comprehensive Plan.
- **Parks and Play Spaces:** Portland HKHC partnered and subcontracted with the Community Cycling Center to implement a bike repair hub and bike skills park in the New Columbia housing development.
- **Corner Stores:** Portland HKHC assisted Village Gardens, Janus Youth Programs, and Home Forward in opening Village Market. The corner store in the New Columbia Housing Development sold healthy food and produce at affordable prices.
- **Community Gardens:** The partnership established a community garden for residents at Lents Village, Eliot Square, and Unthank Plaza in partnership with Village Gardens.

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

**Systems Thinking in Communities: Portland and Multnomah County, Oregon**

"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 Portland and Multnomah County, Oregon 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.

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.

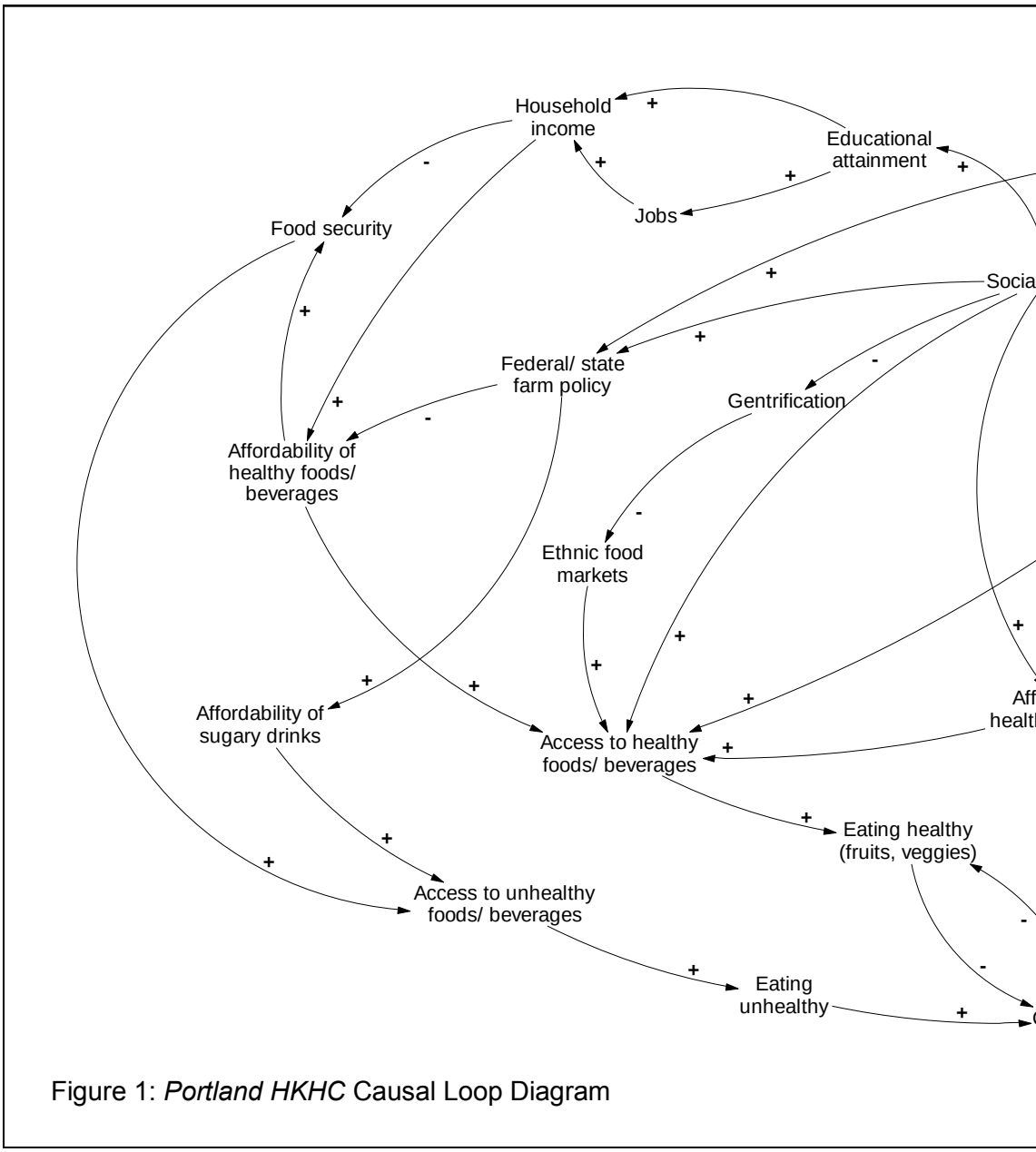
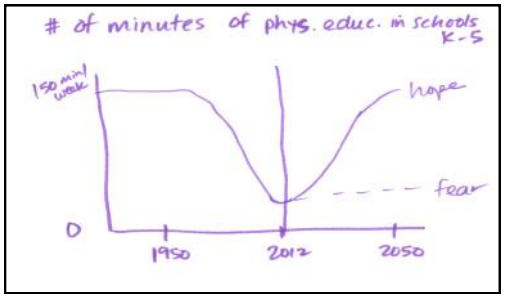



Figure 1: *Portland HKHC* Causal Loop Diagram

**Group Model Building**

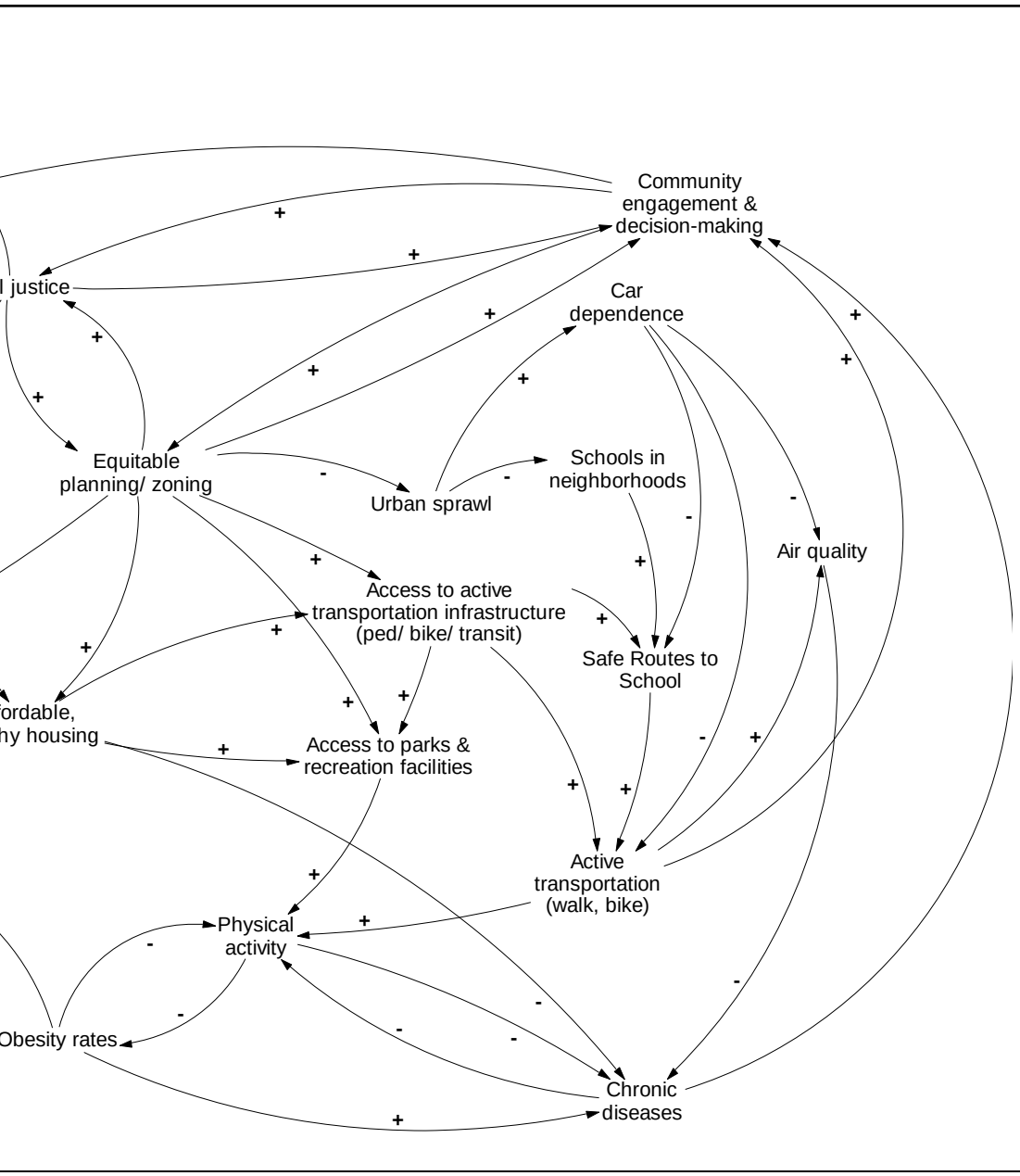
Members of the *Portland HKHC* partnership participated in a group model building session in May, 2012 and generated this system. also referred to as a causal loop diagram (Figure 1). Participants in the group model building session included representatives from policy/advocacy organizations, government agencies, businesses, and community-based 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.




Behavior Over Time Graphs

To identify the range of things that affect or are affected by policy, system, and environmental changes in Portland and Multnomah County 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 minutes of physical education in schools, the number of minutes has dropped off

over the past several decades and the participant hopes that this decline will reverse 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: community engagement and decision-making → equitable planning/ zoning → social justice → community engagement and decision-making.

What is important to notice is that there are other feedback loops interacting simultaneously to influence or to be influenced by community engagement and decision-making. Some variables may increase community engagement and decision-makingwhile 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 *Portland HKHC* 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 Portland and Multnomah County, Oregon and to stimulate greater conversation related to Portland and Multnomah County '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 Portland and Multnomah County, Oregon. 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.

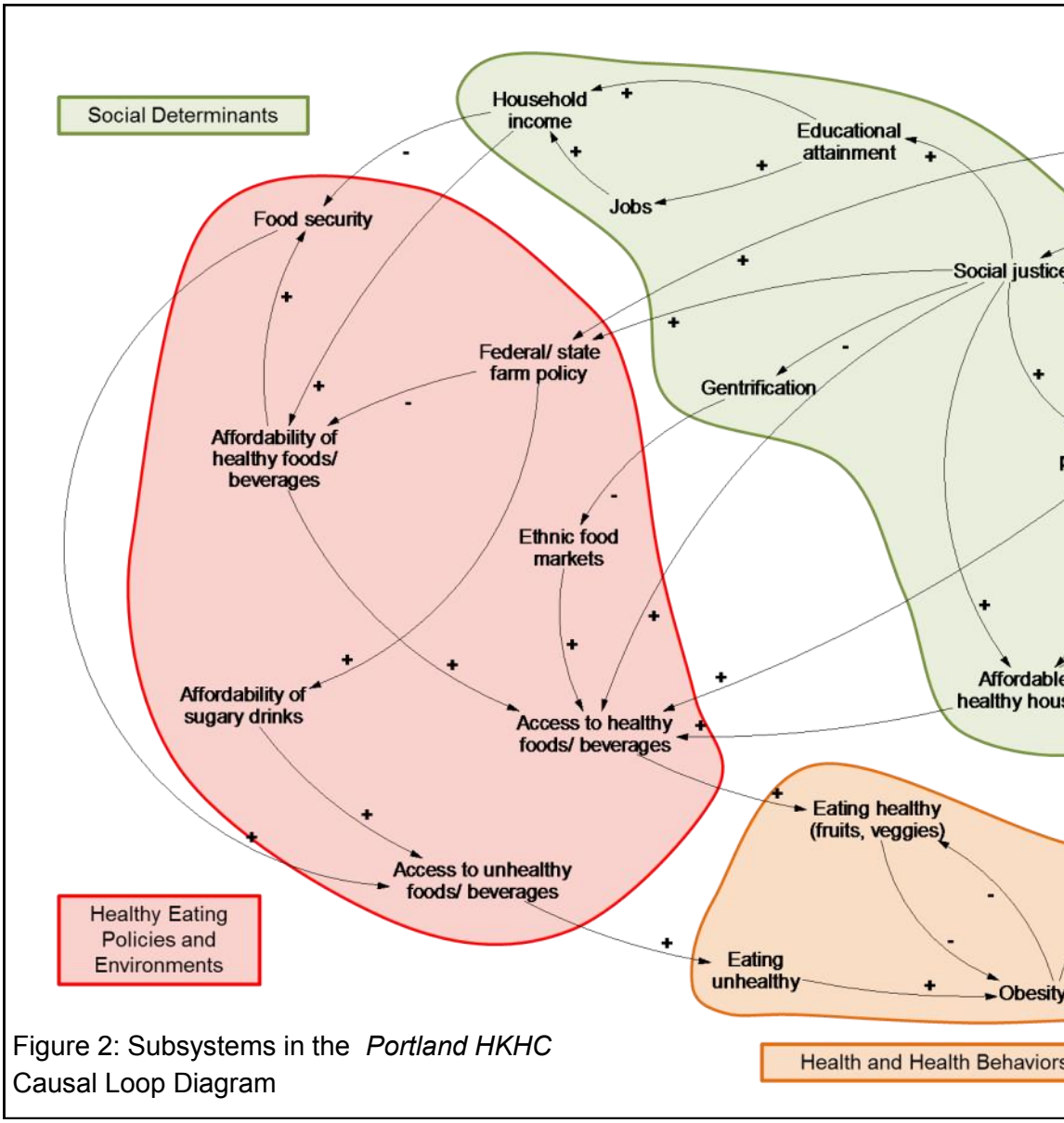



Figure 2: Subsystems in the *Portland HKHC* Causal Loop Diagram

<u>Healthy Eating Policies and Environments (Red)</u>

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 eleven graphs related to policy or environmental strategies (e.g., ethnic food markets) or contexts (e.g., federal and state farm policy) that affected or were affected by the work of *Portland HKHC*. The variables represent participants' conversations from the behavior over time graph and causal loop diagram exercises.

<u>Active Living Policies and Environments (Blue)</u>

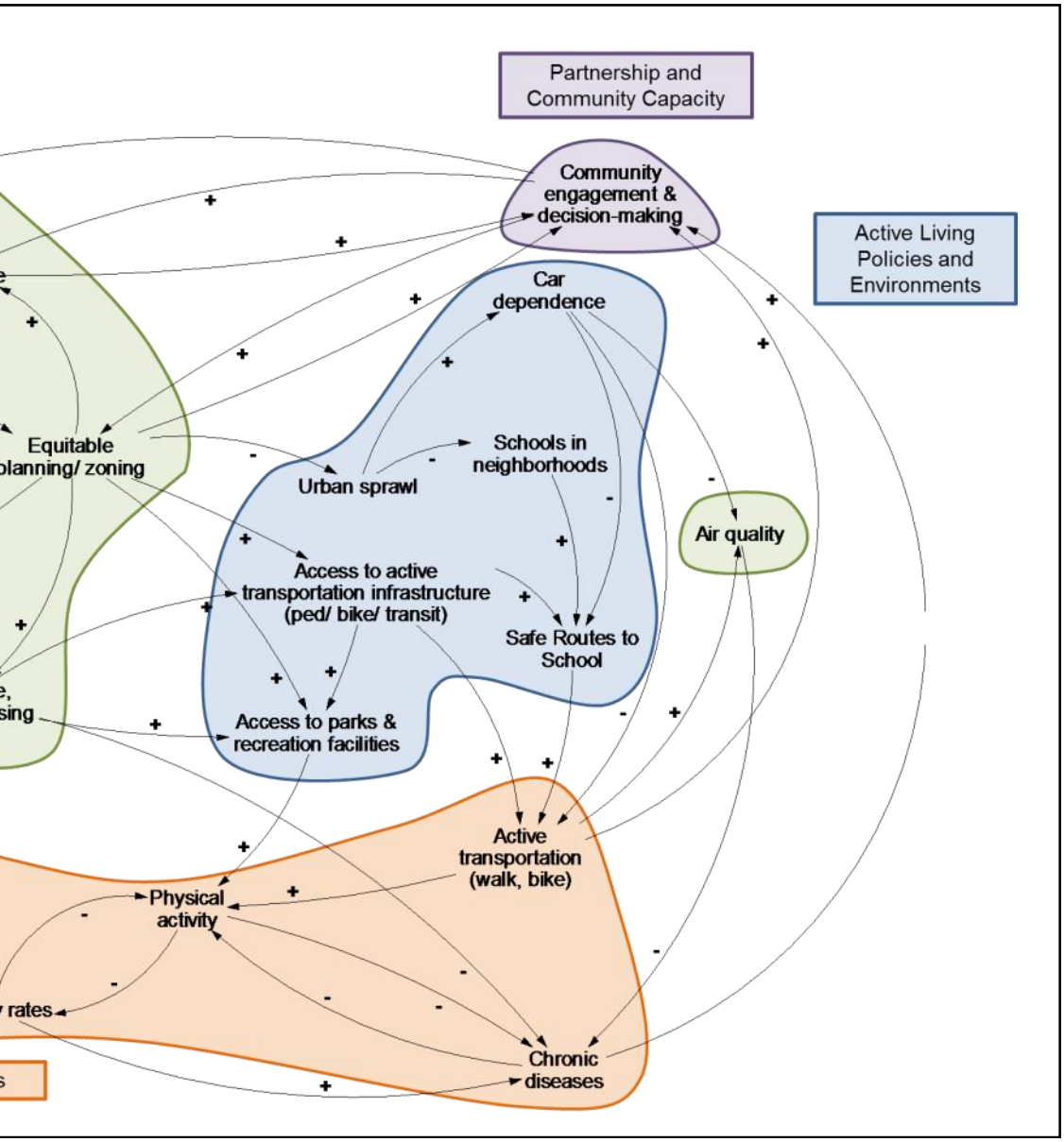
The active living policy and environmental subsystem includes design, planning, construction, and enforcement or maintenance related to access to opportunities for active transportation and recreation. For this topic, the group model building participants developed seven graphs related to policy or environmental strategies (e.g., Safe Routes to School) or contexts (e.g., car dependence) that affected or were affected by the partnership's work.

<u>Health and Health Behaviors (Orange)</u>

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., active transportation such as walking and biking).

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, *Portland HKHC* worked to build community capacity through increased community engagement and decision-making. This subsystem also includes community factors outside the partnership that may influence or be influenced by their efforts.




Social Determinants

Finally, the social determinants subsystem denotes societal conditions (e.g., affordable, healthy housing) and psychosocial influences 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 *Portland HKHC* partners or by other representatives in Portland and Multnomah County, Oregon . 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 *Portland HKHC*. 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.

**Parks and Play Spaces Feedback Loop**

To simplify the discussion about feedback loops, several loops drawn from the Portland HKHC 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 Portland and Multnomah County, Oregon, each feedback loop tells a story about a more specific change process.

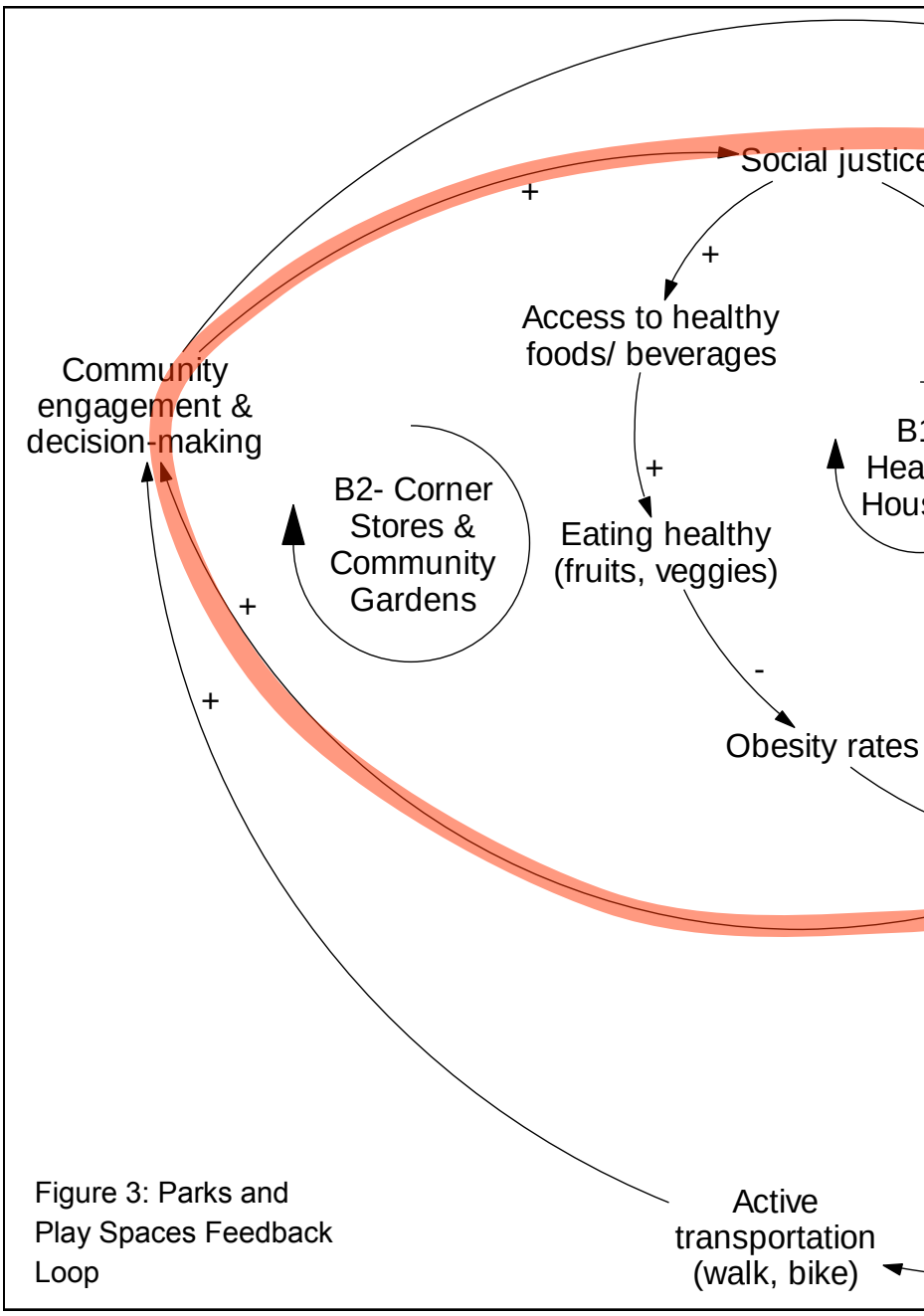



Figure 3: Parks and Play Spaces Feedback Loop

Causal Story for Feedback Loop

*Story A*: In this case , the story is about parks and play spaces (red highlighted loop in Figure 3). Portland and Multnomah County, Oregon partners subcontracted with the Community Cycling Center to implement a bike repair hub and bike skills park in the New Columbia housing development. Participants described how equitable planning and zoning improves access to parks and recreation facilities, increasing physical activity and reducing chronic diseases. In turn, less concern about chronic diseases allows community residents and decision-makers to focus on other efforts to improve social justice in the community as equitable planning and zoning practices are already in place.

*Story B*: While the preceding story reflected a positive scenario for Portland and Multnomah County, Oregon, the same feedback loop also tells the opposite story. Without equitable planning and zoning, there is likely less access to safe, quality parks and recreation facilities for all areas of the community, leading to lower rates of physical activity and higher rates of chronic diseases in these subpopulations. Consequently, this burden of chronic diseases increases community engagement and decision-making to improve social justice through equitable planning and zoning practices.

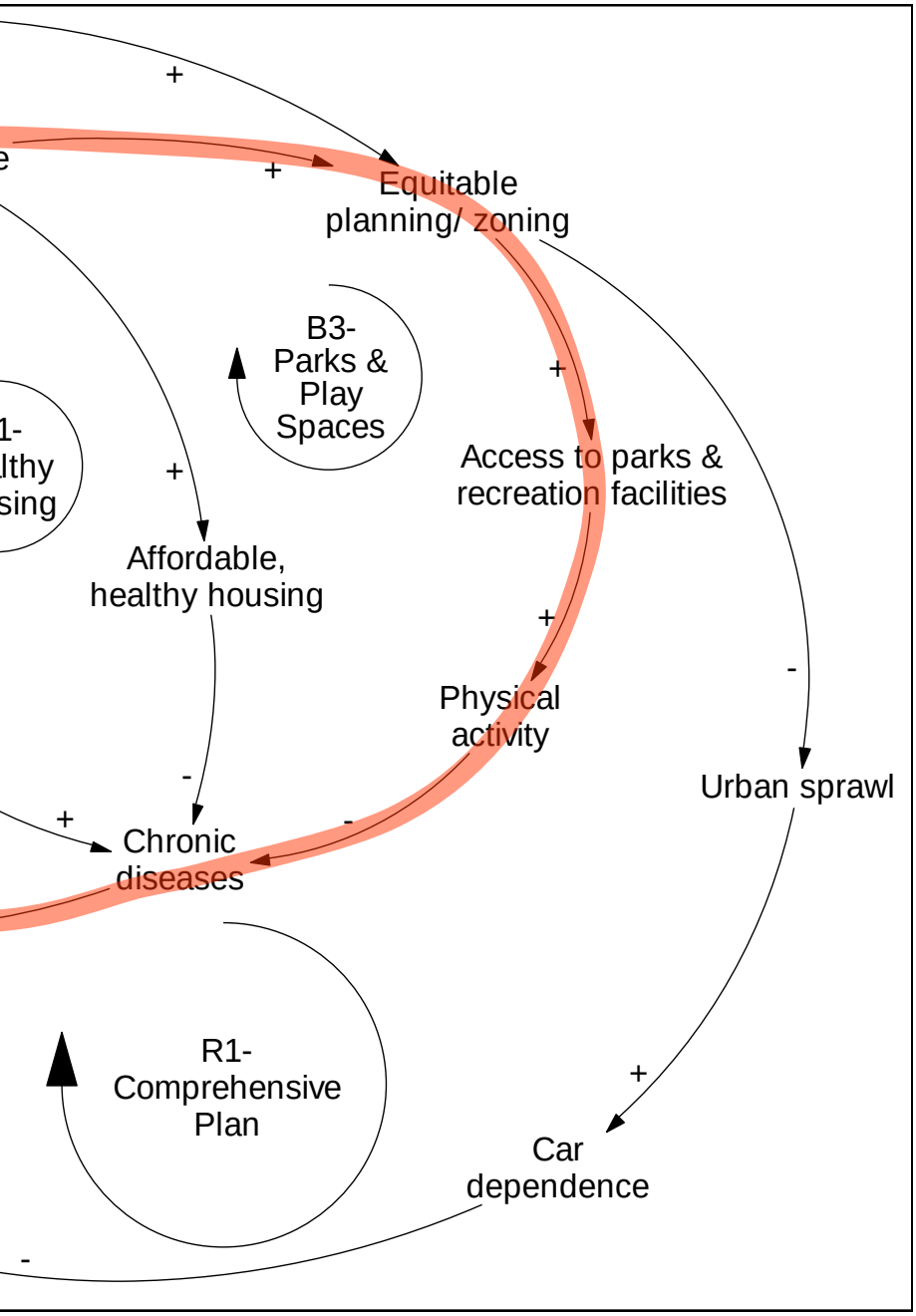
Balancing Loop and Notation

These stories represent a balancing loop, and the notation in the feedback loop identifies it as a balancing loop (see "B3 — Parks and Play Spaces" and red 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

***"There's still a lot of people out there who believe that obesity is nothing but personal responsibility; we know that there's an aspect of personal responsibility. Back in 2000, I don't think we were even talking about or thinking in this way. There has been some increasing recognition since then, mostly from people like the people in this room, but we have a long way to go and building the political will to invest in the kinds of things we need invest in in the built environment to make a difference." (Participant)***

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.

In a balancing loop, the effect of the variables tend to create more of a stable trend over time, as opposed to one that is continually increasing or decreasing. This effect continues through the cycle and returns a stabilizing influence to the original variable, respectively.




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

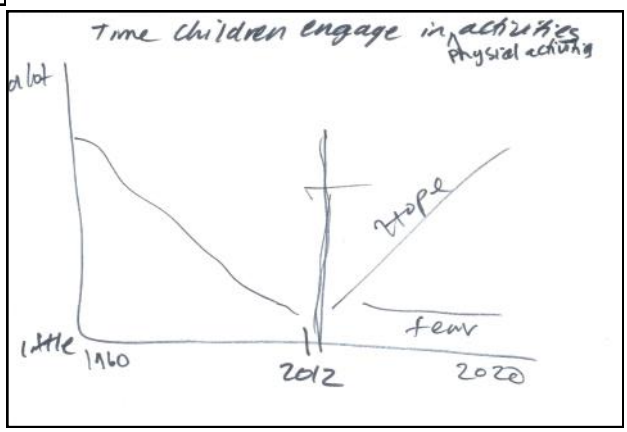
In isolation, this balancing loop represents the influence of parks and play spaces on physical activity and chronic diseases. To understand other influences on these variables, it is important to remember that this reinforcing loop is only one part of the larger CLD (see Figures 1 and 2), and the other loops and causal relationships can have an impact on the variables in this loop.

<u>System Insights for *Portland HKHC*</u>

Participants also identified a dramatic decrease in the time children engage in physical activity since 1960 in Portland and Multnomah County, Oregon (see behavior over time graph).

From the systems thinking exercises, several insights can inform the partners' parks and play spaces strategy. For instance, sharing data on the dramatic decline in children's physical activity and access to and use of public parks and play spaces can build political will (see quote on previous page) and mobilize communities to engage and support equitable planning and zoning to promote health, particularly in high-risk, low-resource communities where these problems are exacerbated by poverty, crime, or other barriers to being active outdoors.

In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including developing assessment tools and resources to measure community engagement and decision-making, social justice, and equitable planning and zoning as well as methods to evaluate the impact of access to parks and recreation facilities on population levels of physical activity and chronic diseases (long-term).



**Opportunities for Systems Thinking in Portland and Multnomah County, Oregon**

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 *Portland HKHC* partners, this storybook also summarized the healthy eating, active living, partnership and community capacity, social determinants, and health and health behaviors subsystems in the Portland and Multnomah County causal loop diagram as well as an example feedback loop corresponding to the partnership's primary strategies.

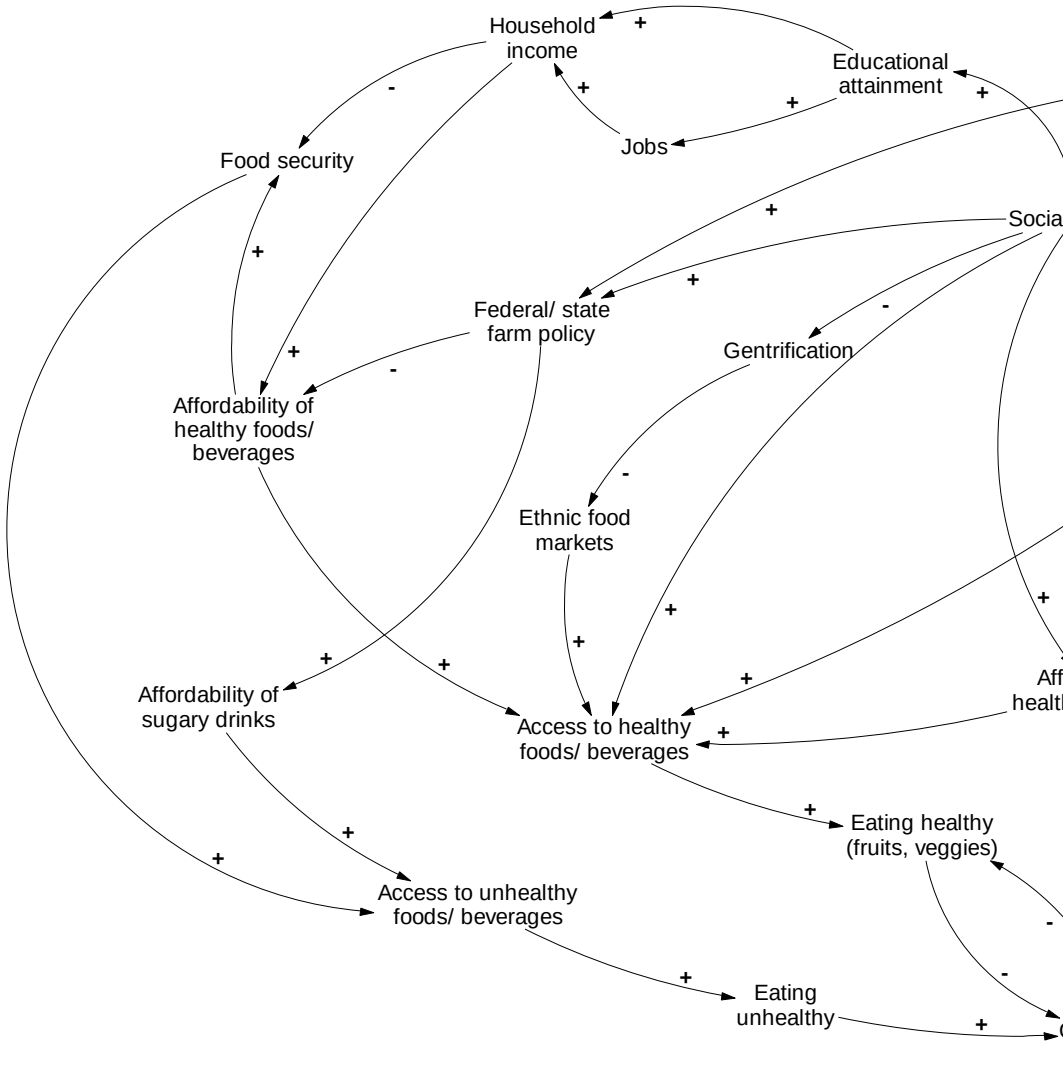



Figure 4: *Portland HKHC* Causal Loop Diagram

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.

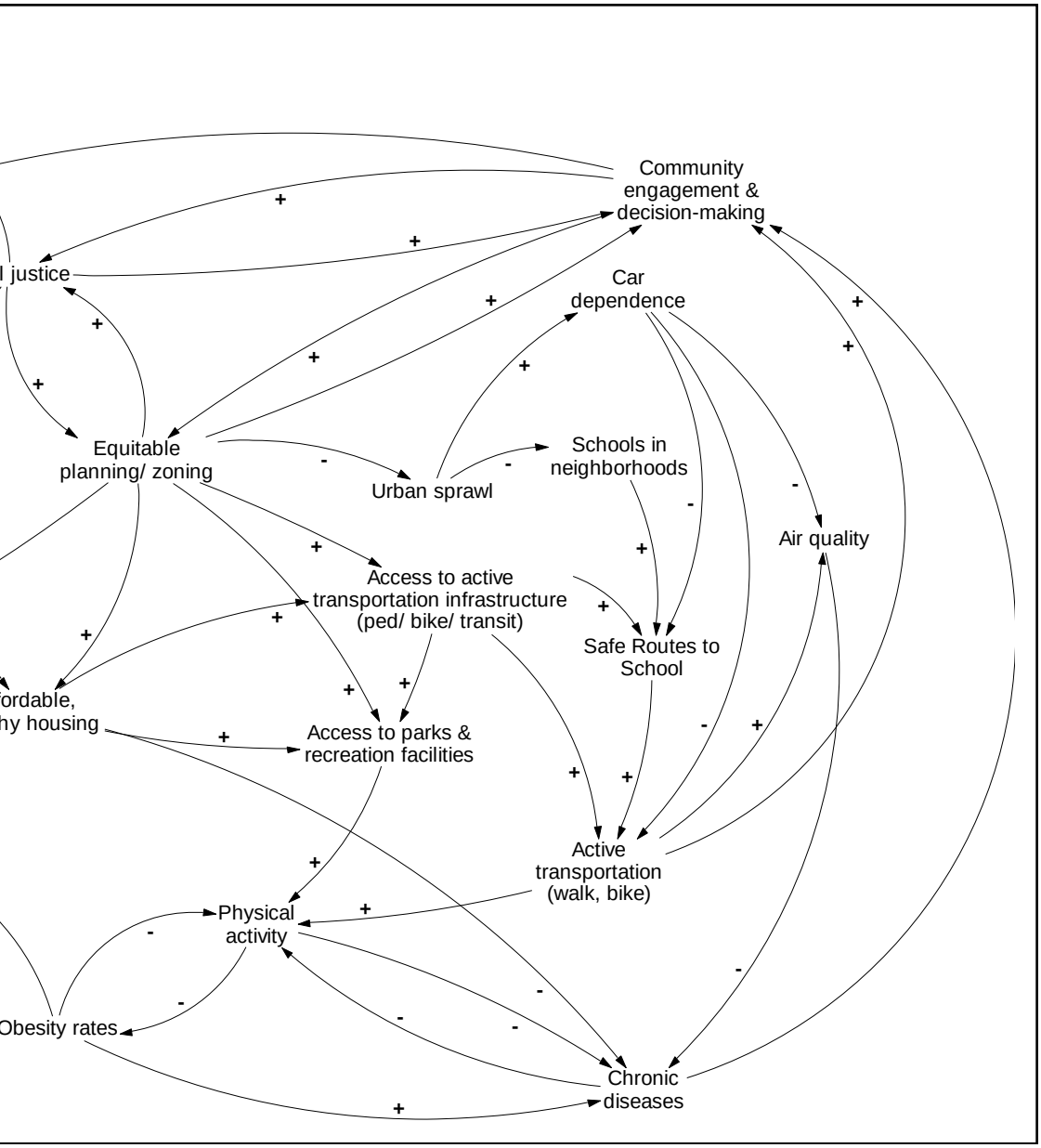
This represented a first attempt to collectively examine the range of things that affect or are affected by policy, system, and environmental changes in Portland and Multnomah County, Oregon to promote healthy eating and active living as well as preventing childhood overweight and obesity.

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

- the participants represent a sample of the *Portland HKHC* 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 E) 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 federal/state immigration policy, affordability of active transportation, urbanization of land, corporatization of food, restaurants, serving sizes, locally/ home grown schools, government assistance programs, density of higher-income populations, perceptions of safety, screen time, active living education/ information, transportation system, school PE, nutrition education/information, marketing/ advertising of unhealthy foods/beverages, health attitudes/beliefs, social responsibility, cooking healthy meals, food storage, connecting to/understanding the environment, stress, equitable implementation/ funding; 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 Portland and Multnomah County 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: Photograph of the original version of the *Portland HKHC* Causal Loop Diagram
- Appendix C: Original translation of the causal loop diagram into Vensim PLE
- Appendix D: Transcript translation of the causal loop diagram into Vensim PLE
- Appendix E: 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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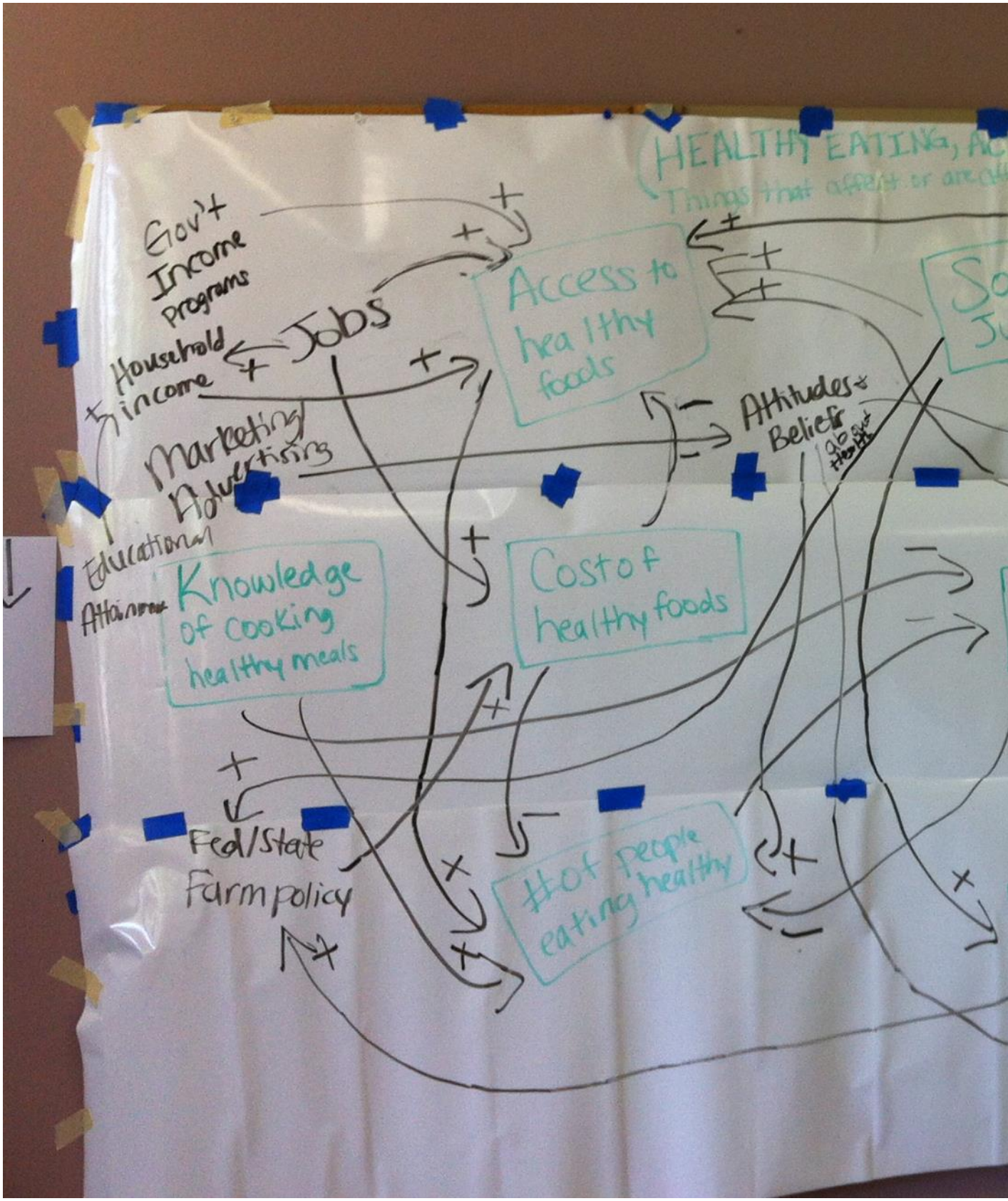
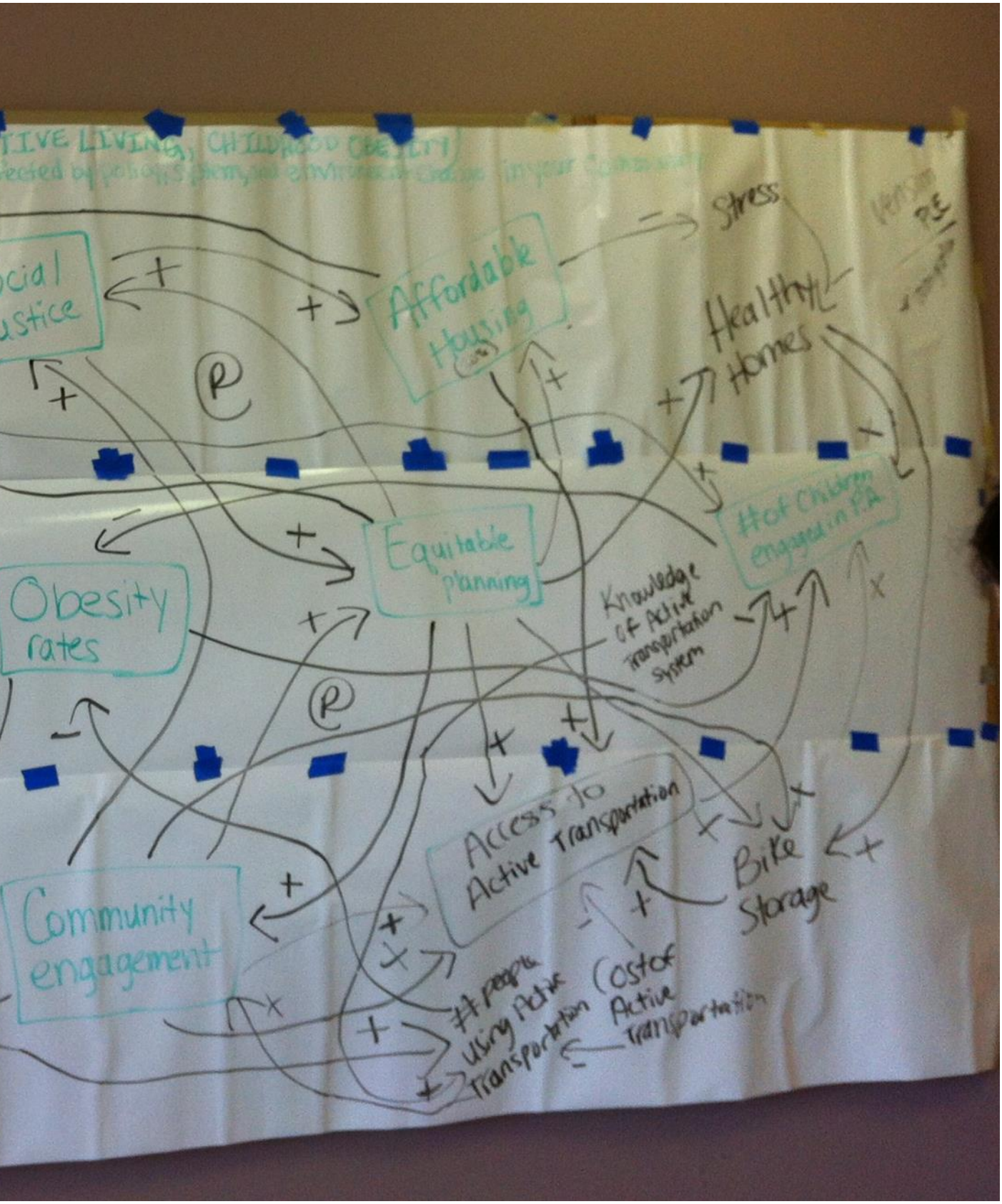
**Appendix A: Behavior Over Time Graphs Generated during Site Visit**

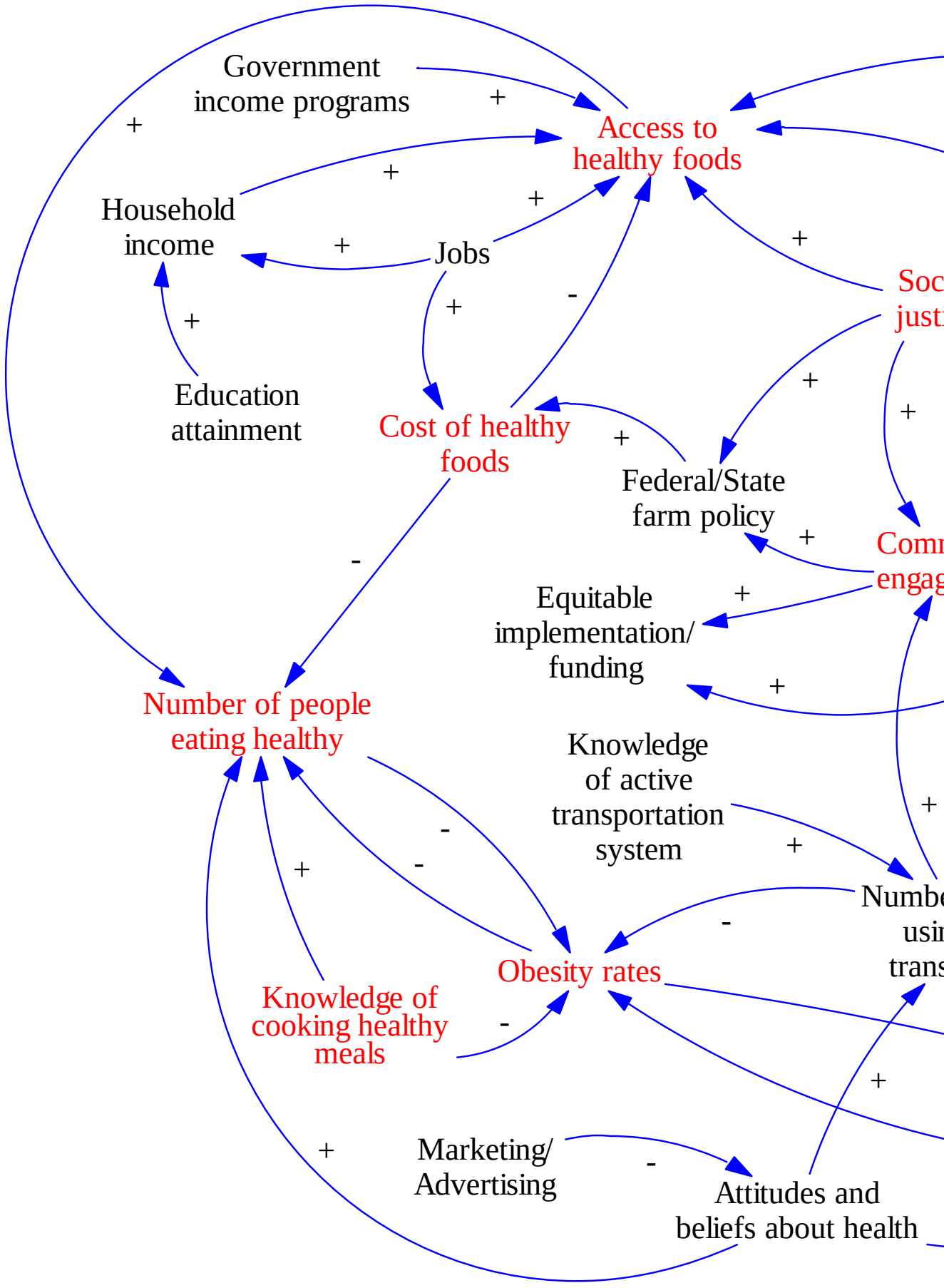
| **Portland and Multnomah County: *Portland HKHC*** | |
|---|---|
| **Categories** | **Number of Graphs** |
| Active Living Behavior | 3 |
| Active Living Environments | 4 |
| Funding | 0 |
| Healthy Eating Behavior | 2 |
| Healthy Eating Environments | 9 |
| Marketing and Media Coverage | 0 |
| Obesity and Long Term Outcomes | 4 |
| Partnership & Community Capacity | 1 |
| Policies | 2 |
| Programs & Promotions (Education and Awareness) | 6 |
| Social Determinants of Health | 6 |
| **Total Graphs** | **38** |

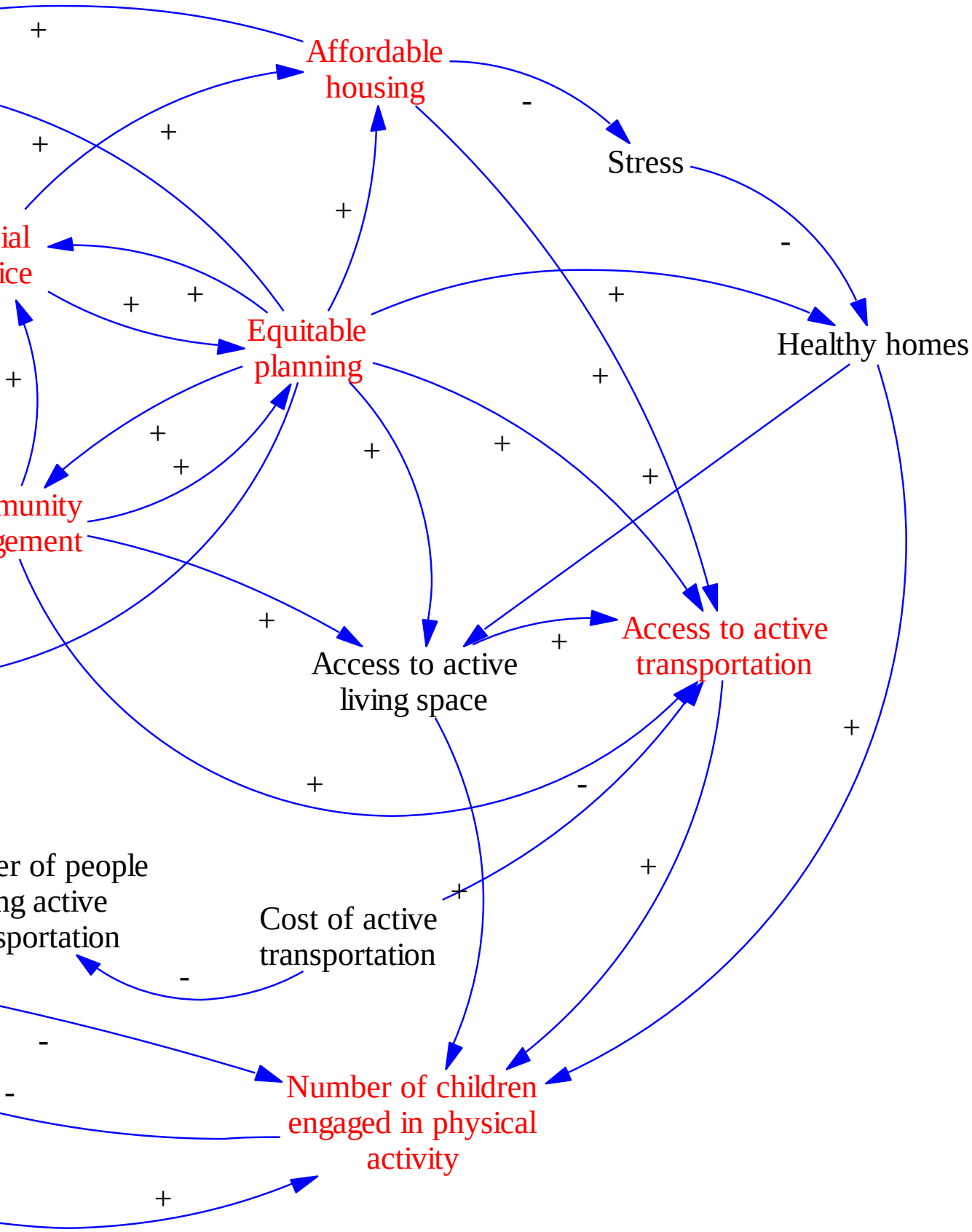
**Appendix B: Photograph of the Original Version of the *Portland HKHC* Causal Loop Diagram**



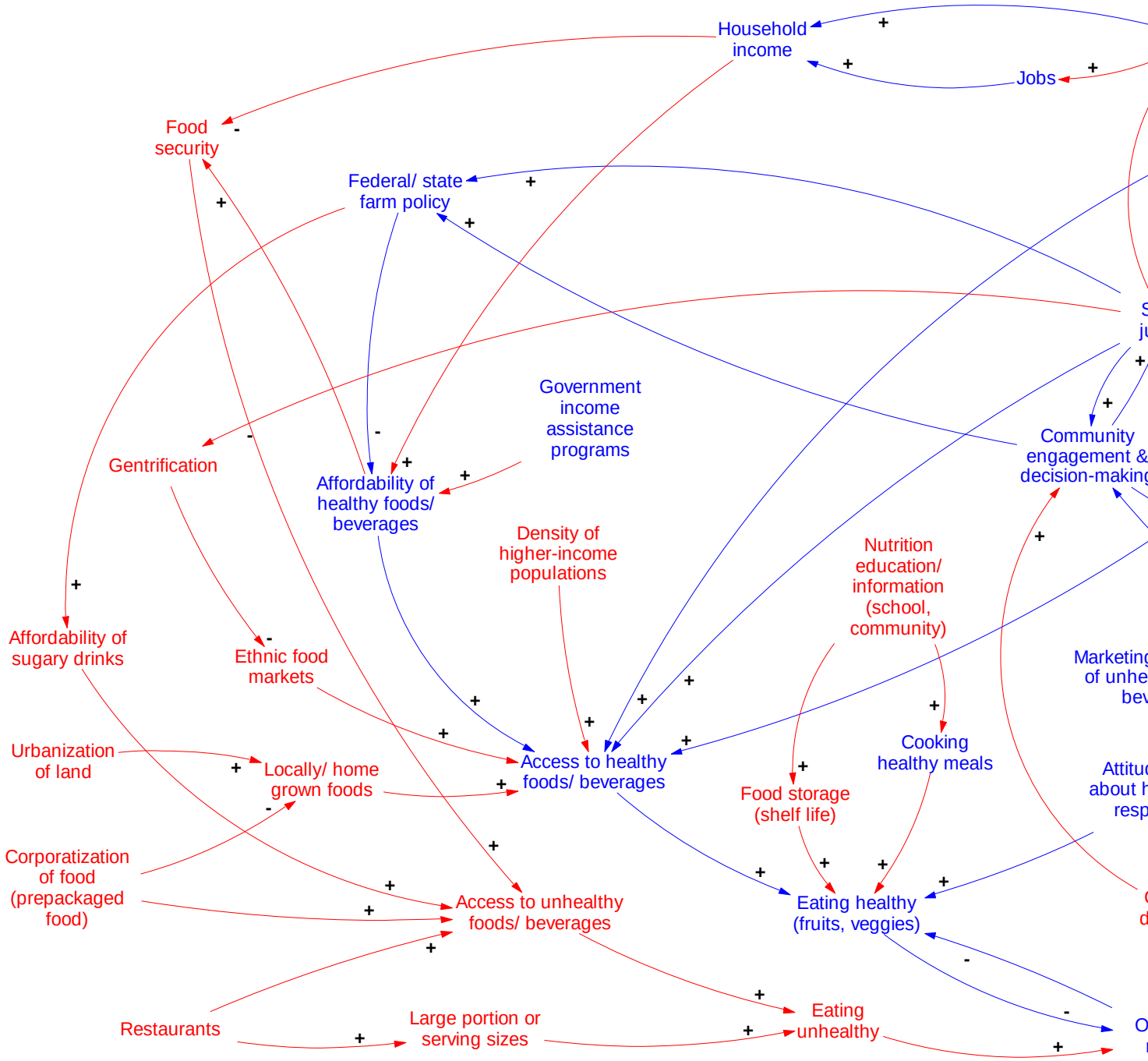

Stress
Affordable Housing
Healthy Homes
Equitable planning
Obesity rates
Knowledge of Active transportation system
Access to Active Transportation
Bike Storage
Community engagement
# people using Active Transportation
Cost of Active Transportation

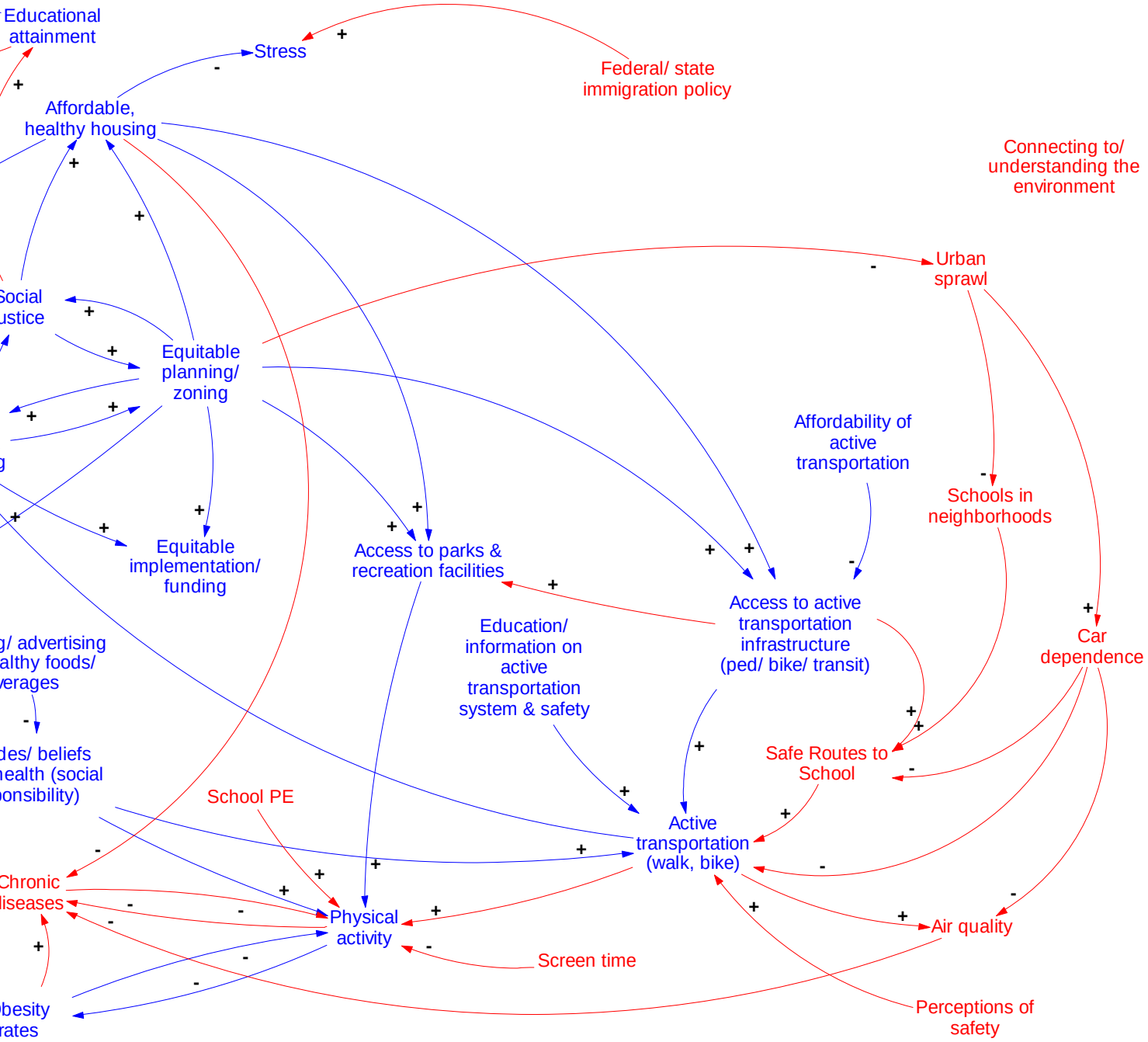
**Appendix C: Original Translation of the Causal Loop Diagram into Vensim PLE**



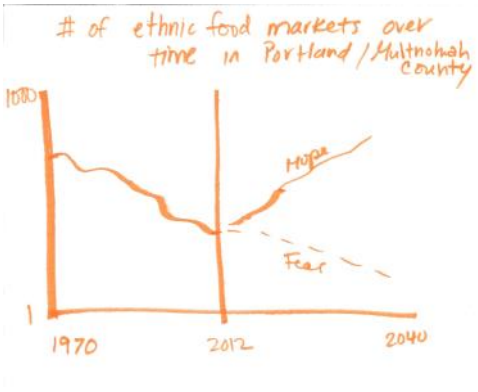

Affordable housing
Stress
ial ice
Equitable planning
Healthy homes
munity gement
Access to active living space
Access to active transportation
er of people ng active sportation
Cost of active transportation
Number of children engaged in physical activity

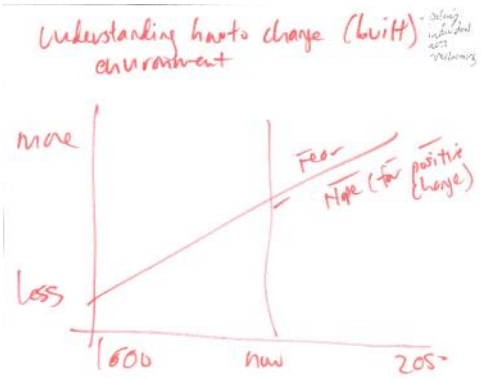
**Appendix D: Transcript Translation of the Causal Loop Diagram into Vensim PLE**

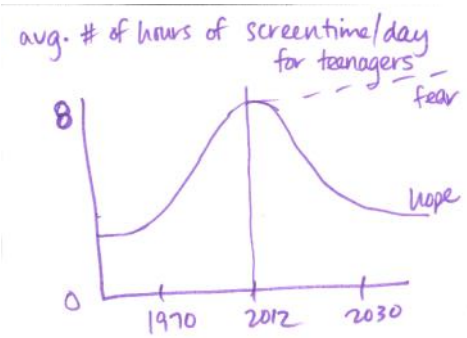


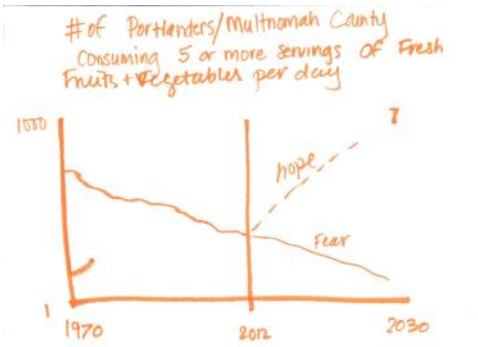

Educational attainment
Stress
Federal/ state immigration policy
Affordable, healthy housing
Connecting to/ understanding the environment
Urban sprawl
Social ustice
Equitable planning/ zoning
Affordability of active transportation
Schools in neighborhoods
Equitable implementation/ funding
Access to parks & recreation facilities
Access to active transportation infrastructure (ped/ bike/ transit)
Car dependence
g/ advertising althy foods/ verages
Education/ information on active transportation system & safety
des/ beliefs ealth (social onsibility)
Safe Routes to School
School PE
Active transportation (walk, bike)
Chronic iseases
Physical activity
Air quality
Screen time
besity rates
Perceptions of safety

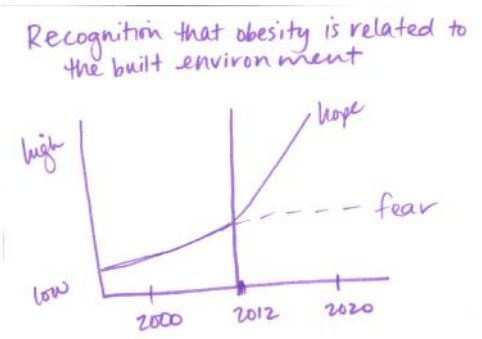
## Appendix E: Behavior Over Time Graphs not Represented in the Storybook

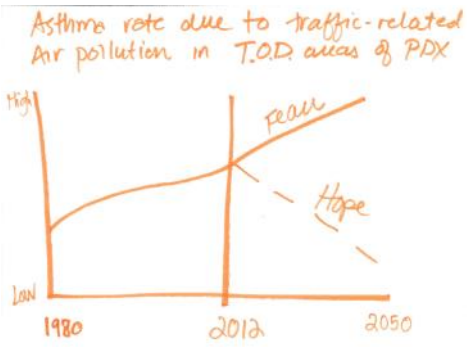


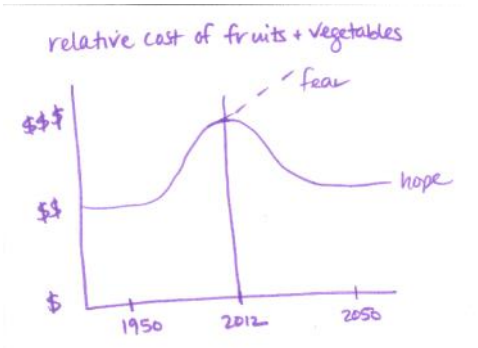



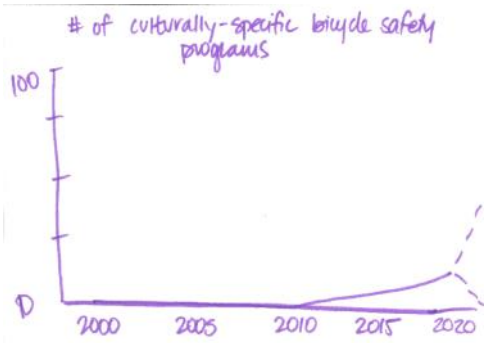



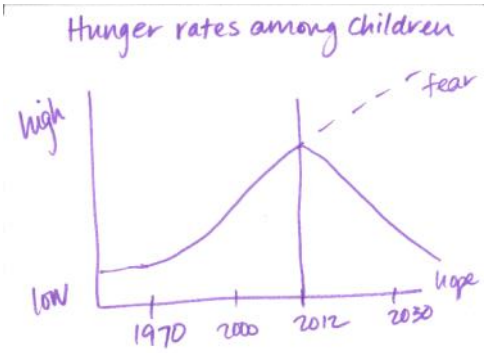



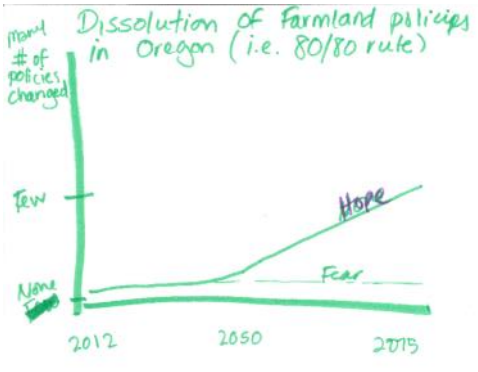



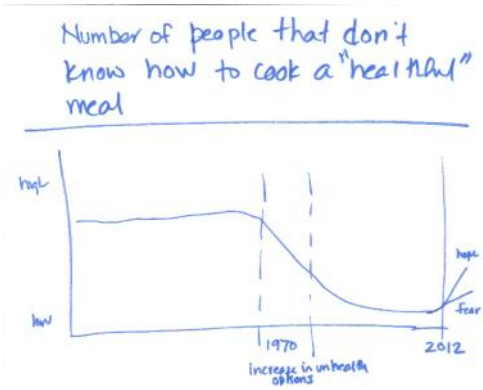



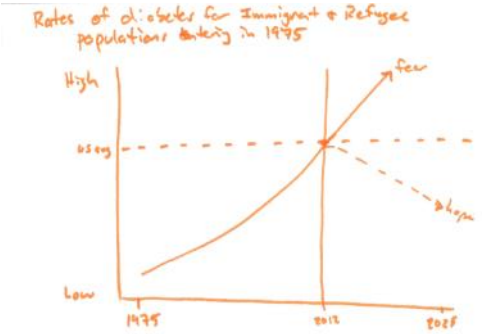



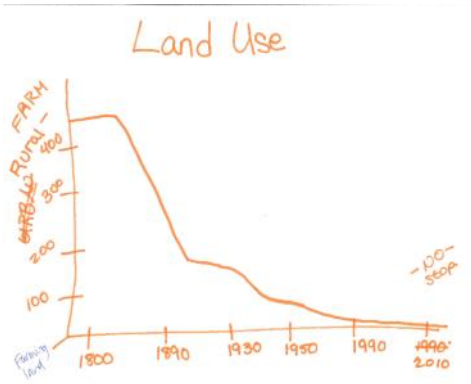



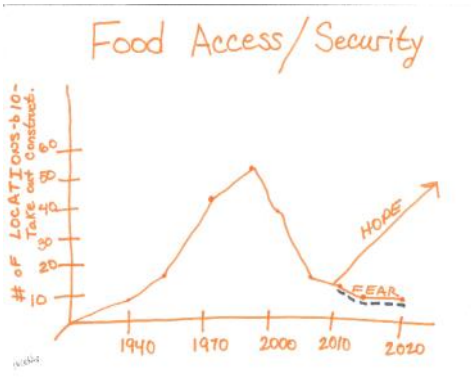



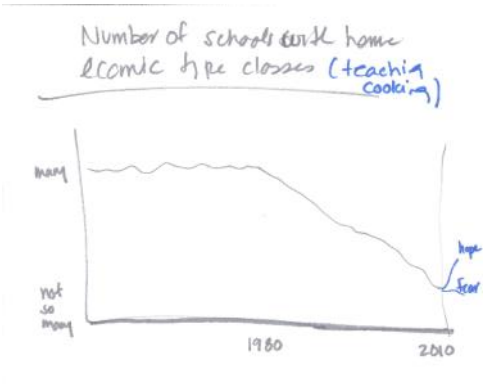



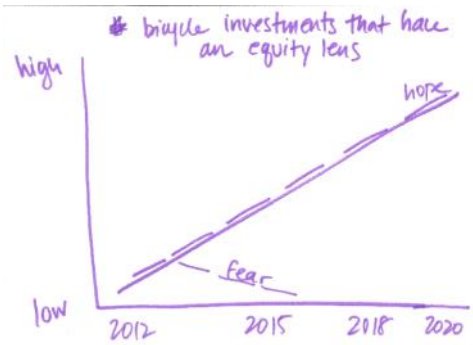



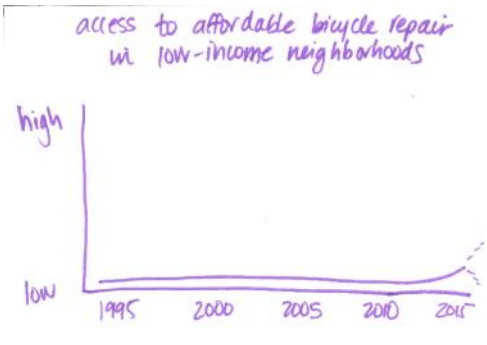



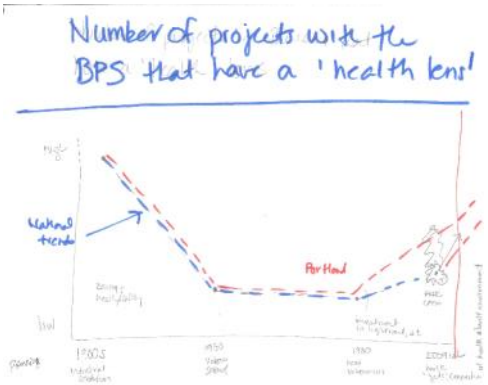

Land Use
FARM
RURAL
400
300
200
100
1800
1890
1930
1950
1990
2010

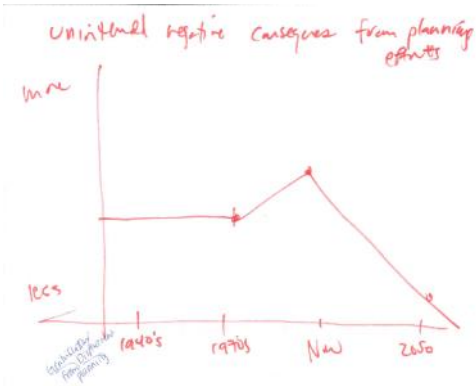

Food Access / Security
# of LOCATIONS to Take out Consumed.
60
50
40
30
20
10
HOPE
FEAR
1940
1970
2000
2010
2020

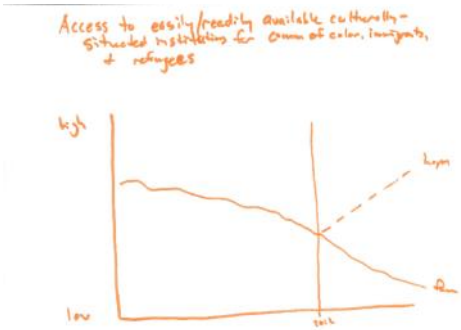

Number of schools with home ecomic type classes (teaching cooking)
many
not so many
hope
fear
1980
2010

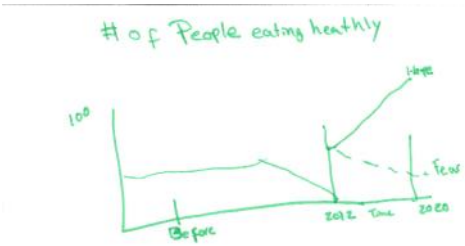

* bicycle investments that have an equity lens
high
low
hope
fear
2012
2015
2018
2020

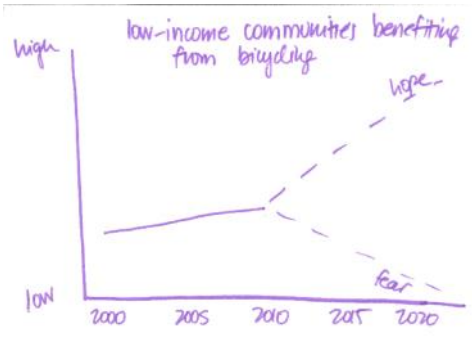

access to affordable bicycle repair in low-income neighborhoods
high
low
1995
2000
2005
2010
2015

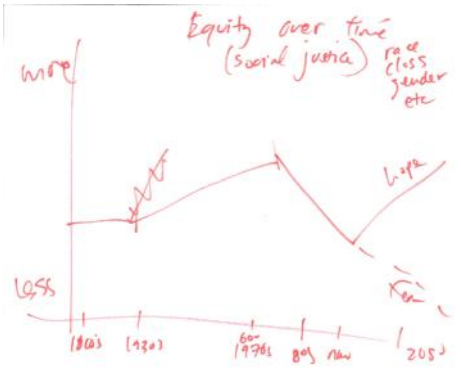

Number of projects with the BPS that have a 'health lens'
Forward

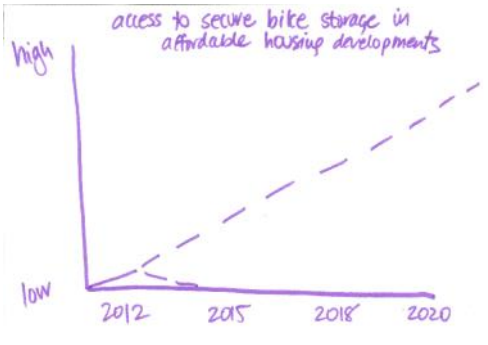

unintended negative consequences from planning efforts
more
less
1940's
1970's
Now
2050

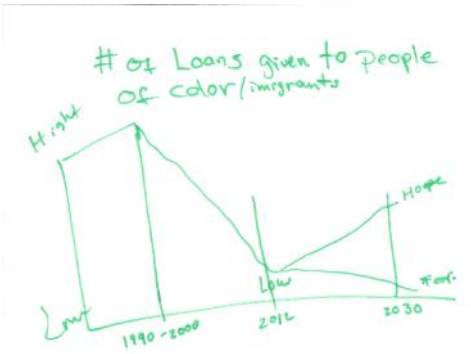

Access to easily/readily available culturally-situated institutions for comm of color, immigrants, & refugees
high
low
2012

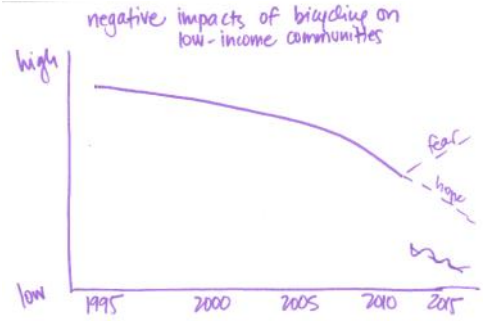

# of People eating healthly
100
hope
fear
Before
2012
Time
2050


low-income communities benefiting from bicycling
high
low
hope
fear
2000
2005
2010
2015
2020

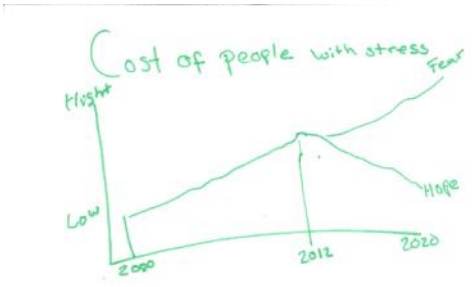

Equity over time (social justice)
race class gender etc
more
less
hope
fear
1800's
1930
1970's
2050

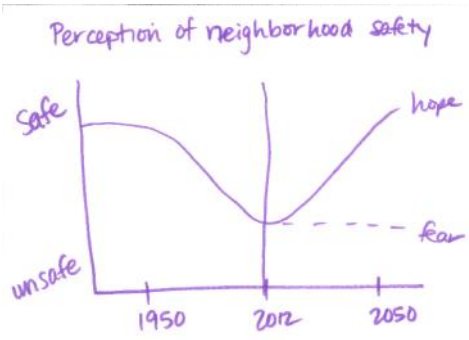

access to secure bike storage in affordable housing developments
high
low
2012
2015
2018
2020

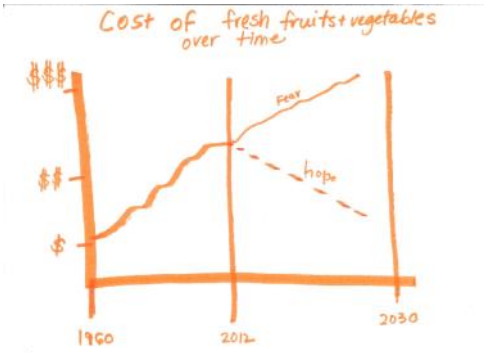

# of Loans given to People of color/immigrants
Hight
Low
Hope
Fear
1990-2000
2012
2030


negative impacts of bicycling on low-income communities
high
low
fear
hope
1995
2000
2005
2010
2015


relative cost of sugary drinks
$$$
$$
$
hope
fear
1950
2012
2050


Cost of people with stress
Hight
Low
Fear
Hope
2000
2012
2020


Perception of neighborhood safety
Safe
unsafe
hope
fear
1950
2012
2050


Cost of fresh fruits+vegetables over time
$$$
$$
$
Fear
hope
1950
2012
2030