A Systems Approach to Childhood Obesity Prevention

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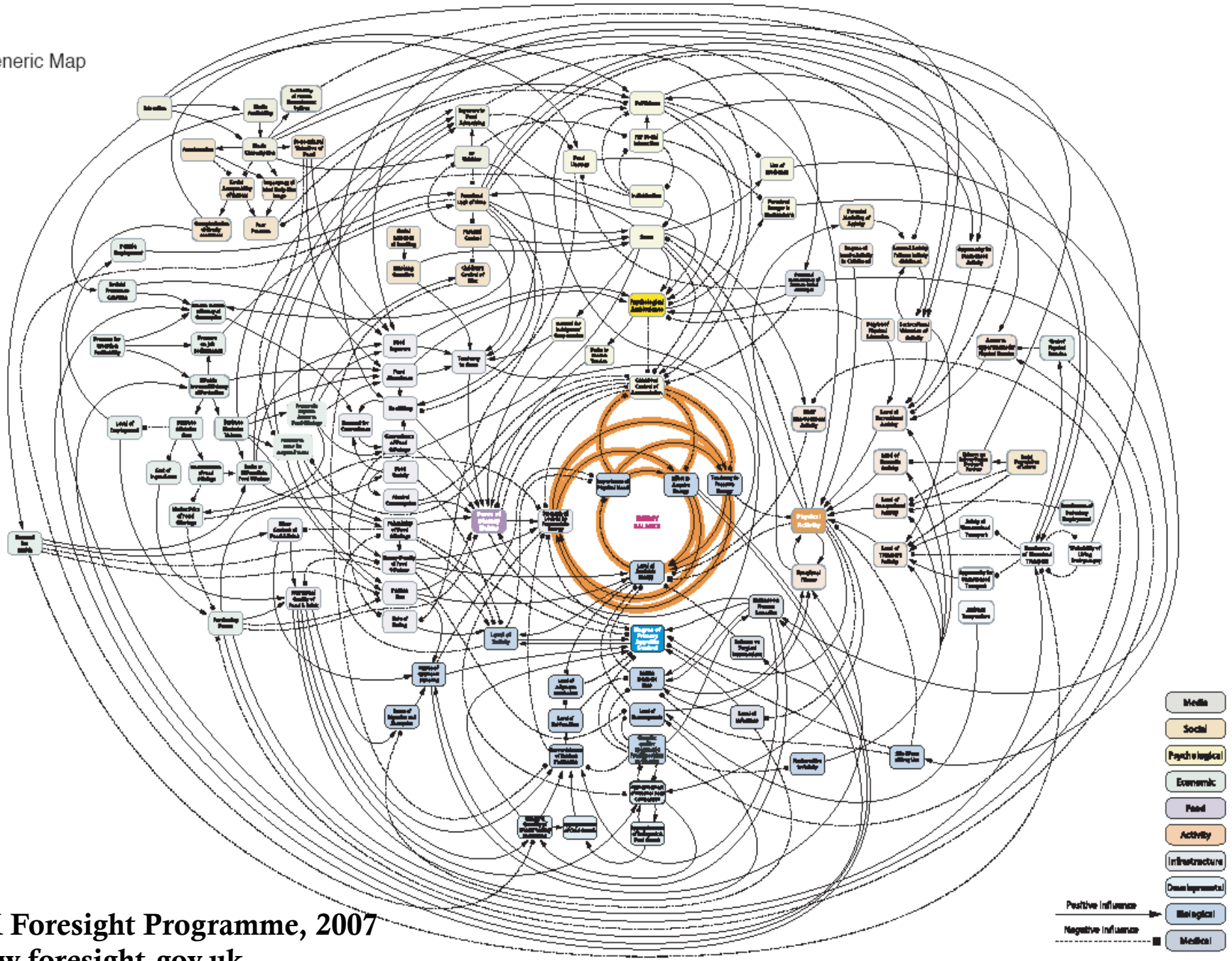
Outline

1. What is systems thinking?
2. Applications to obesity
3. Two examples of research and practice
4. Final thoughts and a few useful resources

1. What does it mean to think in systems?

Map 0

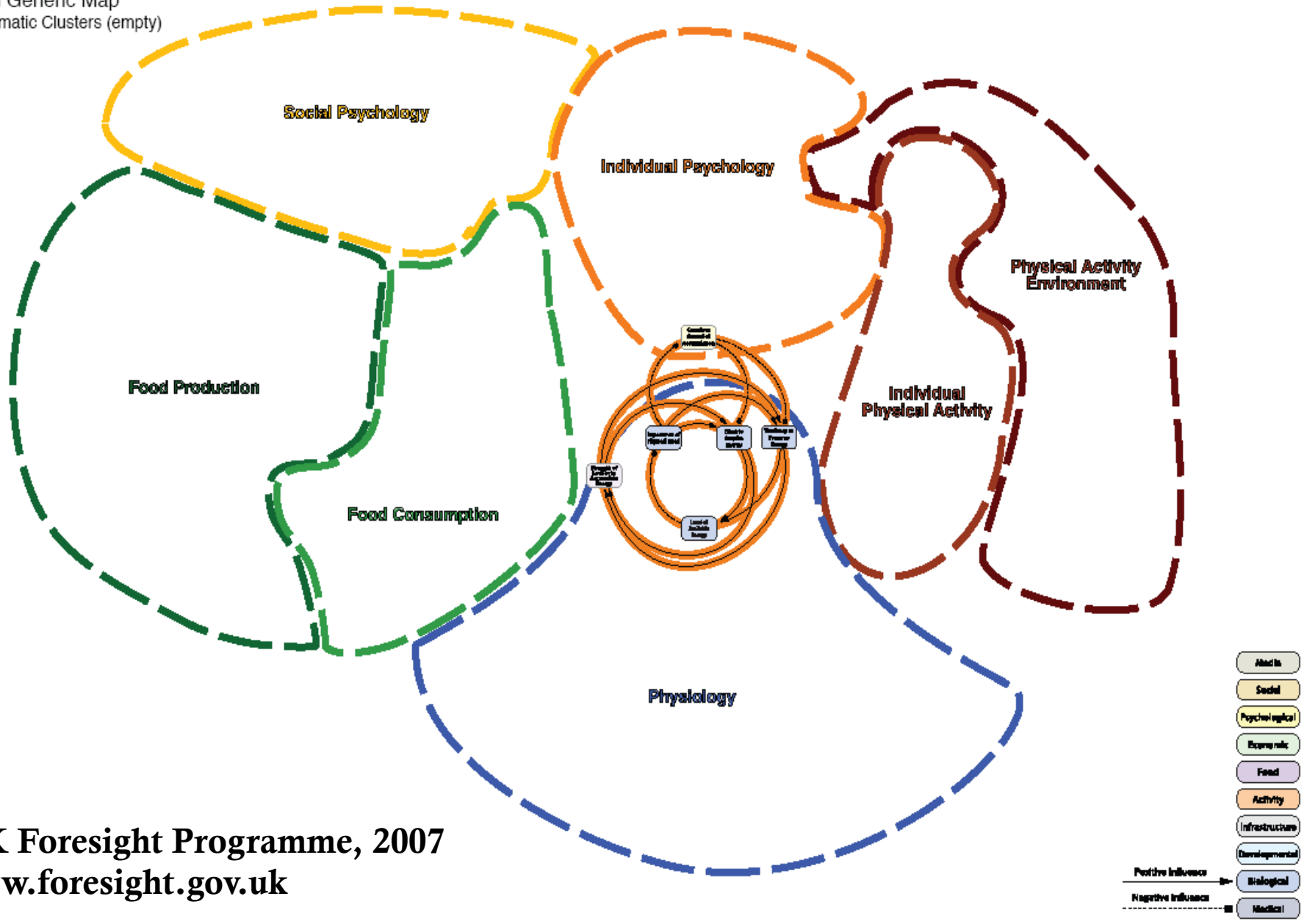
Full Generic Map



U.K Foresight Programme, 2007
www.foresight.gov.uk

Map 4

Full Generic Map
Thematic Clusters (empty)



U.K Foresight Programme, 2007
www.foresight.gov.uk

Key Characteristics of Complex Systems

- Heterogeneous
- Each actor and sector in society matters
- Dynamically interactive
- Feedback loops; learning; adaptation
- Emergent phenomena possible
- Tipping
- Non-equilibrium
- Opposite of reductionism (whole is greater than sum of parts)

What is systems thinking?

Constructing mental models and representing relationships

- 30,000-ft thinking (big-picture, horizontal thinking)
- Systems-as-cause thinking (self-generation phenomena, no "external forces)
- Dynamic thinking (trajectories v. equilibrium points)
- Operational thinking (stocks and flows)
- Closed-loop thinking (feedbacks)

Source: B. Richmond

What is systems thinking?

Simulating mental models

- Scientific thinking (simulations, adaptive learning)

Communicating and diffusing models of complex systems

- Empathic thinking (listening and communicating, responding to feedback on mental models)
- Generic thinking (transcending fields)

Source: B. Richmond

A systems approach focuses on the interconnections across actors, factors and sectors that contribute to childhood obesity

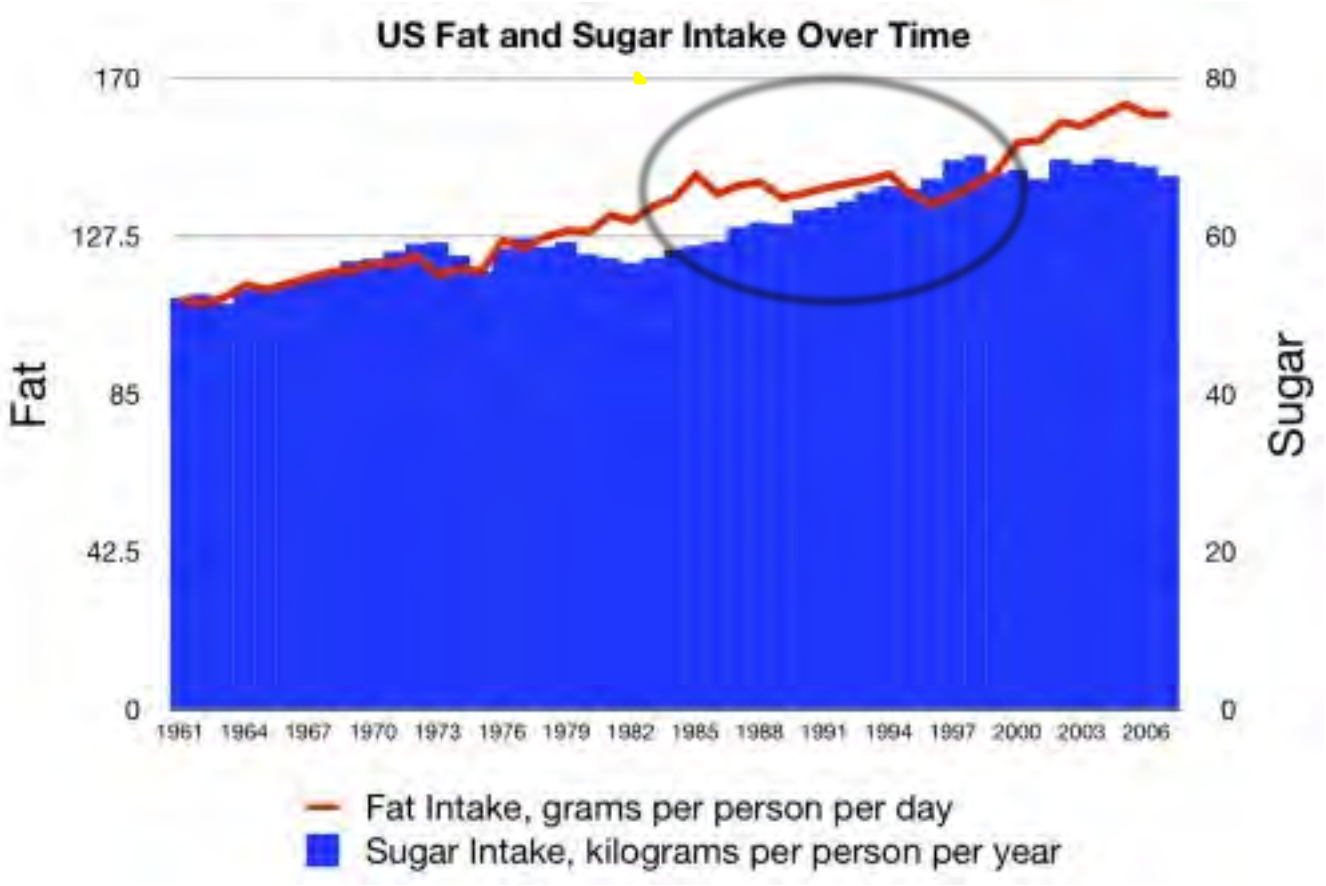
2. How can systems thinking be applied to childhood obesity?

Applications for Obesity

- Cope with complexities of childhood obesity
- Understand interpersonal, community and intersectoral dynamics – not just traditional risk factors – for generating solutions
- Create virtual laboratories for intervention design and testing sustainable solutions
- Generate new hypotheses and identify gaps in empirical data
- Bring together multiple disciplines & sectors
- Integrate multiple data sources
- Anticipate intended and unintended consequences

Unintended Consequences

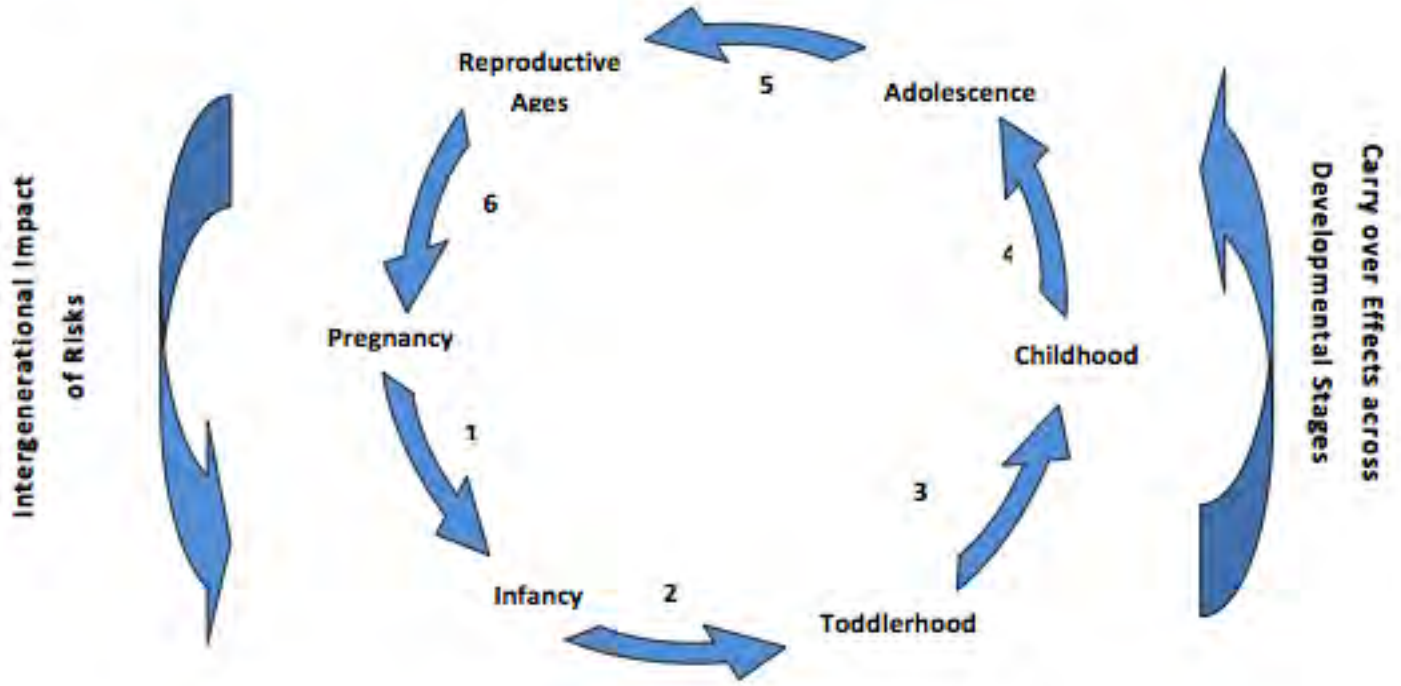
- The call for low-fat diets



Data: OECD

The Perils of Unintended Consequences

Developmental Connections



1 Intrauterine Programming

2 Breastfeeding, early food exposure, attachment stage

3 Childcare, habit formation, adiposity rebound

4 Brain maturation, self-management, puberty, health behavior change, increased salience of peer effects & school effects

5 Independence, increasing life stress

6 Pre-conception parental health status, prenatal care

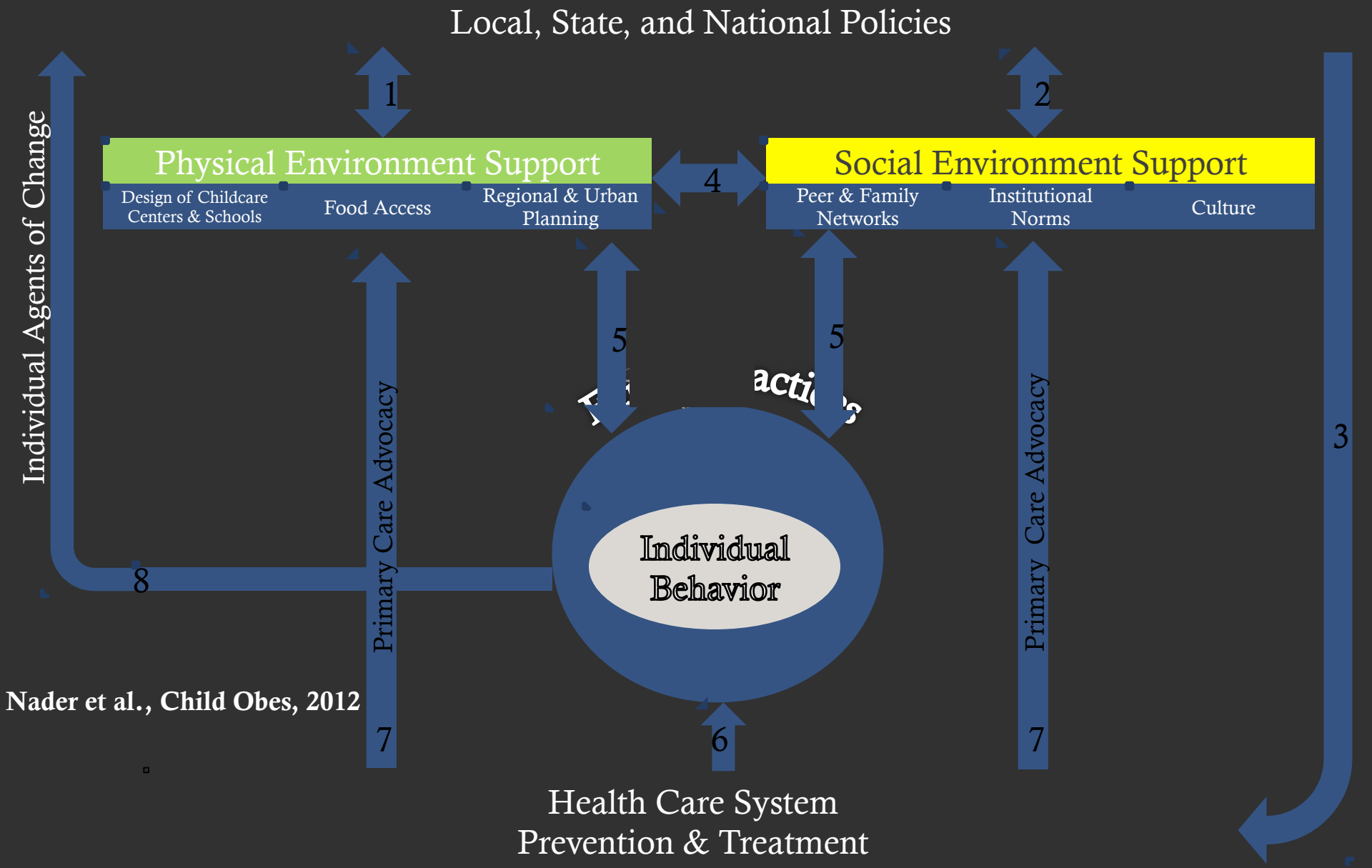
Esposito et al., PCD, 2009

Nader et al, Child Obes, 2012

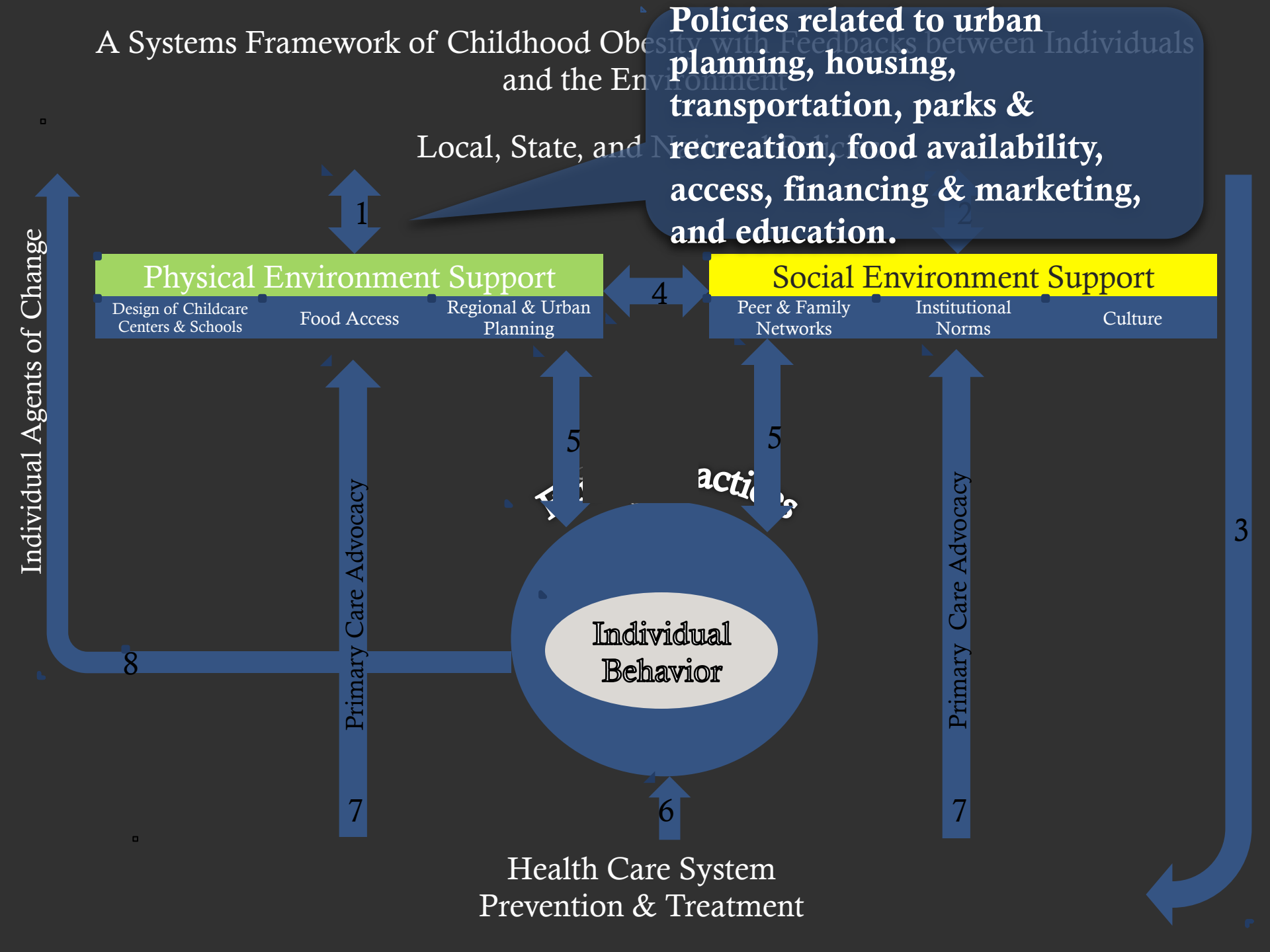
Social Networks in Contexts

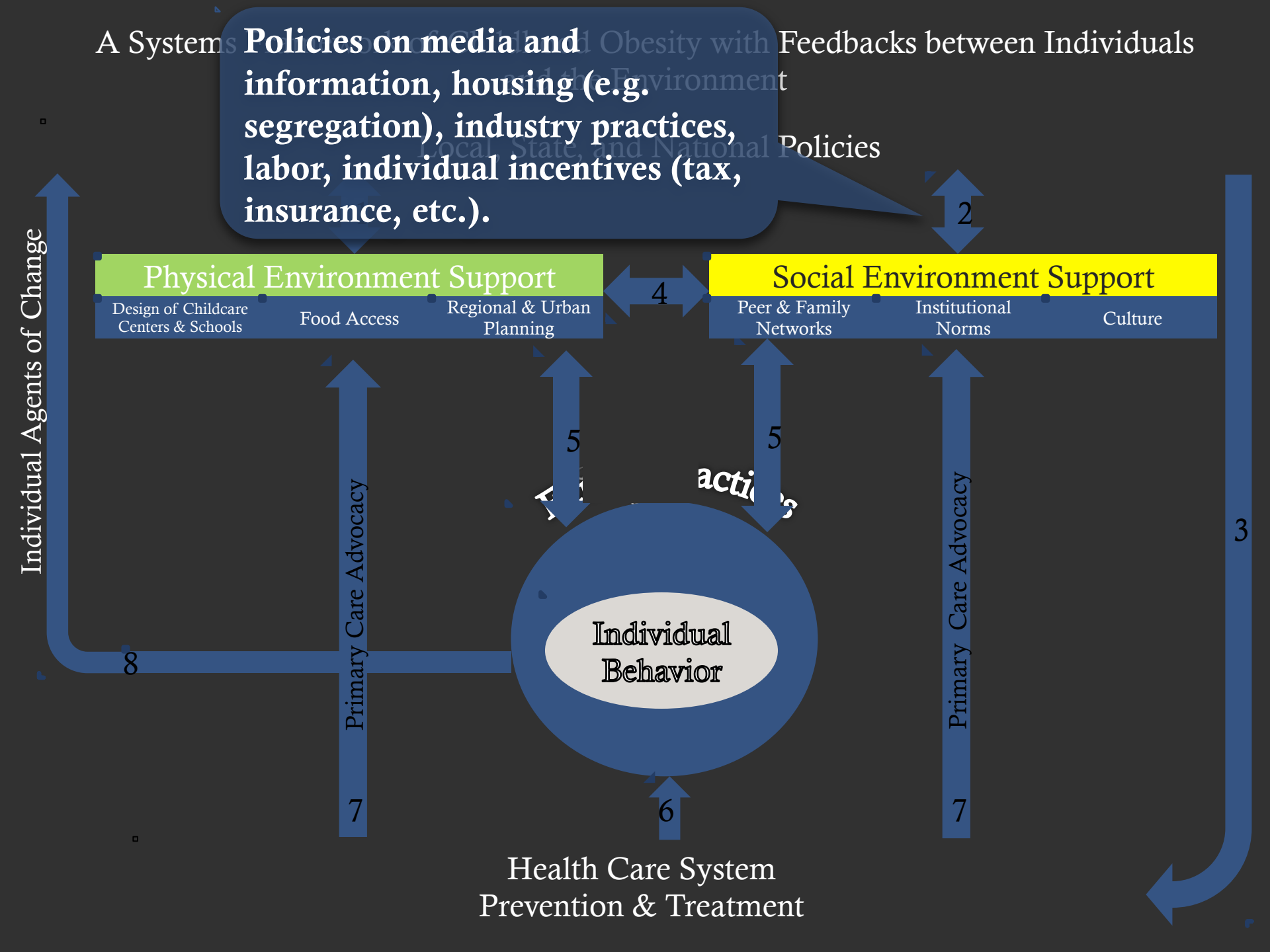
Christakis & Fowler, NEJM, 2007

A Systems Framework of Childhood Obesity with Feedbacks between Individuals and the Environment



Nader et al., Child Obes, 2012


A Systems Framework of Childhood Obesity with Feedbacks between Individuals and the Environment
Local, State, and National Policies
Policies related to urban planning, housing, transportation, parks & recreation, food availability, access, financing & marketing, and education.
1
2
Physical Environment Support
Design of Childcare Centers & Schools
Food Access
Regional & Urban Planning
4
Social Environment Support
Peer & Family Networks
Institutional Norms
Culture
Individual Agents of Change
5
5
Primary Care Advocacy
Individual Behavior
3
8
7
6
7
Primary Care Advocacy
Health Care System
Prevention & Treatment


A Systems Model of Childhood Obesity with Feedbacks between Individuals and the Environment
Policies on media and information, housing (e.g. segregation), industry practices, labor, individual incentives (tax, insurance, etc.).
Local, State, and National Policies
2
Physical Environment Support
Design of Childcare Centers & Schools
Food Access
Regional & Urban Planning
4
Social Environment Support
Peer & Family Networks
Institutional Norms
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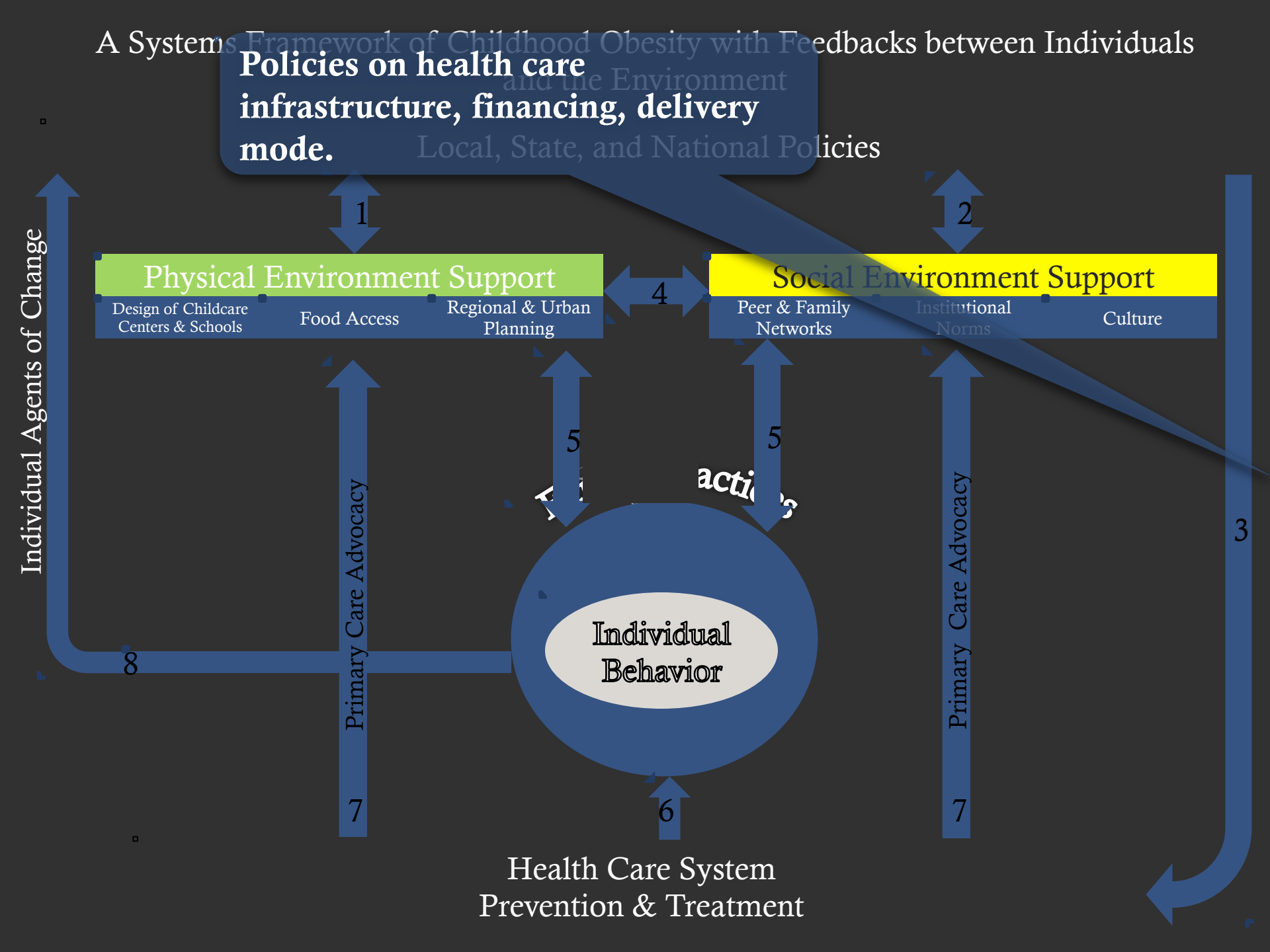
A Systems Framework of Childhood Obesity with Feedbacks between Individuals and the Environment
Policies on health care infrastructure, financing, delivery mode.
Local, State, and National Policies
1
2
Physical Environment Support
Design of Childcare Centers & Schools
Food Access
Regional & Urban Planning
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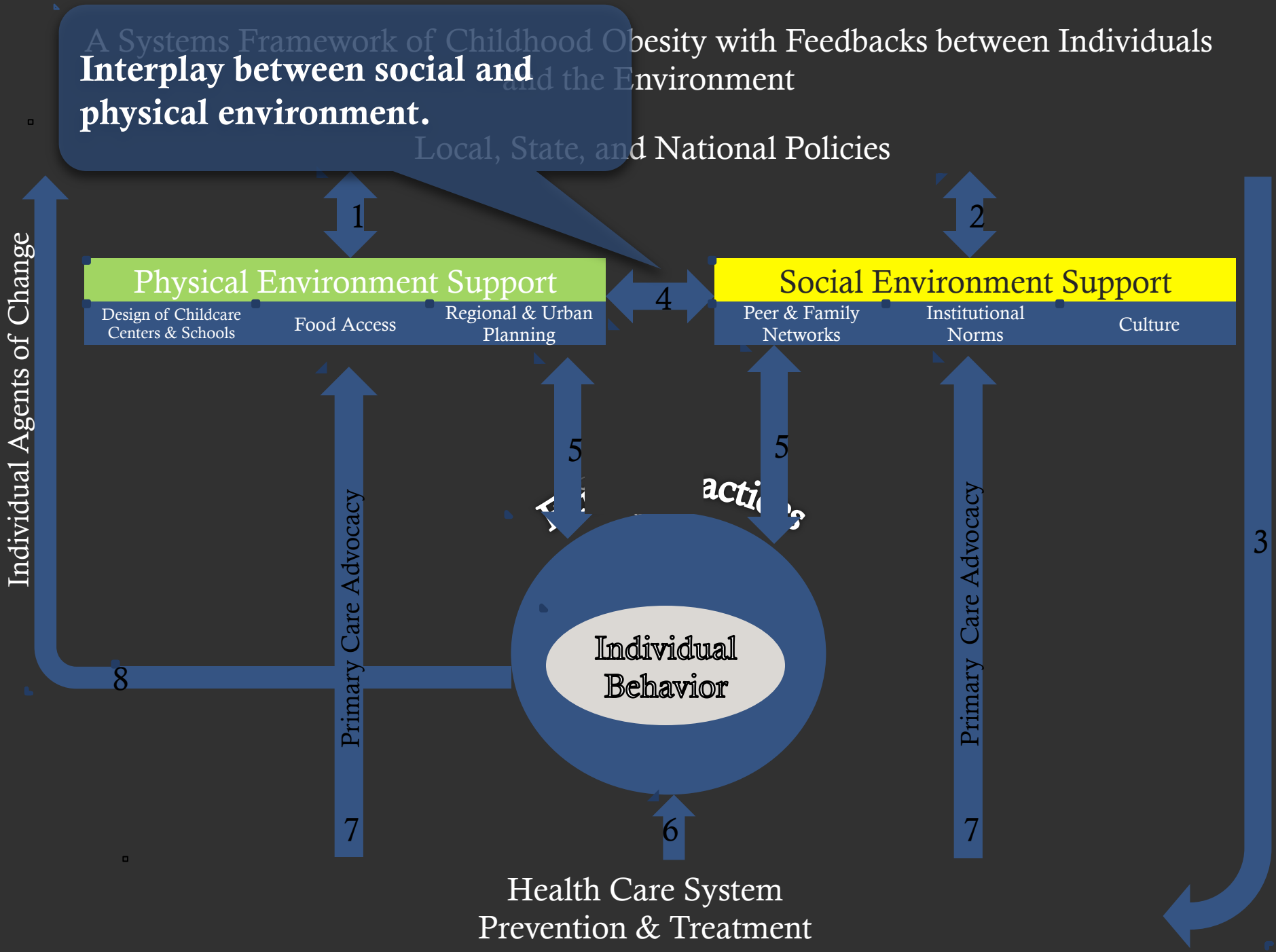
A Systems Framework of Childhood Obesity with Feedbacks between Individuals and the Environment
Interplay between social and physical environment.
Local, State, and National Policies
1
2
Physical Environment Support
Design of Childcare Centers & Schools
Food Access
Regional & Urban Planning
4
Social Environment Support
Peer & Family Networks
Institutional Norms
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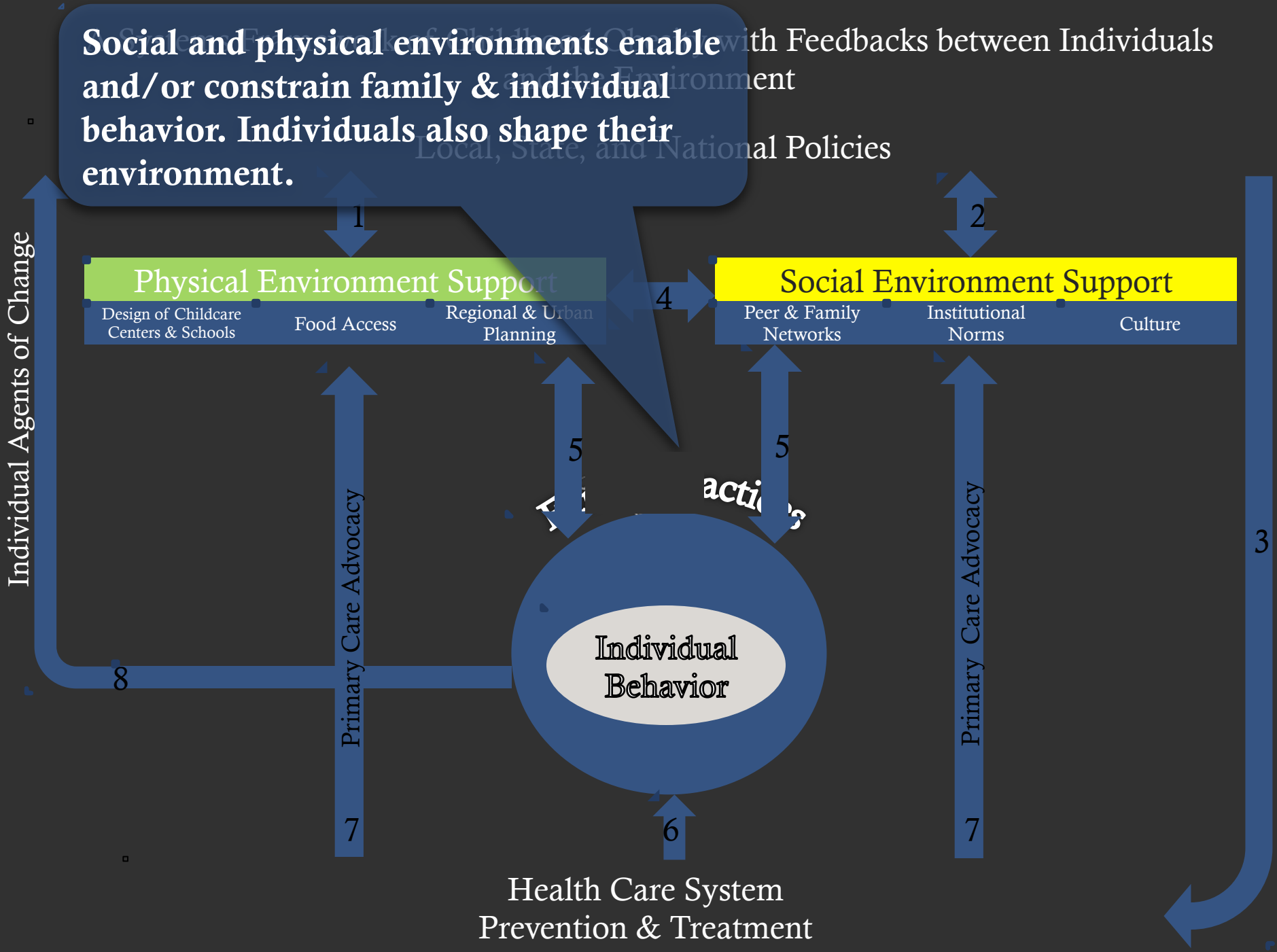
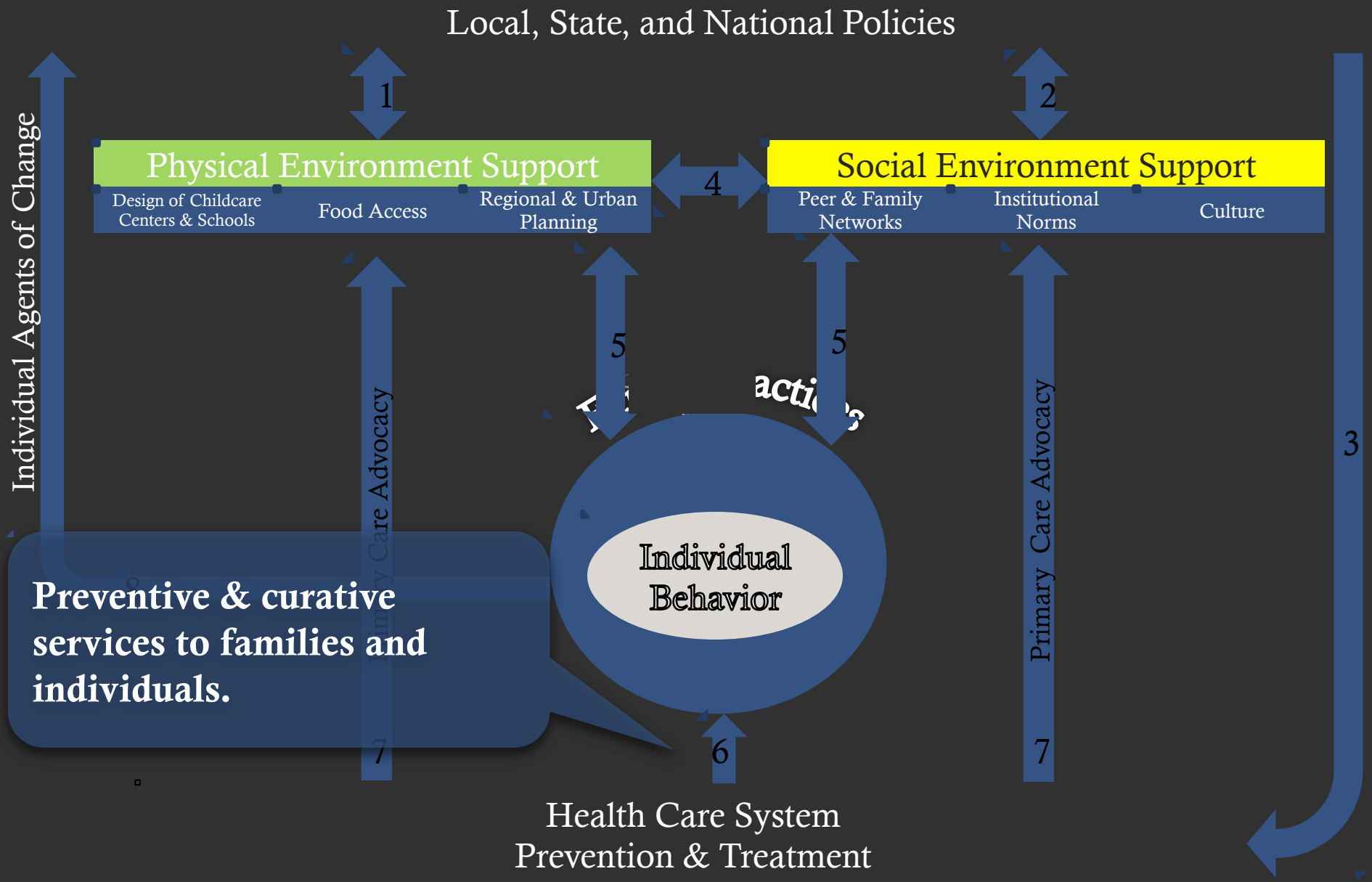
Health Care System
Prevention & Treatment

Social and physical environments enable and/or constrain family & individual behavior. Individuals also shape their environment.

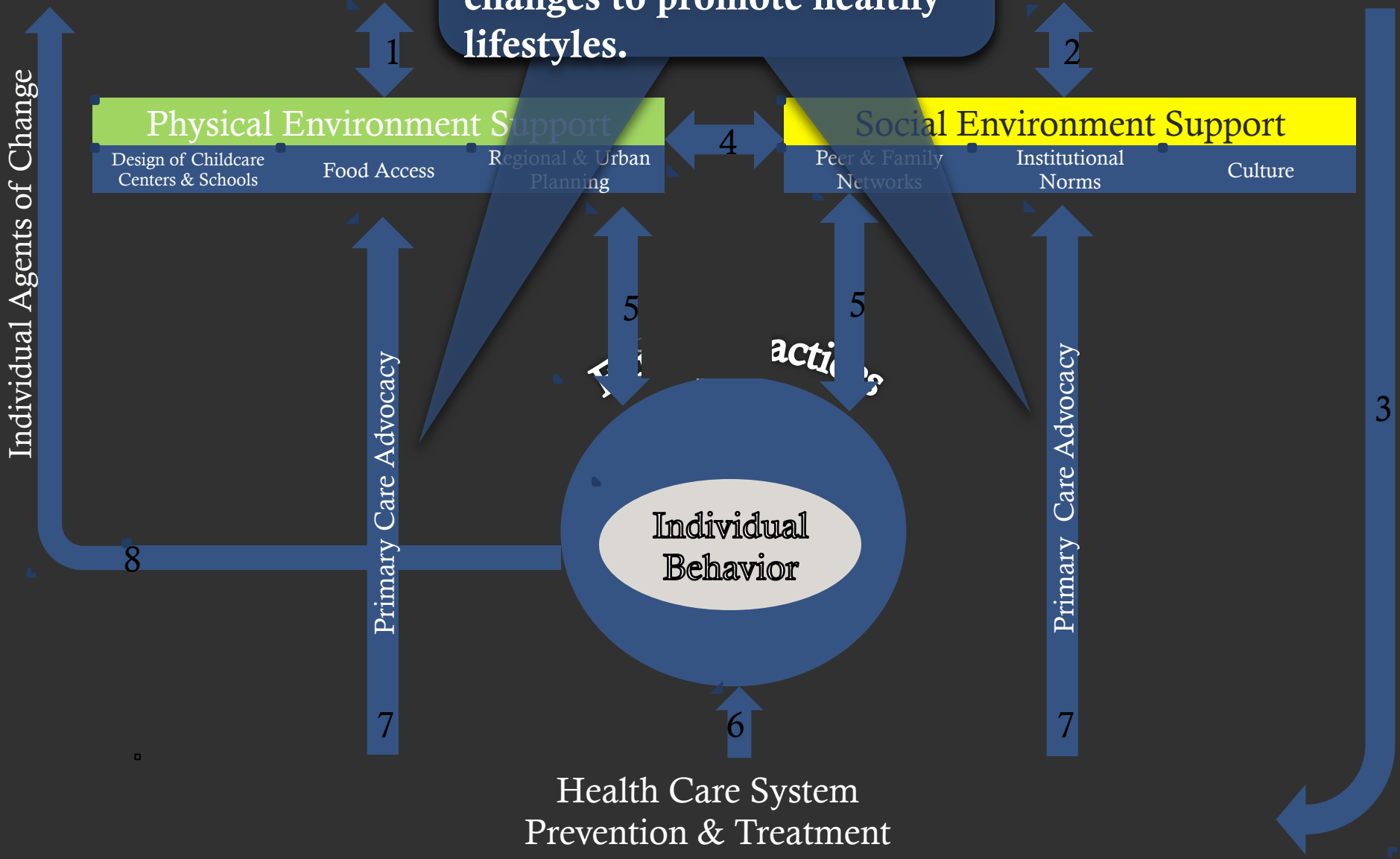


A Systems Framework of Childhood Obesity with Feedbacks between Individuals and the Environment



A Systems Framework ks between Individuals

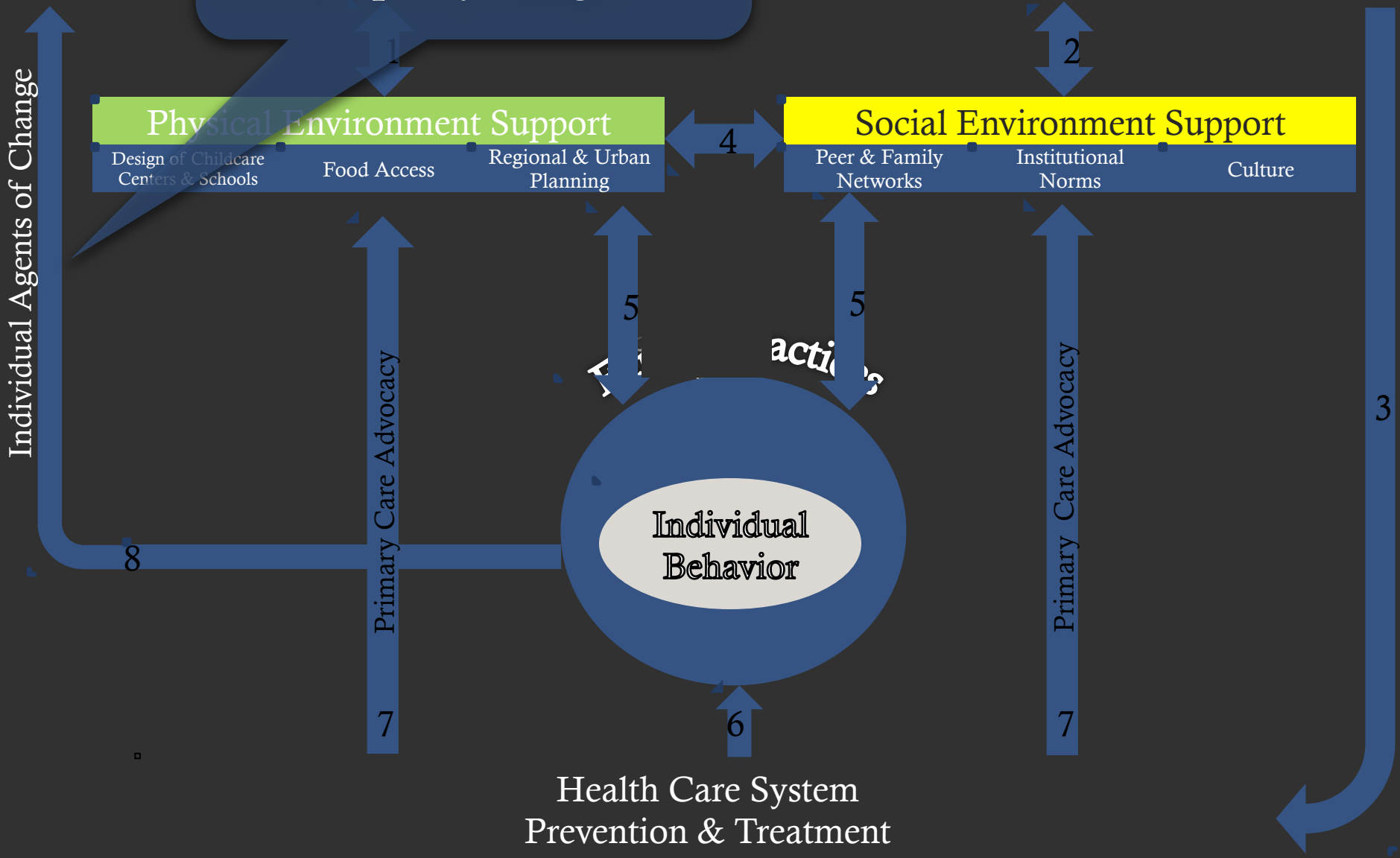
Health care providers and practices as advocates of social & environmental changes to promote healthy lifestyles.



A Systems Framework of Childhood Obesity with Feedbacks between Individuals and the Environment

Individual empowerment and community mobilization to effect policy change.

Local, State, and National Policies



Health Care System
Prevention & Treatment

Sustainability, Scalability, Reach

- How do we ensure sustained interventions and intervention effects?

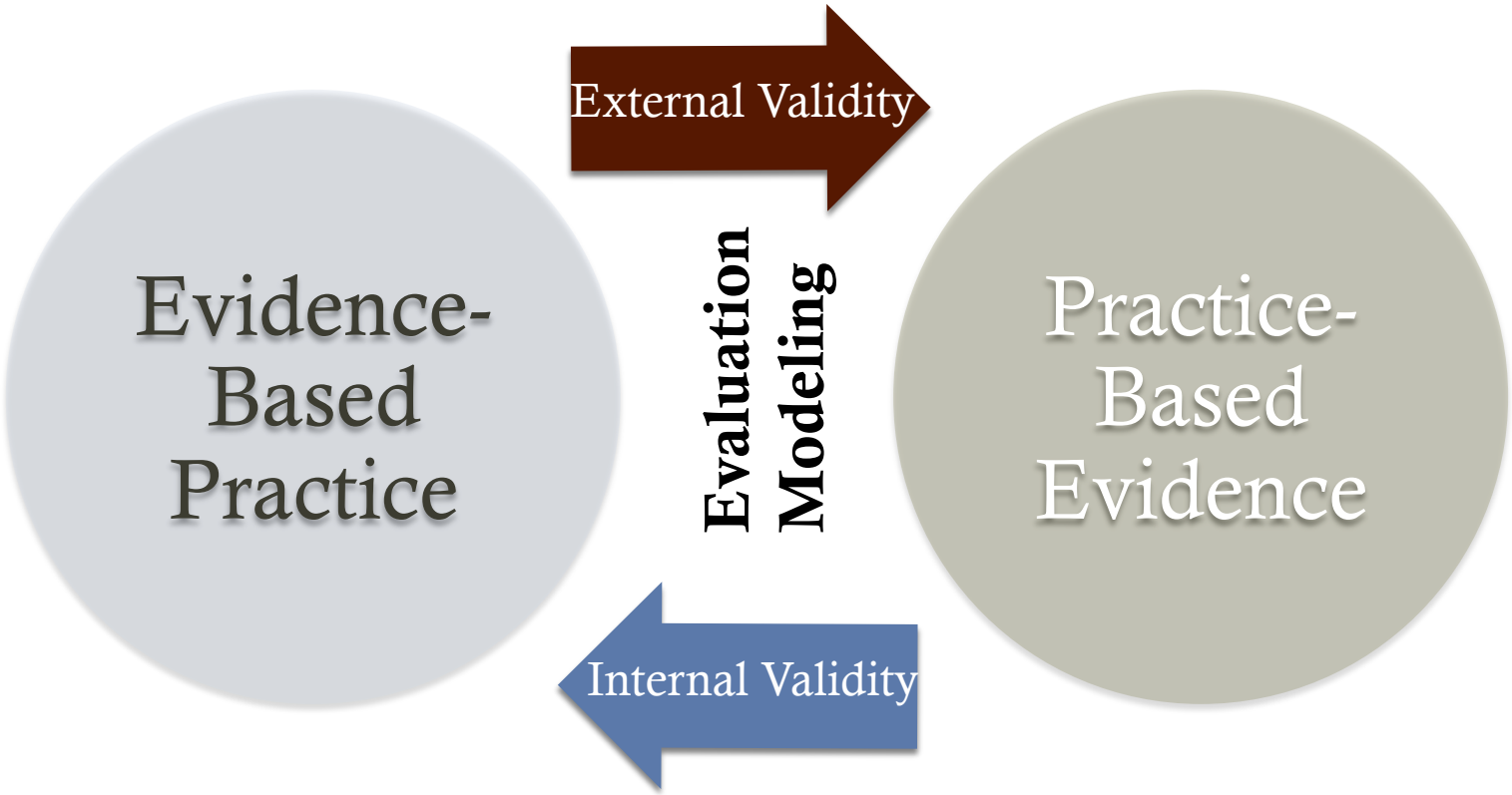
- How do we diffuse and scale-up effective interventions? Interventions often only attain cost-effectiveness when they achieve economy of scale.

- How do we ensure different communities all benefit from interventions?

Table 1b: PRIVATE SECTOR		Locus of the Driver	
		Top-Down	**Bottom-Up**
Locus of Change	**Policy**	Top-down, policy interventions in the private sector stem from large industries. Sustainability and scalability are very strong, and the reach can be wide as well if the customer base is large. These interventions do not occur as frequently as public policy interventions since it is challenging to coalesce competitors from a given industry around public health. Example: *Healthy Weight Commitment* (http://www.healthyweightcommit.org/).	Bottom-up, policy interventions in the private sector stem from private nonprofit organizations, associations, and lobby groups. These organizations can often be more agile than public institutions in mobilizing resources, offering greater sustainability, scalability, and reach than similar public initiatives for their programs. Examples: *The Alliance for a Healthier Generation* (http://www.healthiergeneration.org/); *Children Now* for regulating food marketing to children (http://www.childrennow.org/index.php/learn/advertising_obesity).
		Sustainability: High **Scalability:** High **Reach**: Medium-High	**Sustainability**: Medium - High **Scalability:** High **Reach:** Medium - High
	Behavior Change and Community Health Promotion	Top-down, behavior change interventions are more common than top-down policy interventions in the private sector, with or without demonstrable outcomes. With industry backing, sustainability, scalability, and reach are generally relatively strong and are sometimes uniquely a function of business interests rather than public health outcomes. An example of this type of interventions is the *Blue Cross Blue Shield Association* childhood obesity programs (http://www.bcbs.com/innovations/good-health-club/); *NFL's Play 60 Campaign*, a national youth health and fitness campaign focused on increasing the wellness of young fans by encouraging them to be active for at least 60 minutes a day (http://www.nfl.com/play60).	Bottom-up, behavior change interventions in the private sectors employ business models to sustain and scale up programs. Compared to similar bottom-up public efforts, these interventions have greater sustainability, scalability, and potentially reach. Contrary to top-down behavior change efforts in the private sector, this type of intervention does depend strongly on public health outcomes. Example: MEND (http://www.mendprogramme.org).
		Sustainability: High **Scalability:** Medium-High **Reach**: Medium	**Sustainability**: Medium - High **Scalability:** Medium **Reach**: Medium

Huang et al., Children's Healthcare, 2011

Knowledge Transfer Loop



Systems Thinking Helps Avoid Common Pitfalls Stemming from Laundry-List Cause-and-Effect Thinking

- Independent effects (from causal factors)
- One-way causality (feedbacks)
- Linearity of effects (dynamically variable over time)
- Instantaneous effects (delays are everywhere)

What Systems Science Is Not

- Crystal ball to predict the future
- Guessing game of what solutions are for a given problem
- Free of theoretical and data considerations
- Replacement of existing toolbox
- All models are wrong; some are useful. (George Box)

From individual approaches…

Health Education

To an environmental and policy focus…

healthy places

An Initiative of Healthy Chicago

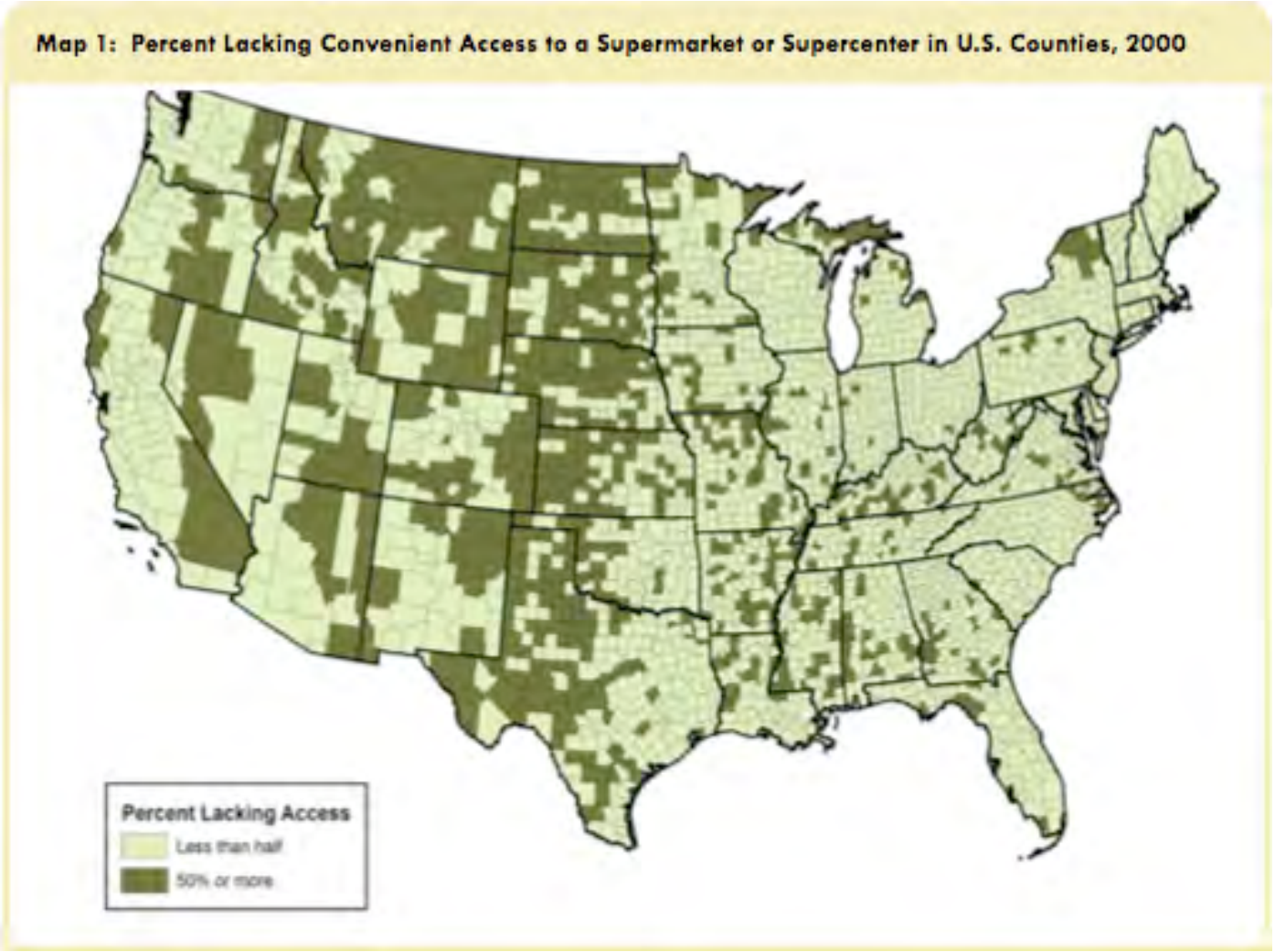
Consortium to Lower Obesity in Chicago Children

clocc

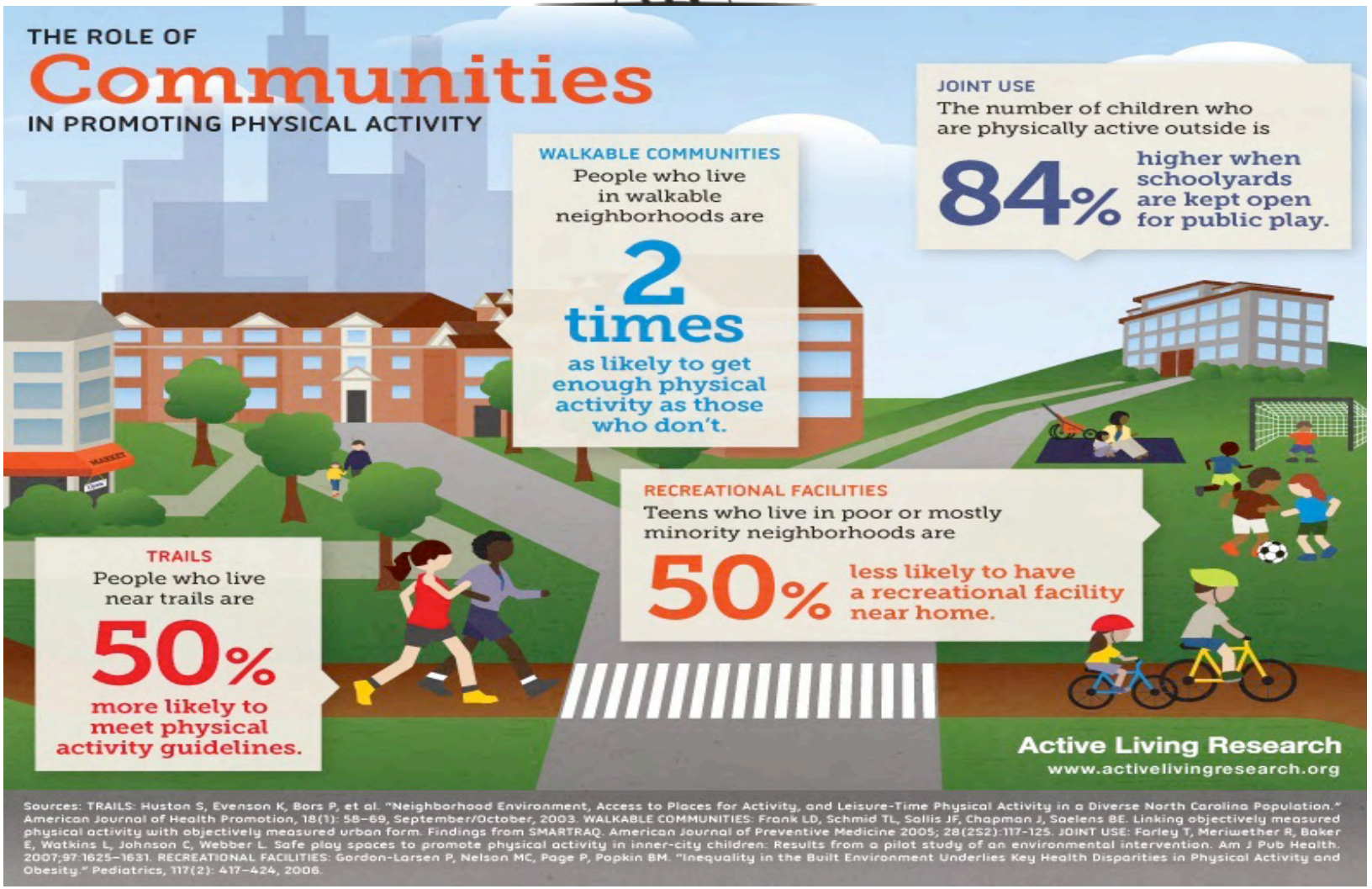
How do we achieve policy adoption and implementation?

If we build it, will they come?

Food deserts in the U.S.



Active communities



New ventures…
How to bring the human factor and the environment together

3. Two Examples of Research and Practice

- How to intervene on both the supply of and demand for health, healthy products, healthy places and healthy policies?
- How to create social movements and shift social norms?
- Can culture be changed or realigned?

Designer Schools: Buckingham, Virginia

Team:

UNMC (T. Huang)
UVA (M. Trowbridge)
VMDO Architects

Gorman et al, Obesity, 2007
Huang et al., Prev Chronic Dis, in press

Supported in Part: UVA Youth-NEX

HEALTHY EATING DESIGN GUIDELINES FOR SCHOOL ARCHITECTURE

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[1]College of Public Health, University of Nebraska Medical Center, Omaha, NE; [2]School of Medicine University of Virginia, Charlottesville, VA; [3]VMDO Architects, Charlottesville, VA

Integrating **Architecture** and **Public Health** to Inform **Design Strategies** for **Schools** Conducive to **Healthy Eating**

BACKGROUND

- Creating healthy school food environments is a national strategy to prevent and reduce childhood obesity; yet there is no guidance on designing schools to promote healthy eating and physical activity
- Previous work in architecture has shown that school design impacts student behaviors, development, and academic performance (1-3)
- Research has begun to show that issues such as food display and cafeteria design features can impact children's eating behaviors in schools (4-7)

THEORETICAL FRAMEWORKS

- Architecture – Environmental Psychology considers the transactional nature of environment and social life and proxemics, which explores physical space and social interactions
- Social Science – Behavioral Economics considers cues in environment that implicitly motivate or "nudge" consumer health behavior
  Social Systems Models consider school grounds to community for integrated system

Dining Zone with Natural Light, Flexible Seating, and Educational Signage (Rendering: VMDO Architects)

KEY CONCEPTS

- 10 domains were established (e.g., commercial kitchen, signage, etc.)
- Each domain includes a main objective and specific design strategies
- Features of the design guidelines are meant to be testable hypotheses rather than fully established recommendations

GUIDELINE PRINCIPLES

- Provide equipment and spaces that facilitate the incorporation of fresh and healthy food choices into the school and its community
- Provide facilities to engage the school community directly in food production and preparation
- Apply evidence- and theory-based behavioral science principles to 'nudge' the school community towards healthy-eating behaviors and attitudes
- Use building/landscape features to promote awareness of healthy, sustainable food practices
- Conceive and articulate school spaces as community assets to multiply the benefits of school-based healthy food initiatives

On-Site Food Production and Outdoor Classroom (Rendering: VMDO Architects)

Application of the Guidelines:

Architectural Design Process - Buckingham County, VA Primary + Elementary School

1. Programming
Identify and understand the architectural problem and uncover goals and needs

2. Schematic Design
Formulate potential design solutions based on the programming needs/problems

3. Design Development
Further refine, develop, and integrate key spaces

4. Construction Documentation
Translate decisions into a format to communicate the design for construction contractors

- Buckingham County Public Schools identified healthy eating as a priority for a school design
- The Design Guidelines became part of the architectural problem to solve throughout the design process

- At schematic design stage, the level of detail is limited, but involves issues such as building layout in relationship to surrounding structures/context and interior sequencing of spaces

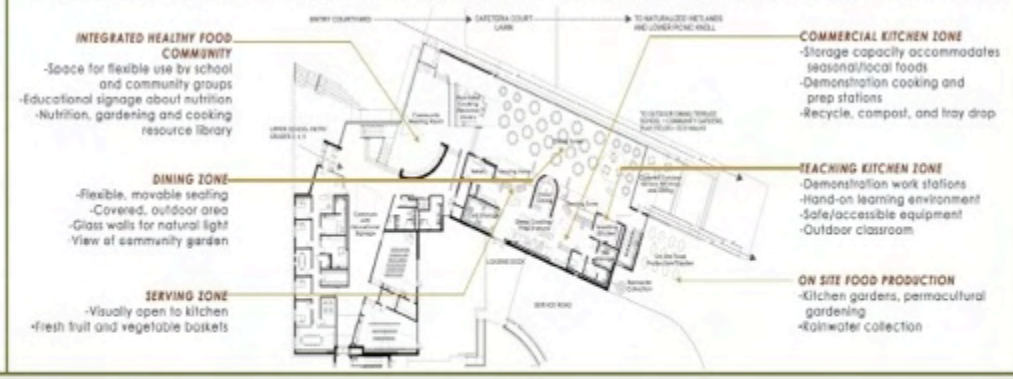
- The design development phase is progressively more detailed. The plan below highlights sample elements corresponding to the Design Guidelines. Construction documentation includes every detail of the structure to be built

View of Open Serving Area and Teaching Kitchen (Rendering: VMDO Architects)

RESEARCH OPPORTUNITIES

- The Healthy Eating Design Guidelines present an opportunity to grow the evidence base for health promoting architecture
- Convergence of architectural and public health theories creates new behavior change pathways. E.g., improved healthy eating may occur as a default function of the physical change in the environment, with normative changes (i.e., cultural shifts) occurring slowly over time
- A mixed methods study of the Buckingham County Project illustrated will evaluate the effect of the new architecture on school-level practices and curricula, food procurement, staff attitudes, and student food purchases, knowledge, attitudes and norms over time

CARTER G. WOODSON EDUCTION COMPLEX, BUCKINGHAM COUNTY PRIMARY + ELEMENTARY SCHOOL, CAFETERIA/COMMONS/KITCHEN FLOOR PLAN



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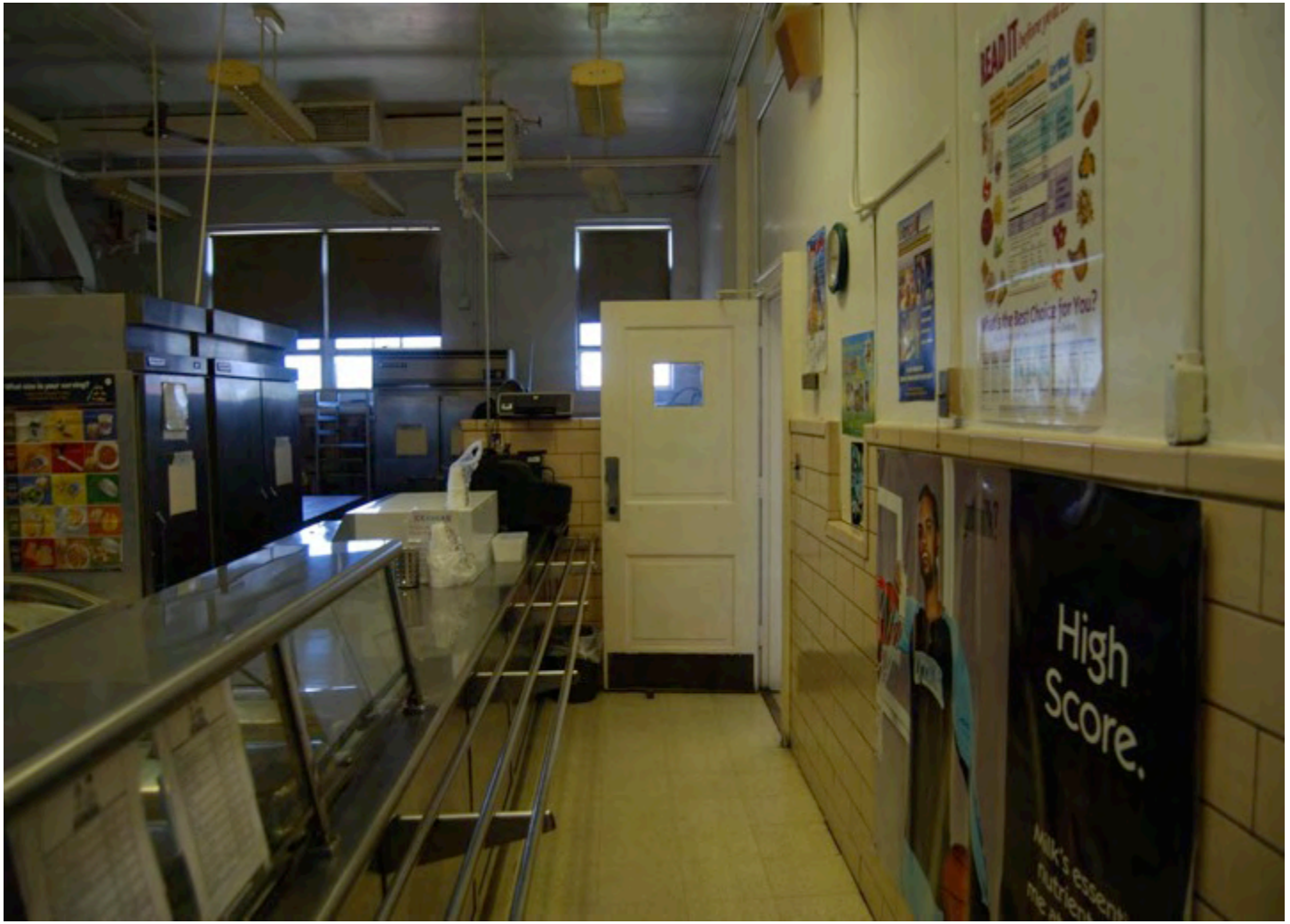
6. Perry CL, Bishop DB, Taylor GL, Davis M, Story M, Gray C, et al. A randomized school trial of environmental strategies to encourage fruit and vegetable consumption among children. Health Educ Behav 2004;31(1):65-76.
7. Bauserman S, Wang M, Studer N, Crawford P. An Evaluation of the School Lunch Initiative: Final Report. Berkeley, CA: Dr. Robert C. and Veronica Atkins Center for Weight and Health, University of California; 2010.

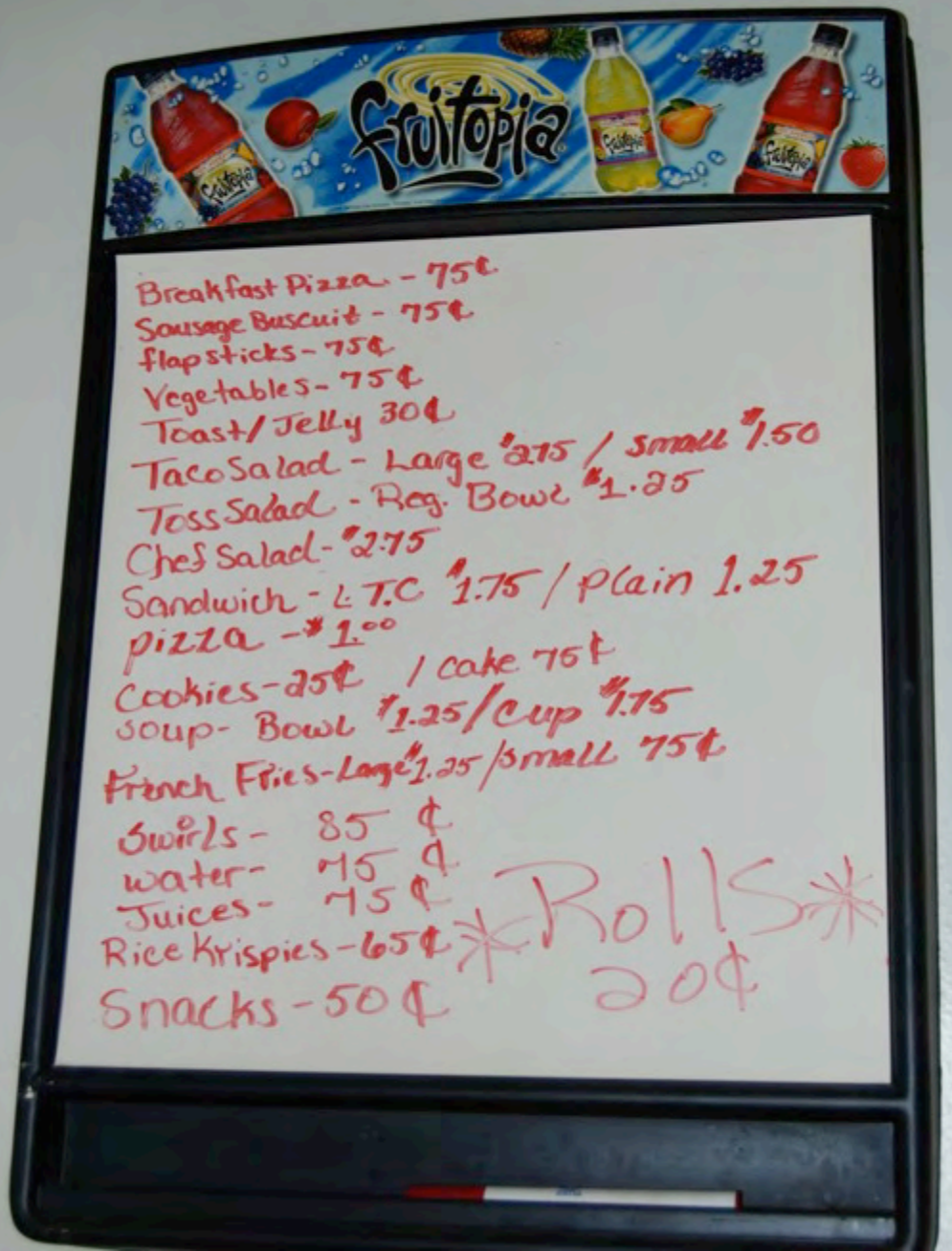
ACKNOWLEDGEMENTS

Buckingham County Public School District
Youth Nex, University of Virginia

Institutional dining hall

Old kitchen & servery




Fruitopia
Breakfast Pizza - 75¢
Sausage Buscuit - 75¢
flapsticks - 75¢
Vegetables - 75¢
Toast/Jelly 30¢
Taco Salad - Large $2.75 / small $1.50
Toss Salad - Reg. Bowl $1.25
Chef Salad - $2.75
Sandwich - L.T.C $1.75 / plain 1.25
pizza - $1.00
Cookies - 25¢ / cake 75¢
soup - Bowl $1.25 / cup $.75
French Fries - Large $1.25 / small 75¢
Swirls - 85 ¢
water - 75 ¢
Juices - 75 ¢
Rice Krispies - 65¢
Snacks - 50¢
Rolls
20¢


Real Fruit Juice
Vitamin & Calcium
Enriched
"Refreshing Drinks"
swirl

PROGRAMMATIC MACRO ZONES: ENVIRONMENTAL SYNERGIES FOR A FOOD SMART SCHOOL

1_COMMERICAL KITCHEN ZONE

1.1 Cold storage / freezer
1.2 Dry storage
1.3 Bakery
1.4 Demonstration cooking + prep stations
1.5 Cooking equipment/hood
1.6 Recycle, compost + tray drop

2_TEACHING KITCHEN ZONE

2.1 Vegetable prep sinks + equipment storage
2.2 Demonstration work stations
2.3 All glass doors to open to seating
2.4 Outdoor classroom adjacent to seating, power source for equipment
2.5 Outdoor kitchen accessible to indoor teaching kitchen

3_SERVING ZONES

3.1 Hot + cold lunch service visually open to kitchen
3.2 Fresh fruit & vegetable baskets
3.3 Check out

4_DINING ZONES

4.1 Grades K-1-2 seating at round tables - all glass north facing views
4.2 Grades 3-4-5 seating at round tables - all glass north + east facing views
4.3 Variety of seating for small groups at round tables + cafe tables
4.4 Flexible, movable soft seating for casual meet ups and snack time
4.5 Covered upper terrace for class and dining use
4.6 Lower terrace for class and dining use: amphitheater steps for seating

5_AESTHETICS OF HEALTHY FOOD ENVIRONMENTS

5.1 Hot/Cold food counter with display case
5.2 Incorporation of appealing lights and colors
5.3 Integrated audio capabilities

6_EDUCATIONAL SIGNAGE, WAYFINDING AND MARKETING

6.1 Menu signage highlighting seasonal fresh foods + nutrition facts
6.2 Slate chalkboard - writing surface
6.3 Educational + wayfinding signage to feature health and nutrition information

7_WATER ACCESS AND VENDING MACHINES

7.1 Fresh water station adjacent to milk + juice cart

8_ON-SITE FOOD PRODUCTION

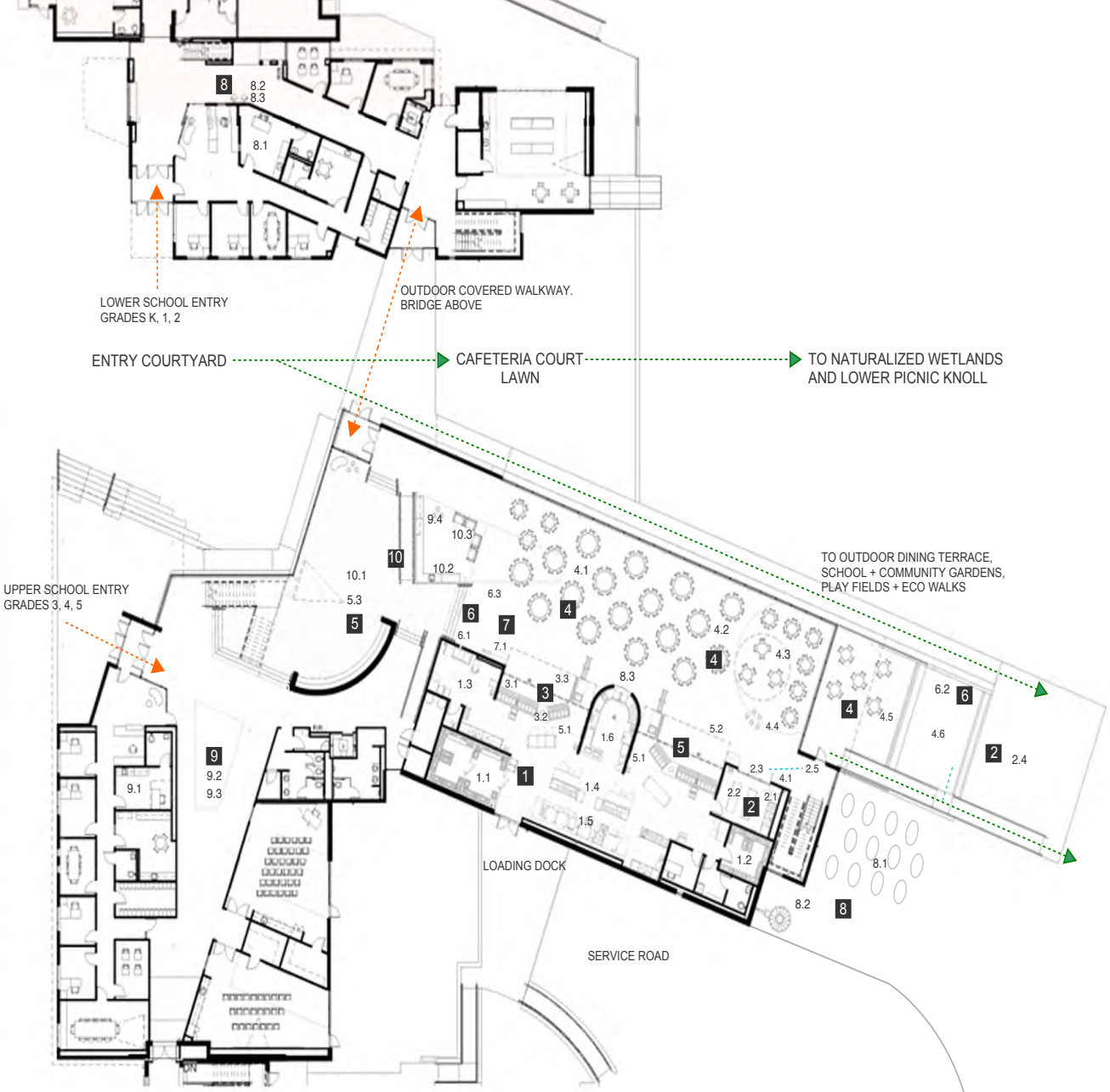
8.1 Kitchen gardens; permacultural gardening - herbs, vegetables, flowers with access to rainwater cistern collection, outdoor power, and compost station
8.2 Non-potable water sources: rainwater collection cistern, hose bib

9_INTEGRATED HEALTHY FOOD EDUCATION FACILITIES

9.1 Wellness center/clinic
9.2 Wellness center lounge + exhibition commons
9.3 Educational + wayfinding signage to feature health and nutrition information
9.4 Nutrition, gardening and cooking resource library

10_INTEGRATED COMMUNITY HEALTHY FOOD EDUCATION

10.1 Community meeting room with exhibition display, project screen + seating
10.2 Prep sink, counter and storage area
10.3 Soft lounge seating



BUCKINGHAM COUNTY (DILLWYN) UPPER + LOWER ELEMENTARY SCHOOLS
CAFETERIA COMMONS/KITCHEN FLOOR PLAN +
OUTDOOR CIRCULATION CONNECTIONS

School in construction


DINING COMMONS

Cafe

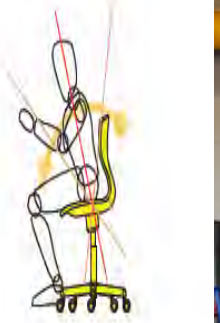

KNOW YOUR FARMER
KNOW YOUR FOOD
organic
farm
menu
cooking lab

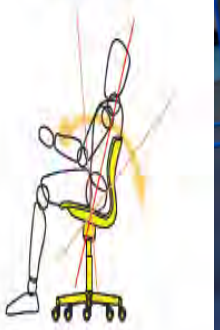
Food Lab

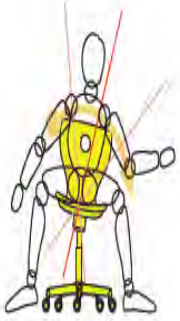
Creating Food Smart Youth

School Garden


DEN








One touch of nature
makes the whole world kin.
William Shakespeare

Design "Software"

- To optimize the use of design features:

  - Operator's Manual
  - Student-Led Guided Tour (in collaboration with USGBC)
  - Series of Workshops with School & Community Stakeholders
  - Technical Assistance (e.g., Experience Food Project/Chef Tom French)

Latino Health Movement through Youth Advocacy, Social Marketing & Partnerships

Support: RWJF/Active Living Research
Nebraska Research Initiative

Initiative Framework

- Designed to develop youth activists to enhance community readiness to address childhood obesity in Omaha's Latino community.

- Empower families to make healthy choices and create an environment that is conducive to healthy lifestyles.

- It is youth driven and community participatory. Community ownership and sustainability of change are key.

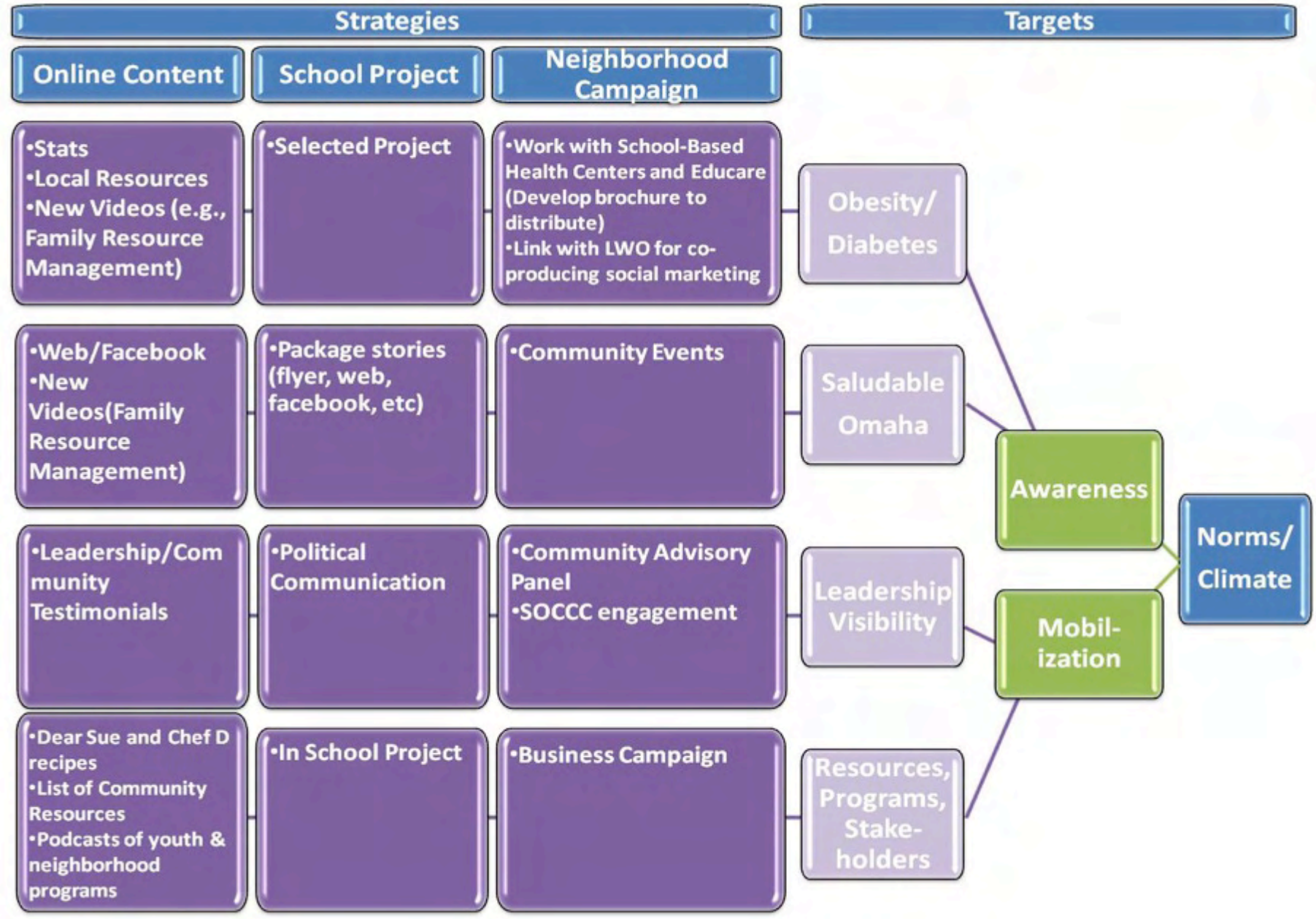
Art and Science

- Marriage of art, media, and science.
  http://www.youtube.com/watch?v=YCTgcUTSH6E
- The goal is to catalyze a social movement about Latino health.

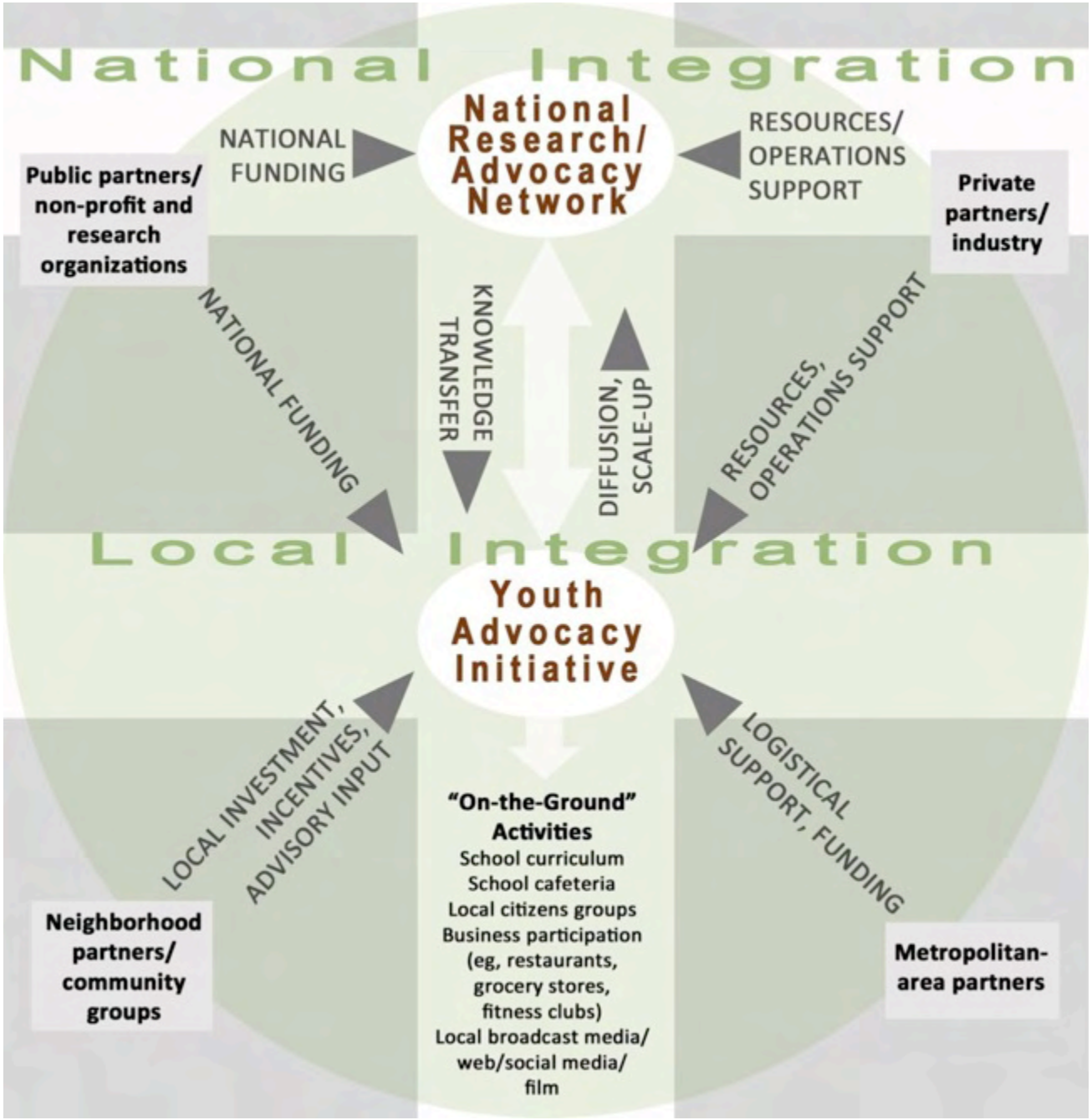
The founding youth advocate cohort designed and developed the logo, brand, and containers for generating a Latino health movement

SaludableOmaha

SaludableOmaha Logic Model



Integrated Model for Generating Social Movement



Frerichs et al, 2012

4. Final Thoughts

- Solution-oriented approach, paradigm shift, convergence of fields
- Systems thinking compels us to ask different questions and come up with non-linear solutions
- Multicomponent ≠ Multilevel ≠ Systems Science
- Important to involve systems thinkers at outset of program design
- Complements traditional toolbox

Blending the individual, social & environmental…

Some Useful Resources

- Donella Meadows: Thinking in Systems: A Primer
- Tarek Hamid: Thinking in Circles about Obesity
- Joy Richmond el al (eds): Tracing Connections: Voices of Systems Thinkers
- Diane Finegood: *The complex systems science of obesity*. In: John Cawley (ed.): The Oxford Handbook of the Social Science of Obesity