



Class Four

Urban Policy ***4211/6606***

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Class Four

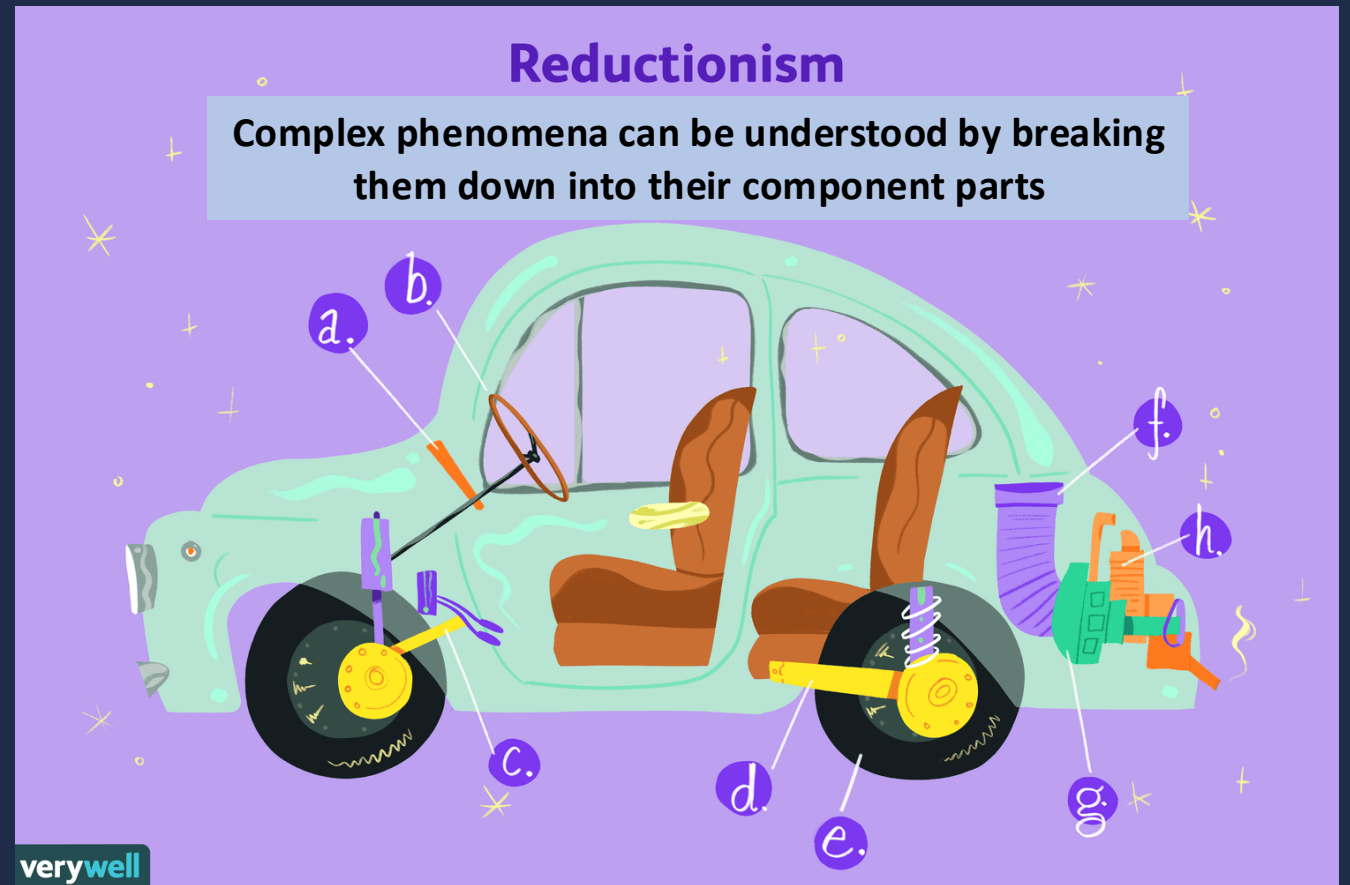
Emergence and the City as a Complex Adaptive System

Cities create value by delivering connectivity in their functioning as networks

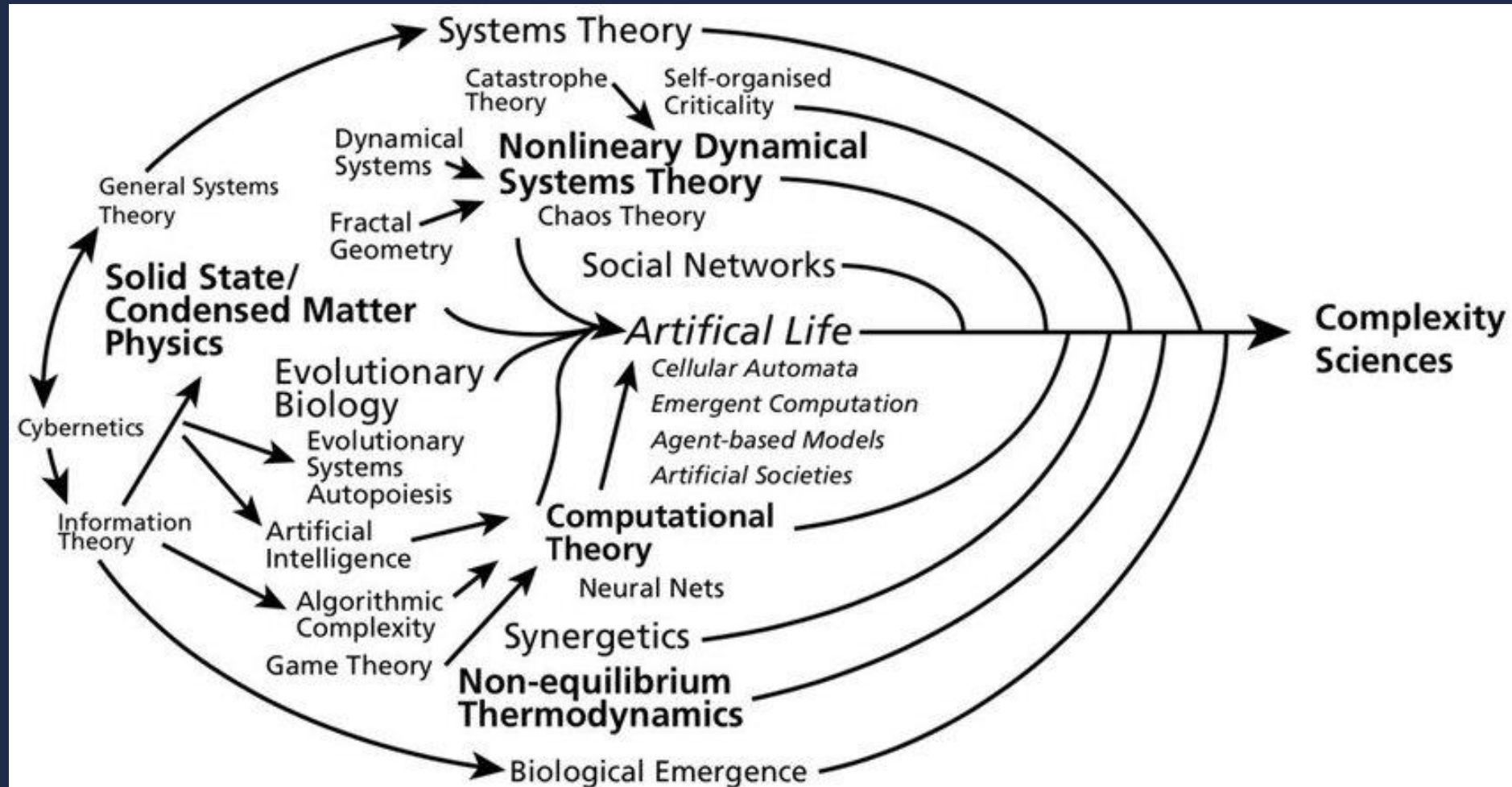
- Subject to **increasing returns to scale**, which serves as the **engine for urbanization**
- Networks are dependent on **resilient and sustainable infrastructure**
- Policies that have disrupted the healthy functioning of cities as networks have been largely driven by **racial animus**
 - Redlining, zoning, public housing, urban renewal, etc.
 - Have created specific, disconnected geographies that do not function in a healthy manner: distressed neighborhoods
- Efforts to engineer outcomes in these distressed neighborhoods have failed because they are not properly defining the problem: **cities are problems of “organized complexity”**

Reductionism has governed science since Galileo

- All phenomenon can be broken into component parts to yield an understanding of how it works
 - “Clockwork universe” of Newton
- You don’t lose any “meaning” when doing so
 - The whole *is* the sum of its parts
- The world is an engineering problem



Complexity science is rooted in systems theory

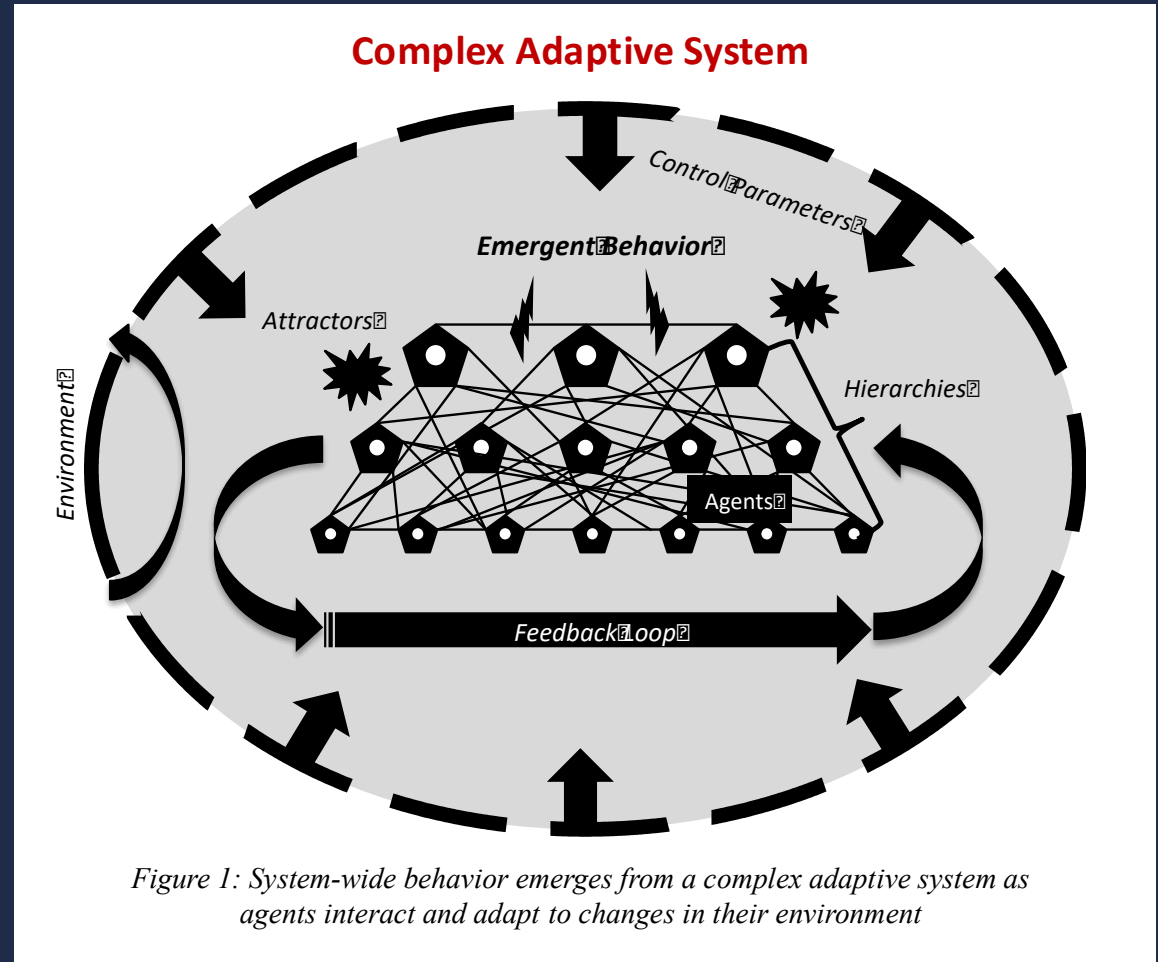


Complexity science deals with “self organizing” systems

- **Diversity among the components** as sources of novelty to ensure ongoing evolution, regeneration, and adaptation
- **Nonlinear** interactions; widespread information flow and **feedback loops**
- **Self-organization**; results from attractors in the system, and from adaptation to changes in the larger environment and other agents
- **Local information processing**; local interactions among autonomous agents. Typically agents “see” only their part of the system and act locally; no global control
- **Emergence**; exhibits unpredictable global behavior or patterns; **spontaneous order emerges** from local system interaction
- **Adaptation**; open and responsive to changes to the larger environment or context and to other agents in the system, continuously processing, learning, and incorporating new information
- **Organization across multiple scales**; agents in the system organized into groups or **hierarchies** which influence how the system evolves
- **Sensitivity to changes in initial conditions**; small changes can create big results at some point in the future

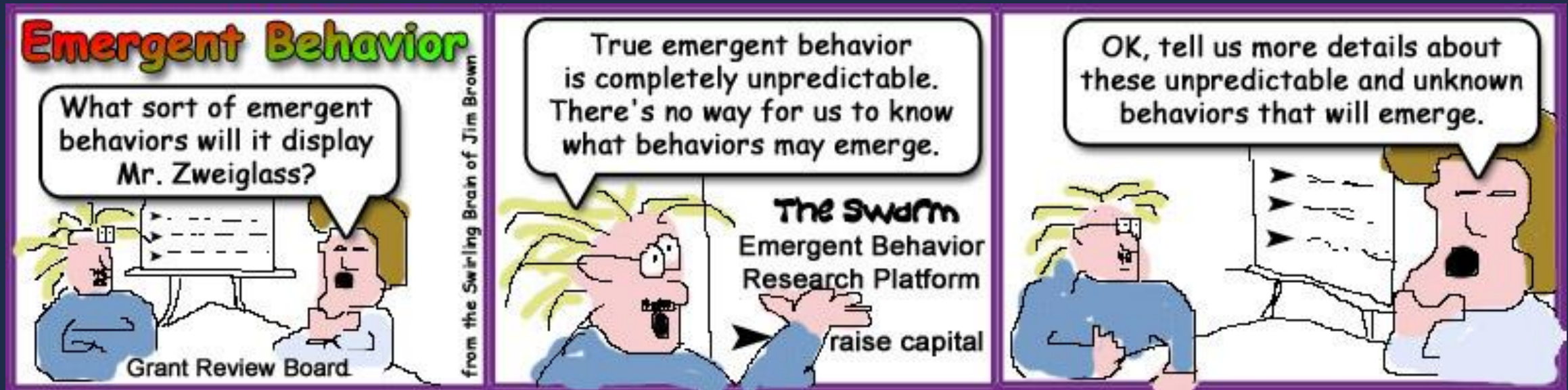
Complex adaptive systems give rise to problems of organized complexity

- Components have own **agendas** (schema) which they adapt in response to **feedback loops** and changes in their environment (changes in **control parameters** and introduction of **attractors**)
- Strongly interconnected “seamless webs” in **hierarchies**
- Subject to **phase transitions, tipping points and emergent behavior**
- Unlimited horizon (both in time and scope), **never settles into an equilibrium state**
- System is **irreducible/non-generalizable**



Emergent behavior is not associated with individual system agents; it is a product of the system itself

- The system undergoes spontaneous **self-organization** into collective structures with properties that cannot be predicted from the properties of the parts, and which the agents **do not possess individually**
- The appropriate **unit of analysis is therefore the system**, not its individual agents



Much of what is interesting in the universe is a product of **emergence** within complex systems

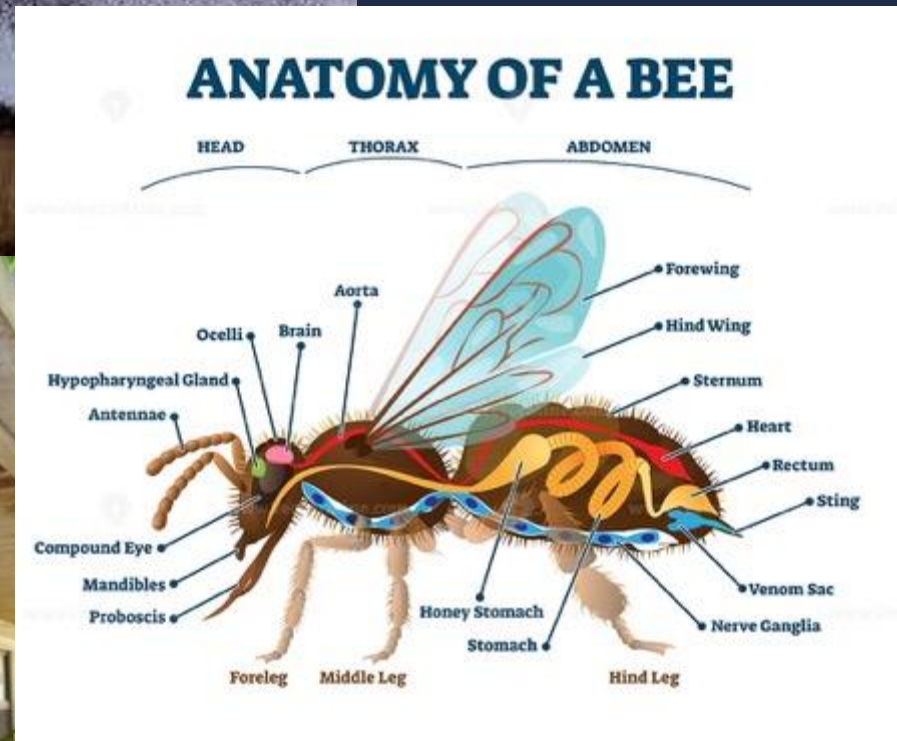


“Emergence is the arising of **novel and coherent structures, patterns and properties** during the process of self-organization in complex systems”.

Jeffrey Goldstein

The swarming of bees is an example of emergent behavior in a complex adaptive system

- Bees are relatively dumb organisms (1 million neurons, compared to 100 billion for humans) and yet **they make highly intelligent decisions** about where to locate a hive
- Where does that **intelligence physically reside?**
 - There is **no reductionist approach** to analyzing bees that will yield an answer
- “Swarming intelligence” is a **quality of the bees, not of the bee**



Emergent behaviors are common in cities

- Individuals compete for resources by developing strategies (**schema**) they think will succeed
- Those schema lead to actions, which **succeed or fail** and by doing so provide **feedback** to guide future decision-making
- The actions of individual agents impact the choices of others, **providing feedback and the further honing of schema**
- Eventually patterns emerge
 - Commuting routes
 - Industry clusters
 - Neighborhood culture
 - White flight
 - Organized crime

Slowing Down Will Get You Through a Traffic Jam Faster

Measures to Minimize Bottlenecks Emphasize the Importance of Cutting Your Speed



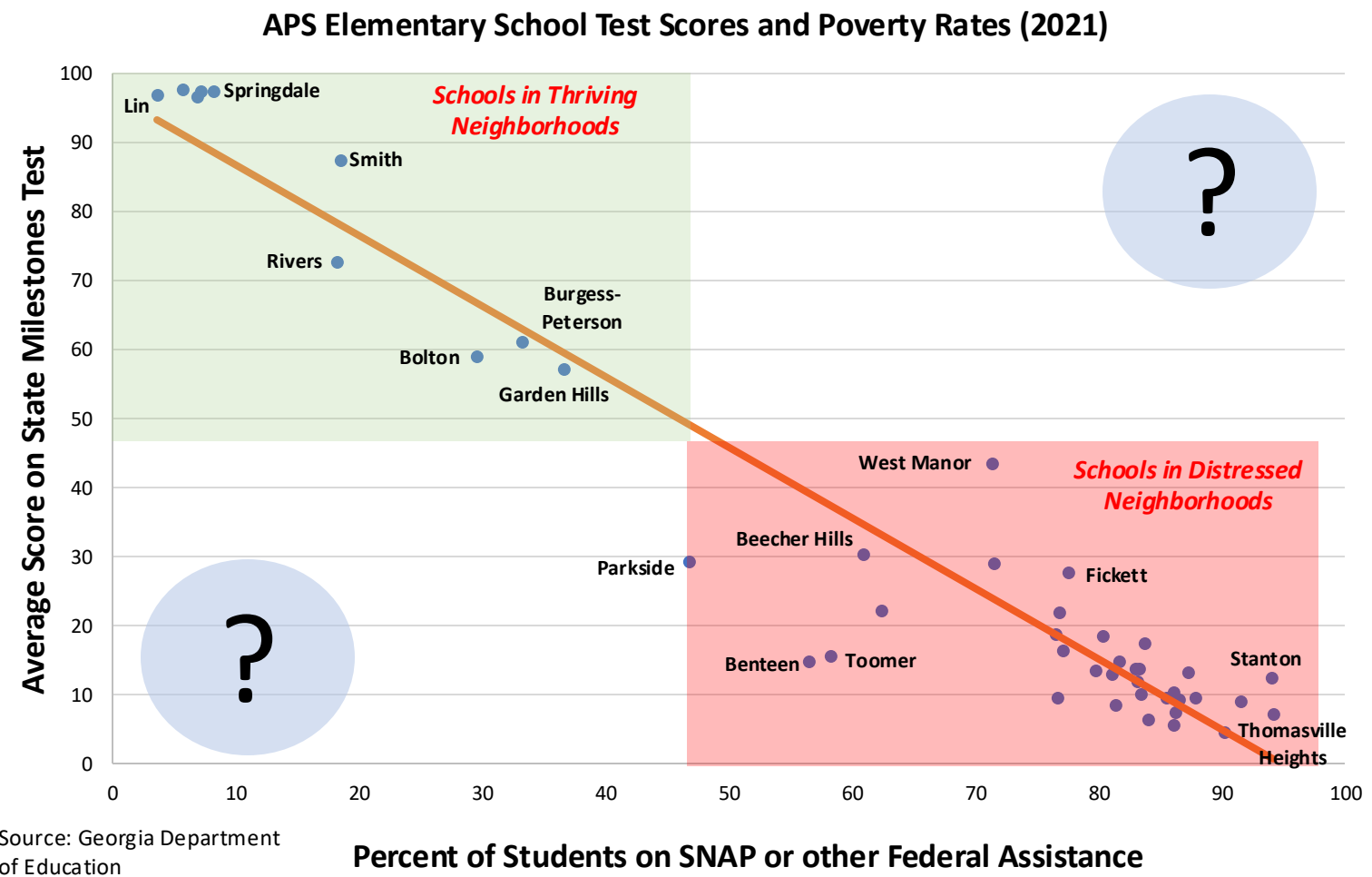
The key question: how do the outcomes we care about actually emerge in our cities?

- Jacobs argued that preferred urban outcomes cannot be engineered because cities are **problems of organized complexity**
 - “dealing simultaneously with a sizeable number of factors which are interrelated into an organic whole”
- What matters is the **state of the system**, not that of its component parts
 - If the system is healthy, it will generate the preferred outcomes **independently and sustainably**
- Which means our goal should be the **creation of the right urban conditions**
 - Jacobs defined those conditions primarily in terms of the built environment: mixed uses, density, human-scaled development; basically the opposite of Modernism then in fashion
- Jacobs pointed out that public safety is an **emergent outcome**, not imposed by the state
 - Is that the case for all urban outcomes?

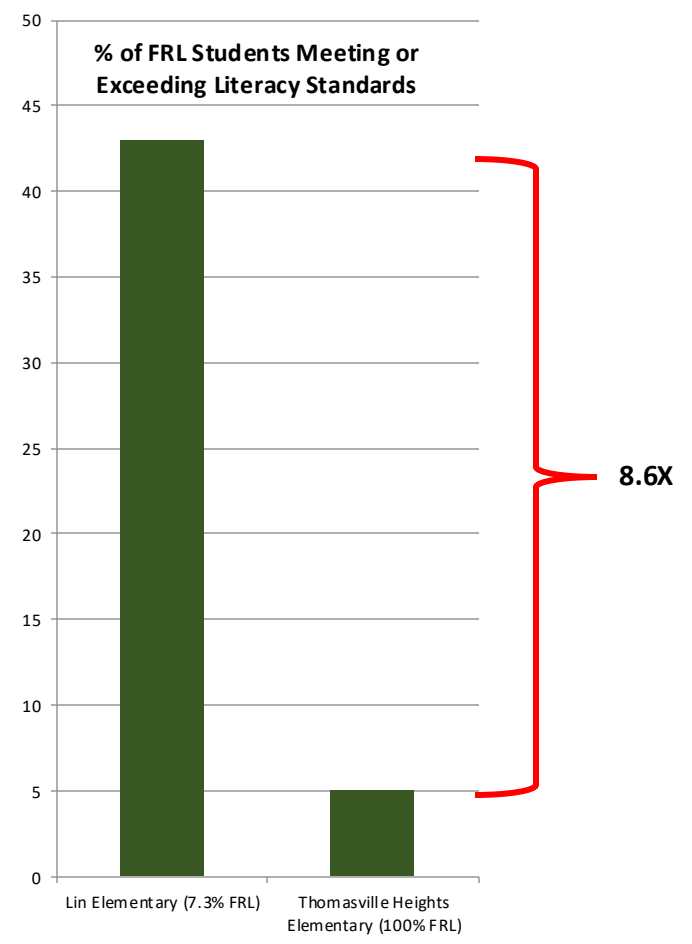


Outcomes in education “emerge” from the conditions of the neighborhoods they serve

Although there is almost a perfect correlation between poverty rates and school performance among APS elementary schools...

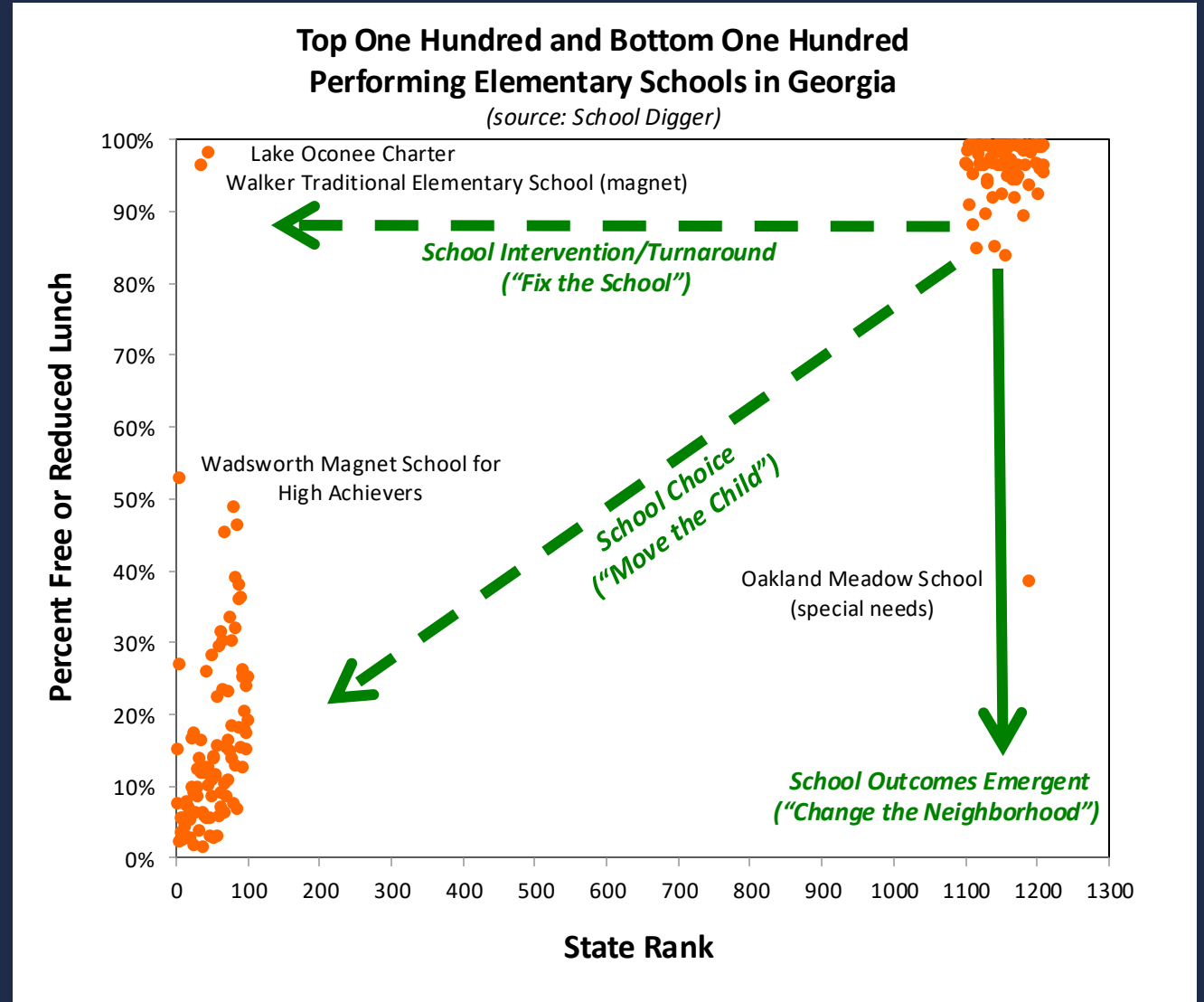


... low income students living in healthy neighborhoods perform substantially better

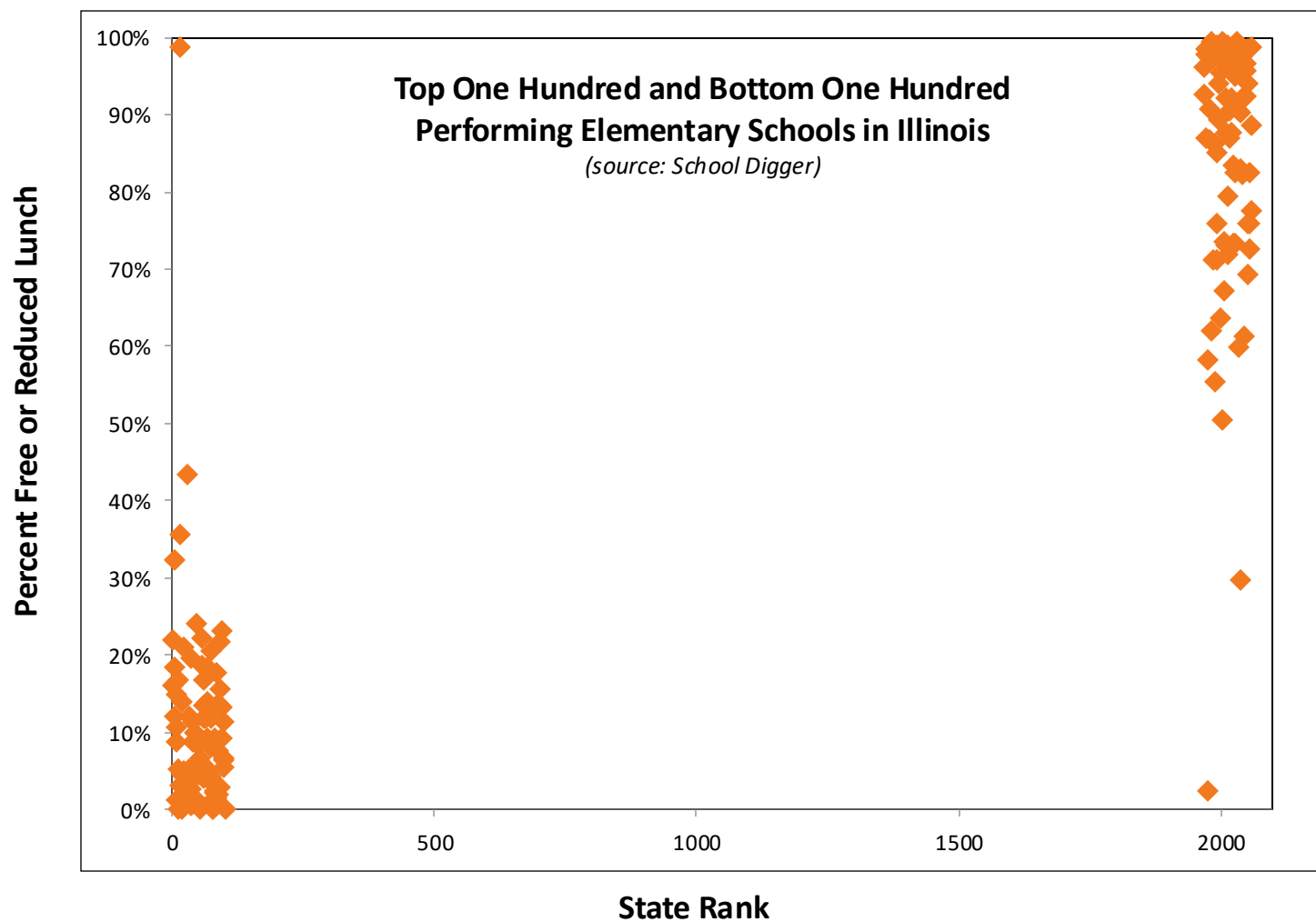


Educational outcomes are highly correlated with place

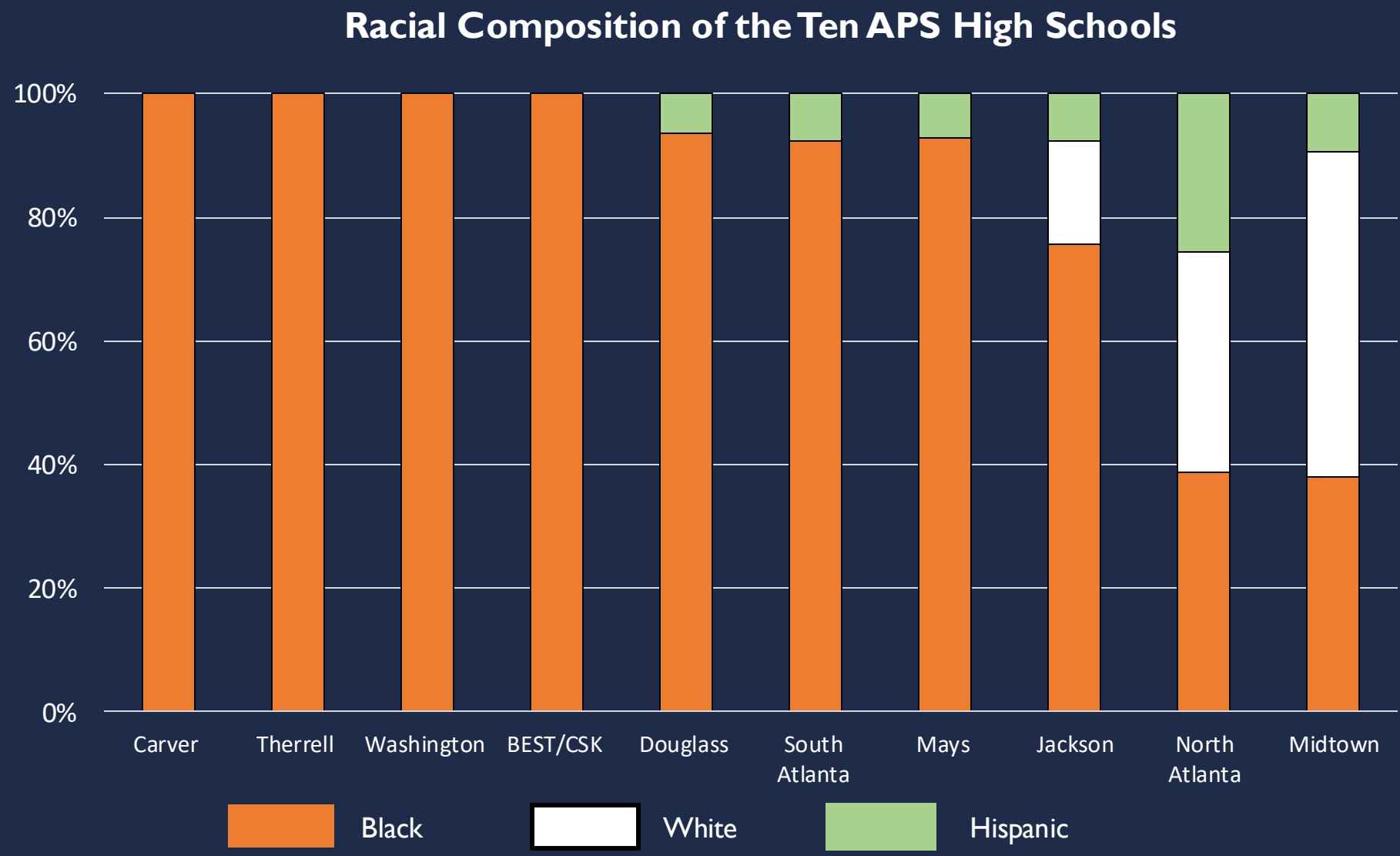
- As a result, trying to “fix” schools at scale that are dominated by low-income children is not going to solve the core problem
- Similarly, encouraging families to send their children to higher performing schools is proving not to be a practical solution either
 - undermines efforts to improve neighborhood health by eliminating the neighborhood school as an economic development asset



This distribution is not a “Georgia thing”; it is consistent across states

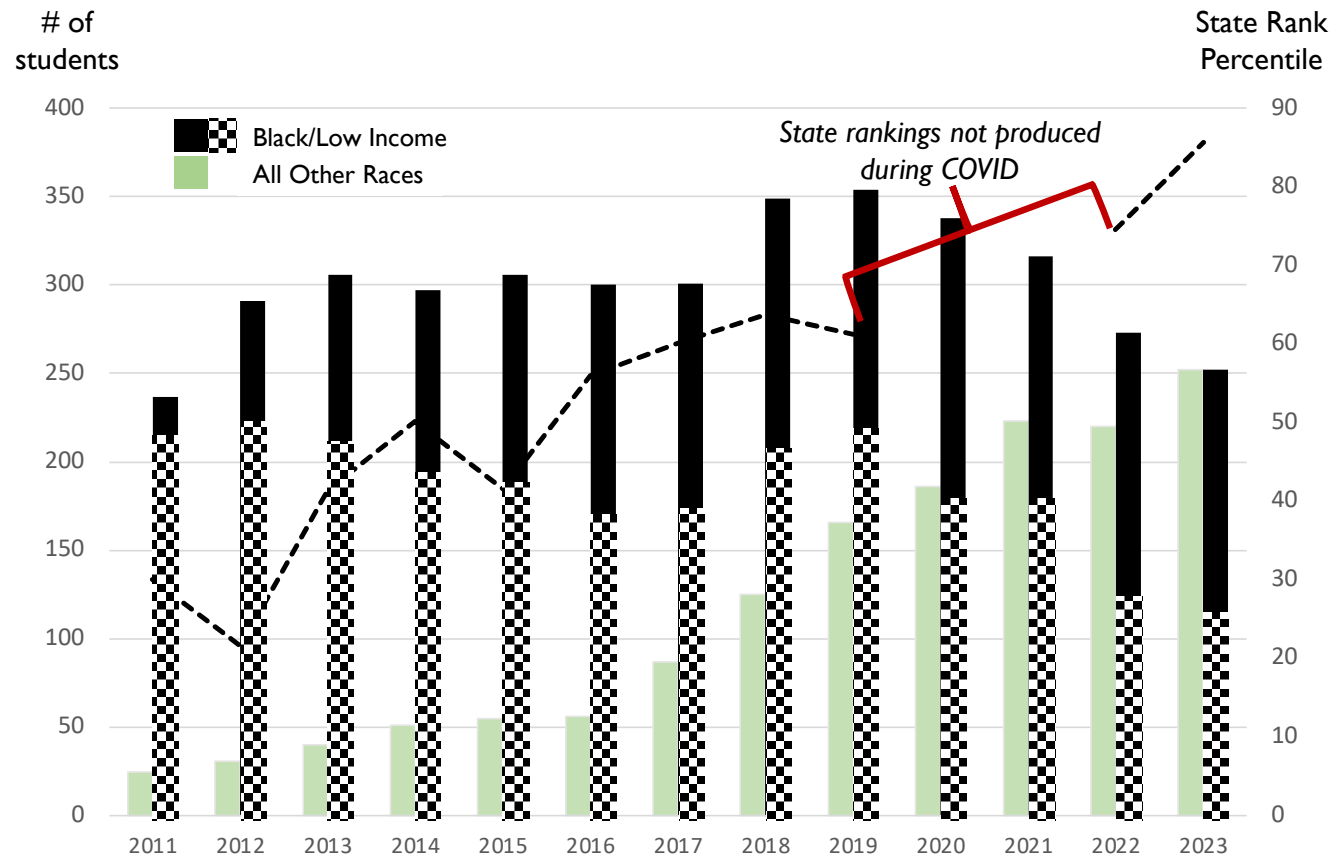


A segregated city results in segregated schools



School performance improves when neighborhood health improves ...

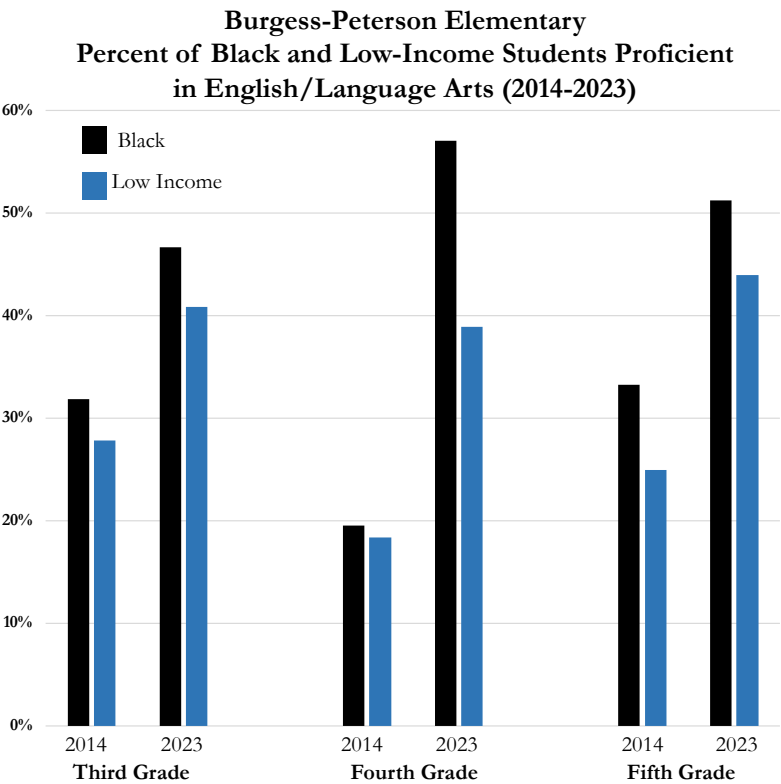
Burgess-Peterson Academy State Ranking and Racial Composition



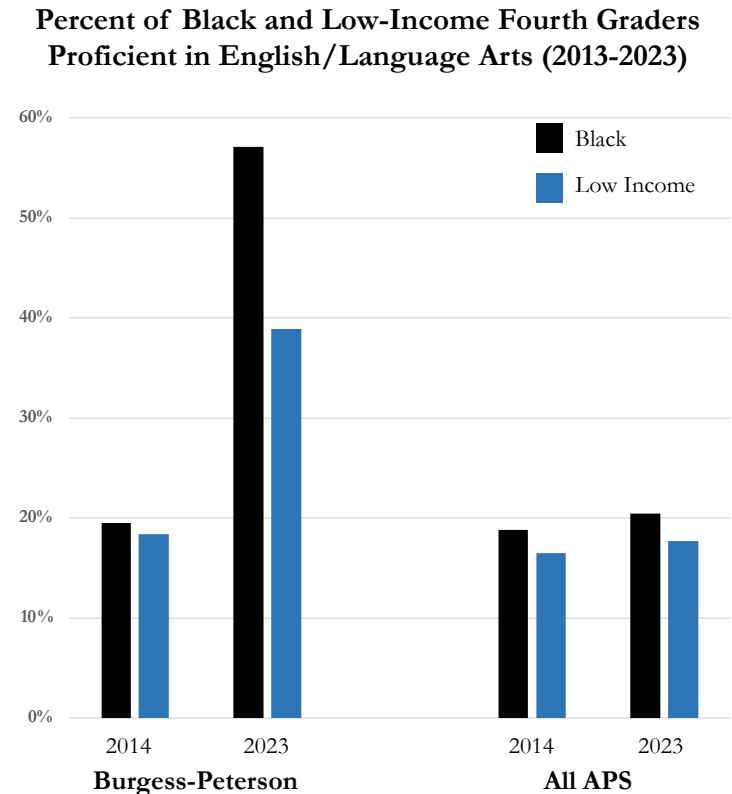
- The symbiotic relationship between school performance and neighborhood health is illustrated in the recent evolution of Burgess-Peterson Academy on Atlanta's eastside
- The two neighborhoods the school serves –East Atlanta and Reynoldstown– have recently revitalized
 - Public investments in the BeltLine, neighborhood revitalization efforts in nearby East Lake and Edgewood, and the subsequent private investments those efforts catalyzed along the Memorial Drive corridor improved the health of these neighborhoods
 - Blight has been mostly eradicated, hundreds of new housing units have been built, a Kroger grocery opened, crime is down sharply, and the population has increased by over 30%
- During this period, **Burgess-Peterson climbed from the 22nd percentile in statewide rankings of elementary schools to the 86th percentile**
 - No other school in Atlanta experienced such a dramatic improvement over this period

... and those improvements benefit low-income Black children

As the neighborhood improved, so did the performance of Black and low-income students at the school; Black and low-income students made dramatic gains across all grades

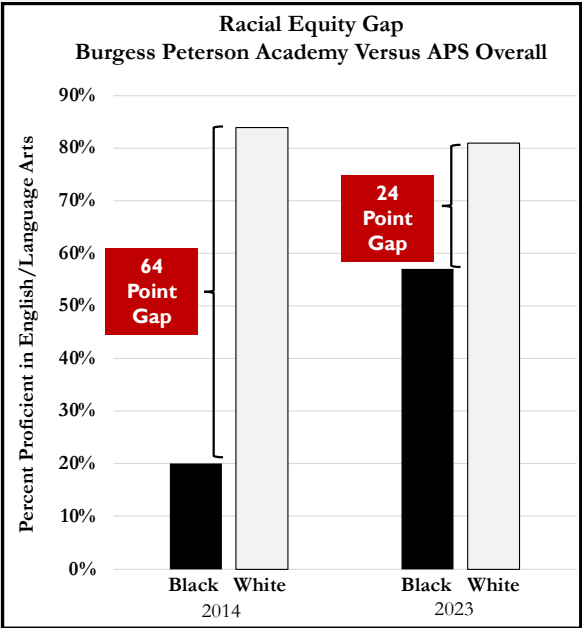


For example, in 2014, only 19% of Black fourth graders at Burgess-Peterson were proficient in English/Language Arts; in 2023, 57% were. By contrast, performance for Black students across the APS system showed almost no improvement during this period



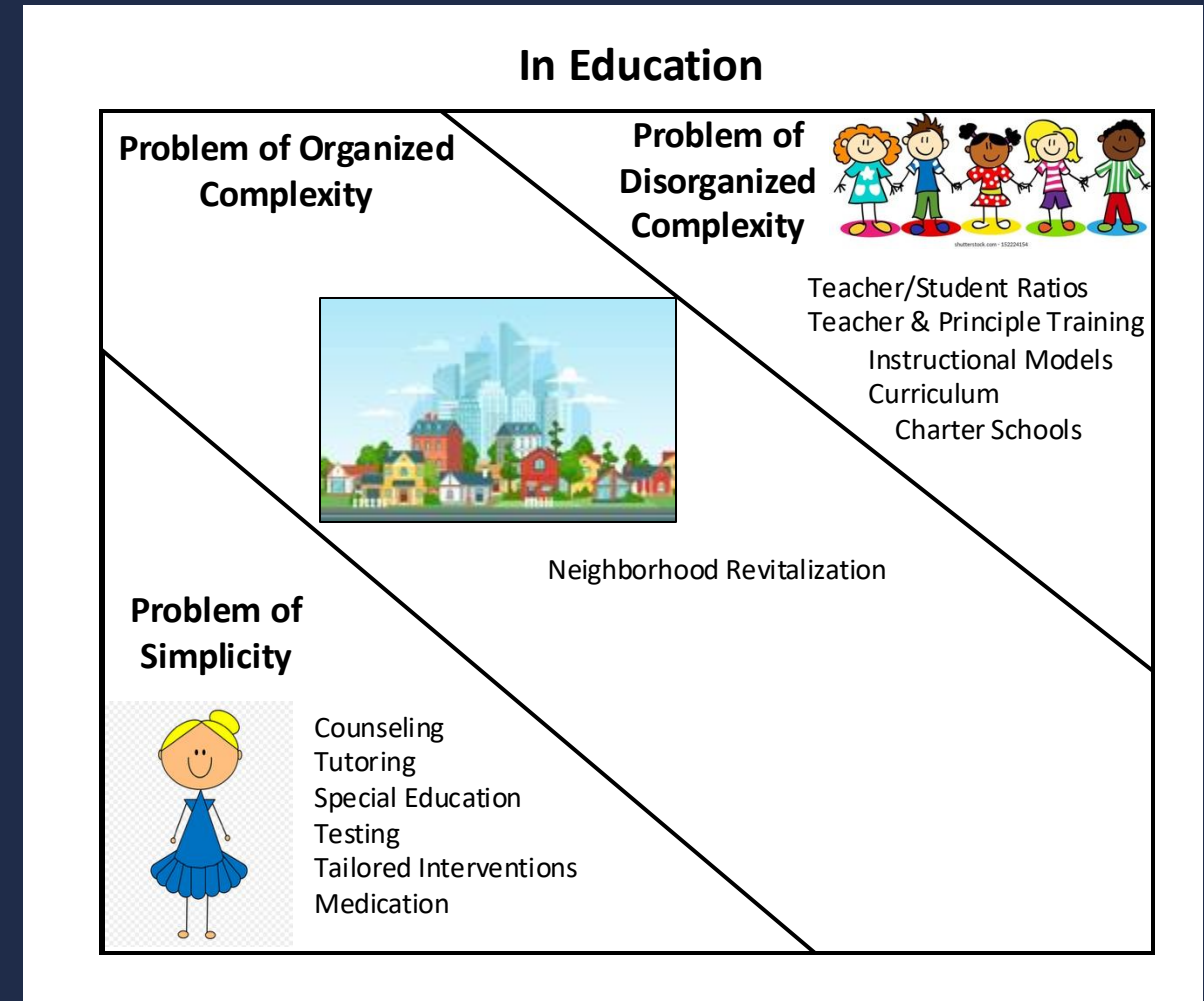
The Burgess-Peterson experience suggests that **neighborhood revitalization can close racial equity gaps** in relatively short periods

- The performance of White fourth graders city-wide decreased slightly during this period, from 84% proficiency in English/Language Arts to 81%
- Therefore **the racial gap** for Black fourth graders at Burgess-Peterson (relative to the district average performance for White students) **has declined from 64 percentage points in 2014 to 24 percentage points in 2023**



If we support efforts to improve the performance of our schools, but we do nothing to integrate our schools, are we endorsing “separate but equal” policies by default?

- All of the education reform efforts currently underway are treating the problem as one of **simplicity of one of disorganized complexity**
- There is no acknowledgement that **educational outcomes emerges** from the circumstances children are born and raised in
- That leads to a set of interventions that **by default leave those conditions in place**: segregated neighborhoods of concentrated poverty
- **Can such an approach ever succeed? Even if it could, is that the country we want to live in?**



Kamau Bobb was the Director of STEM Education Strategy at Google and is the founding Senior Director of the Constellations Center for Education in Computing at Georgia Tech



- Worked with members of the Office and Science and Technology Policy in the Obama Administration to set the national strategy for STEM education at both post-secondary and secondary school levels
- Selected as a member of President Obama's My Brother's Keeper STEM + Entrepreneurship Taskforce to help U.S. cities craft strategies to engage young men and boys of color in the STEM landscape
- Director of the STEM Initiative for the University System of Georgia, a collaborative effort with the governor's office to improve STEM education across the 30 public institutions serving approximately 325,000 students in the state
- His writing on STEM education and culture has been featured in The Atlantic, Black Enterprise, The Root, Edutopia and on the Obama White House Blog
- Kamau holds a Ph.D. in Science and Technology Policy from Georgia Tech and M.S. and B.S. degrees in Mechanical Engineering from the University of California, Berkeley