

Games and Worldmaking

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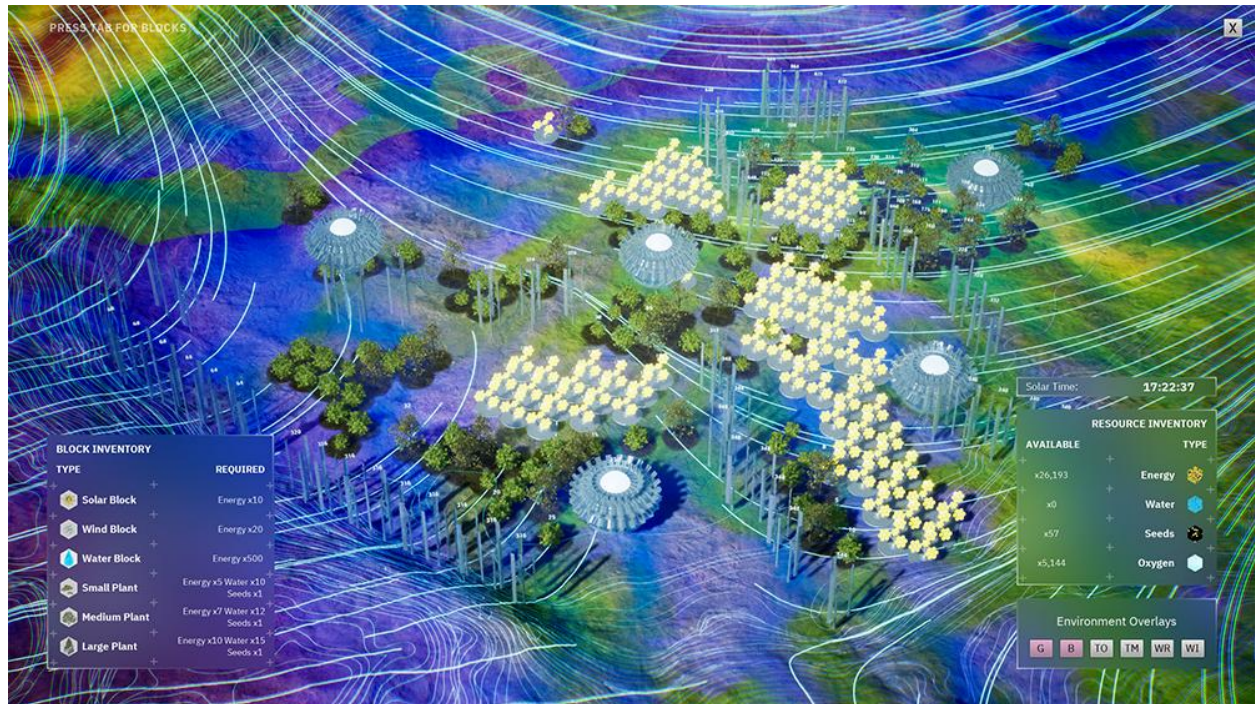


Fig. 1 Planet garden v.1 screenshot, early game state

1. Worldmaking

We live in a period of unprecedented proliferation of constructed, internally coherent virtual worlds, which emerge everywhere, from politics to video games. Our mediascape is brimming with rich, immersive worlds ready to be enjoyed and experienced, or decoded and exploited. One effect of this phenomenon is that we are now asking fundamental questions, such as what consensus reality is and how to engage it. Another effect is that there is a need for a special kind of expertise that can deal with designing and organizing these worlds - and that is where architects possibly have a unique advantage. Architectural thinking, as a special case of visual, analogy-based¹ synthetic reasoning is well positioned to become a crucial expertise, able to operate on multiple scales and in multiple contexts in order to map, analyze and organize a virtual world, while at the same time being able to introduce new systems, rules and forms to it.

¹ For a longer discussion on this, see O.M.Ungers, *City Metaphors*, Buchhandlung Walther König 2011. For the central place of analogies in scientific modeling, see M. Hesse, *Models and Analogies in Science*, and also Douglas Hofstadter, *Surfaces and Essences: Analogy as the Fuel and Fire of Thinking*, Basic Books (2013).

A special case of this approach is something we can name architectural worldmaking², which refers broadly to practices of architectural design which willfully and consciously produce virtual worlds, and understand worlds as the main project of architecture. Architects have a unique perspective and could have a say in how virtual worlds are constructed and inhabited, but there is a caveat which revolves around questions of agency, engagement and control. Worldmaking is an approach to learn from both technically advanced visual and cultural formats such as video games, as well as scientific ways of imaging and sensing to construct new, legitimate, and serious ways of seeing and modeling.

These notions are central to the research seminar called Games and Worldmaking, first conducted by the author at SCI-Arc in summer of 2021, which focused on the intersection of games and architectural design, and foregrounded systems thinking as an approach to design. The seminar is part of the ongoing *Views of Planet City* project, in development at SCI-Arc for the *Pacific Standard Time* exhibition, which will be organized by The Getty Institute in 2024. In the seminar, we developed the first version of Planet Garden, a planetary simulation game, envisioned to be both an interactive model of complex environmental conditions, and a new narrative structure for architectural worldmaking.

Planet Garden is loosely based on Edward O. Wilson's "Half-Earth" idea, a scenario where the entire human population of the world occupies a single massive city and the rest is left to plants and animals. The Half Earth is an important and very interesting thought experiment, almost a proto design, a prompt, an idea for a massive, planetary agglomeration of urban matter which could liberate the rest of the planet to heal and rewild.

The question of the game was, how could we actually model something like that? How do we capture all that complexity and nuance, how do we figure out stakes and variables and come up with consequences and conclusions? The game we are designing is a means to model and host hugely complex urban systems which unravel over time, while being able to legibly present an enormous amount of information visually and through the narrative. As a format, a simulation presents different ways of imaging the World and making sense of reality through models.

The work on game design started as a wide exploration of games and precedents within architectural design, imaging operations, as well as abstract systems that could comprise a possible planetary model. The question of models and modeling of systems comes at the forefront and becomes contrasted to existing architectural strategies of representation.

² The term 'worldmaking' comes from Nelson Goodman's book *Ways of Worldmaking*, and is used here to be distinguished from *worldbuilding*, a more narrow, commercially oriented term.

2. Mythologizing, Representing and Modeling

Among the main influences of this project were the drawings made by Alexander Von Humboldt³, whose work is still crucial for anyone with an interest in representing and modeling phenomena at the intersection of art and science. If, in the classical sense, art makes the world sensible while science makes it intelligible, these images are a great example of combining these forms of knowledge. Scientific illustrations, Humboldt once wrote, should “speak to the senses without fatiguing the mind.”⁴ His famous illustration of Chimborazo volcano in Ecuador shows plant species living at different elevations, and this approach is one of the very early data visualization examples, with an intent of making the world sensible and intelligible at the same time. These illustrations have also had a strong pedagogical intent, a quality we wanted to preserve, and which can serve almost as a test of legibility.

³ For a great introduction to the life and times of Alexander Von Humboldt, see Andrea Wulf, *The Invention of Nature: Alexander von Humboldt's New World*, Vintage (2016)

⁴ Quoted in Funkhouser, H.G.: *Historical development of the graphical representation of statistical data*. *Osiris* 3, 269–404 (1937)



Fig. 2 Alexander von Humboldt, Chimborazo volcano

The project started with a question of imaging a world of nature in the age of Anthropocene. One of the reasons why it is difficult to really comprehend a kind of complex system such as the climate crisis is because it is difficult to model it, which also means to visually represent it in a legible way which humans can understand. This crisis of representation is a well-known problem in the literature on the Anthropocene, most clearly articulated in the book “Against the Anthropocene”, by T.J. Demos⁵.

We do not yet have the tools and formats of visualizing that can fully and legibly describe such a complex thing, and this is, in a way, also a failure of architectural imagination. The standard architectural toolkit is limited and also very dated—it is designed to describe and model objects, not hyperobjects. One of the main interests in the project was inventing new modalities of description and modeling of complex systems through the interactive software format, and this is one of the ideas behind the Planet Garden project.

⁵ T.J. Demos, *Against The Anthropocene*, MIT Press (2016)

Contemporary representational strategies for the Anthropocene broadly fall in two categories, those of mythologizing or objectivizing. The first approach can be observed in the work of photographers such as Edward Burtunsky and Louis Helbig, where the subject matter of environmental disaster becomes almost a new form of the aesthetic sublime. The second strategy comes out of the deployment and artistic use of contemporary geospatial imaging tools. As is well understood by critics, the contemporary geospatial data visualization tools like Google Earth, are embedded in a specific political and economic framework, comprising a visual system delivered and constituted by the post–Cold War and largely Western-based military-state-corporate apparatus. These tools offer an innocent-seeming picture that is in fact a “techno-scientific, militarized, ‘objective’ image.”⁶ Such an image displaces its subject and frames it within a problematic context of neutrality and distancing. Within both frameworks, the expanded spatial and temporal scales of geology and the environment exceed human and machine comprehension and thus present major challenges to representational systems.

Within this condition, the question of imaging - understood here as *making sensible and intelligible the world of the Anthropocene through visual models* - remains and it is not a simple one. Within the current (broadly speaking) architectural production, this topic is mostly treated through the design fictions approach. For example, in the work of Design Earth, the immensity of the problem is reframed through a story driven, narrative approach which centers on the metaphor and where images function as story illustrations, like in a children’s book⁷. Another approach is pursued by Liam Young, in the Planet City project⁸, which focuses on video and animation as the main format. In this work, the imaging strategies of commercial science fiction films take the main stage and serve as anchors for the speculation and spectacle, which serves a double function of designing a new world and educating a new audience. In both cases, it seems, the focus goes beyond design, as these constructed fictions stem from a willful, speculative exaggeration of existing planetary conditions, to produce a heightened state which could trigger a new awareness. In this sense, these projects serve a very important educational purpose, as they frame the problem through the use of established and accepted visual languages of storybooks and films.

The question is whether these projects produce a new world, and more specifically whether they *model* a new world, or any world at all. The key to understanding how design fictions operate is precisely in their medium of production: all of these projects are made through formats (collage, storybook, graphic novel, film, animation) which depend on the logic of compositing. Within this logic, the work is made through a story-dependent arrangement of visual components. The arrangement is arbitrary as it depends only on the demands of the story and does not correspond to any other underlying condition - there is no *model* underneath. In comparison, a game such as, for example, SimCity is *not a fiction* precisely because it depends on the logic of a simulation, a testable, empirical mathematical model which governs its visual space. A simulation is fundamentally different from a fiction, and a story is not a model.

⁶ T.J. Demos, *Against The Anthropocene*

⁷ Design Earth, *Geostories, The Planet After Geoengineering*

⁸ Liam Young, *Planet City*

This is one of the reasons why it seems important to rethink the concept of a design fiction through the new core idea of the simulation⁹. In the book “Virtual Worlds as Philosophical Tools”, Stefano Gualeni traces a lineage of thinking about simulations to Espen Aarseth’s 1994 text called *Hyper/Text/Theory*, and specifically to the idea of cybertextuality. According to this line of reasoning, simulations contain an element not found in fiction and thus need an ontological category of their own. “Simulations are somewhere between reality and fiction: they are not obliged to represent reality, but they have an empirical logic of their own, and therefore should not be called fictions.”¹⁰ This presents us with a fundamental insight into the use of simulations as the future of architectural design: they model internally coherent, testable worlds and go beyond mere fiction-making into worldmaking proper.

3. Simulations, games and systems

In the world of video games, there exists a genre of ‘serious’ simulation games, which comprises games like Maxis software’s *SimCity* and *The Sims*, as well as some other important games like Sid Meier’s *Civilization* and Paradox Studio’s *Stellaris*. These games are conceptually very ambitious and extremely complex as they model the evolution of whole societies and civilizations, operate on very long timescales, and consist of multiple nested models that model histories, economies and evolutions of different species at multiple scales. These games are following a model: “A software toy, grounded in a worldly theory about a complex system, but abstracted into a playable model about an aspect of the world that seemed too boring or obscure to become the subject of a video game.”¹¹ One important feature and obligation of this genre is to present a coherent, legible image of the world, give a face to the immense complexity of the model. The user interface elements of these kinds of games work together to tell a coherent story and the game world, rendered in full 3d in real time, provides an immersive visual and aesthetic experience for the player. Contrary to almost any other type of software, these interfaces are more indebted to the history of scientific illustration and data visualization than they are to the history of graphic design. These types of games are open-ended and not bound to one goal and there is rarely a clear win state.

⁹ For an extended discussion of the simulation as a format, see Damjan Jovanovic, *Screen Space, Real Time*, Monumental Wastelands 01, eds. Deborah Lopez and Hadin Charbel (2022).

¹⁰ Stefano Gualeni, *Virtual Worlds as Philosophical Tools*

¹¹ I. Bogost

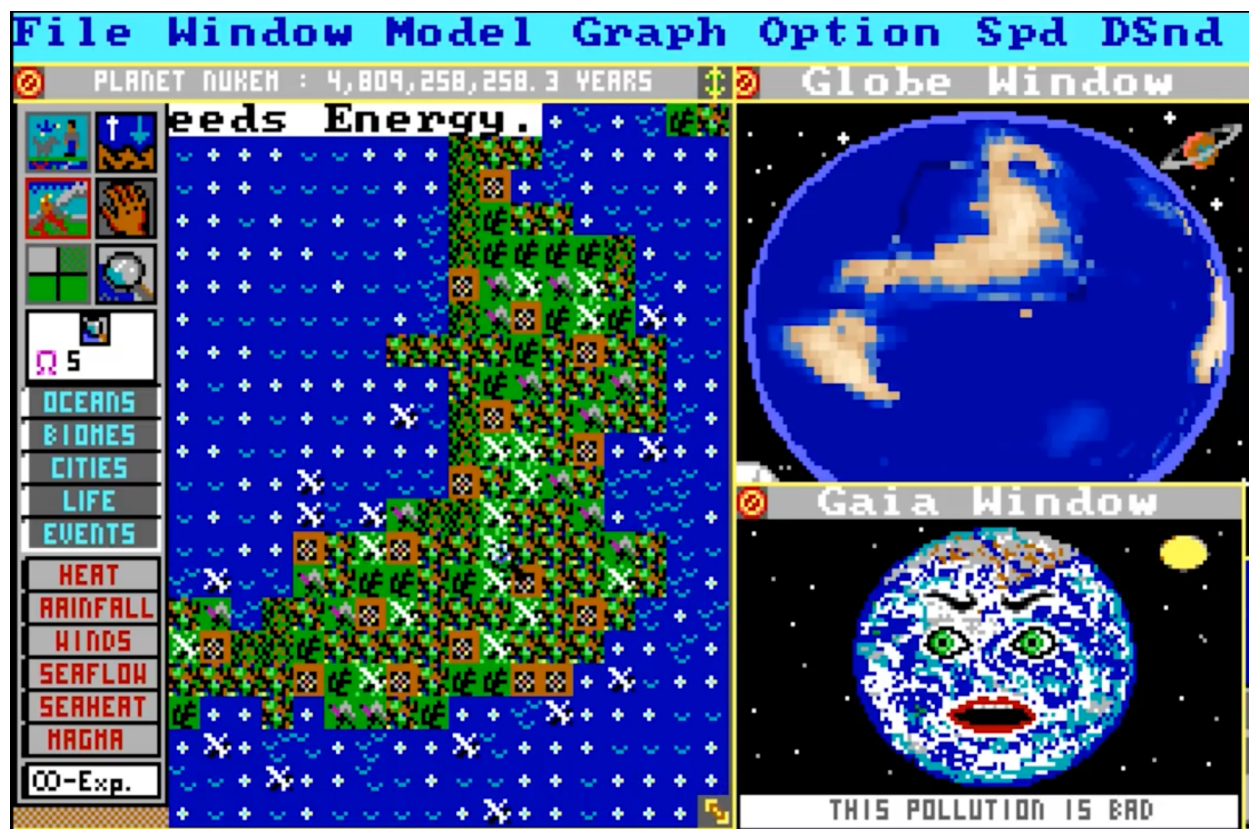


Fig. 3, SimEarth main user interface with the Gaia window

Another feature of the genre is a wealth of underlying mathematical models, each providing for the emergence of complexity and each carrying its own assumptions and biases. For example, SimCity is well known (and some would say notorious) for its rootedness in Jay Forrester's Urban Dynamics approach to modeling urban phenomena, which means that its mathematical model delivers very specific urban conditions and ultimately, a very specific vision of what a city is and could be¹². One of the main questions in the seminar became how we can update this approach on two fronts: by rethinking the mathematical model and by rethinking urban assumptions of the conceptual model.

The work of the game designer Will Wright, the main designer behind the original SimCity, as well as The Sims and Spore, is considered to be at the origin of simulation games as a genre. Wright has developed a vast body of knowledge on modeling simulations, some of which he presented in his 2003 influential talk at the Game Developers Conference (GDC) titled *Dynamics for Designers*¹³. In this talk he outlines a fully fledged theory of modeling of complex phenomena for interactivity, focusing on questions like "how we can use emergence to model larger possibility spaces with simpler components". Some of the main points: science is a modeling activity, and up to now, it has used traditional math as its primary modeling method. This has hit some limits when dealing with complex dynamic and emergent systems. Since the

¹² For an extended discussion on this, see Clayton Ashley, *The Ideology Hiding in SimCity's Black Box*, <https://www.polygon.com/videos/2021/4/1/22352583/simcity-hidden-politics-ideology-urban-dynamics>

¹³ <https://www.youtube.com/watch?v=JBcfiulw-8>

advent of the computer, simulation has emerged as an alternative way of modeling. These are very different: in Wright's view, math is a more linear process, with complex equations, simulation is a more parallel process with simpler components interacting together. Wright also talks about stochastic methods and (brute force) Monte Carlo technique as an example of the simulation approach.

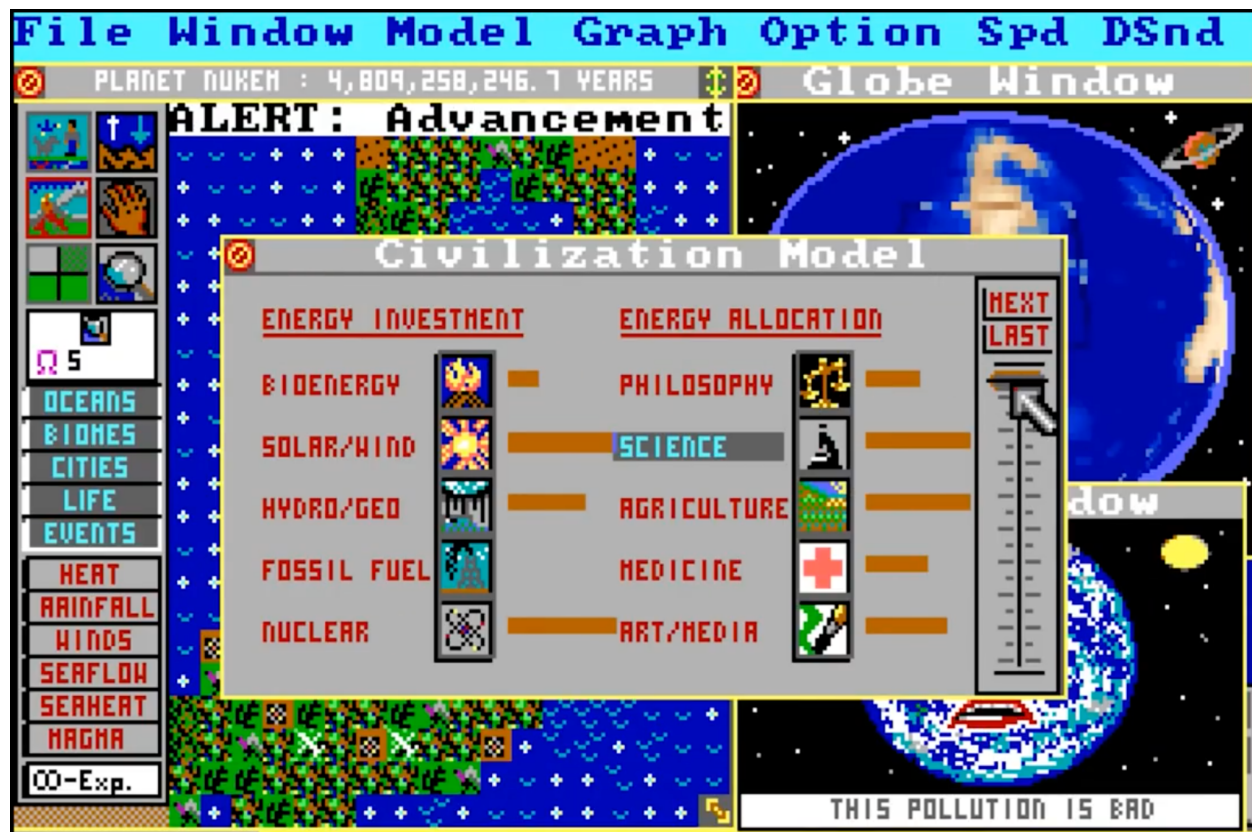


Fig. 4. SimEarth civilization model with sliders

Wright's work was a result of a deep interest in exploring how non-linear models are constructed and represented within the context of interactive video games, and his design approach was to invent novel game design techniques based directly on System Dynamics, a discipline that deals with the modeling of complex, unpredictable and non-linear phenomena. The field has its roots in the cybernetic theories of Norbert Wiener, but it was formalized and created in the mid-1950s by Prof. Jay Forrester at MIT, and later developed by Donella H. Meadows in her seminal book *'Thinking in Systems'*¹⁴.

System dynamics is an approach to understanding the nonlinear behavior of complex systems over time using stocks, flows, internal feedback loops, table functions and time delays. Jay Wright Forrester (1918–2016) was an American computer engineer and systems scientist, credited as the “founding father” of system dynamics. Forrester started from modeling corporate supply chains and went into modeling cities by describing “the major internal forces controlling

¹⁴ Donella H. Meadows, *Thinking in Systems*, Chelsea Green (2008).

the balance of population, housing and industry within an urban area, which he claimed could “simulate the life cycle of a city and predict the impact of proposed remedies on the system”. In the book *Urban Dynamics*, Forrester had turned the city into a formula with just 150 equations and 200 parameters. This book was very controversial, as it implied extreme anti welfare politics and, through its “objective” mathematical model, promoted neoliberal ideas of urban planning. In another publication, called *World Dynamics*, Forrester presented *World2*, a system dynamics model of our world which was the basis of all subsequent models predicting a collapse of our socio-technological-natural system by the mid 21st century. Nine months after ‘*World Dynamics*’, a report called ‘*Limits to Growth*’ was published, which used the *World3* computer model to simulate the consequences of interactions between the earth and human systems. Commissioned by the Club of Rome, the findings of the study were first presented at international gatherings in Moscow and Rio de Janeiro in the summer of 1971, and predicted societal collapse by the year 2040. Most importantly, the report put the idea of a *finite planet* into focus.

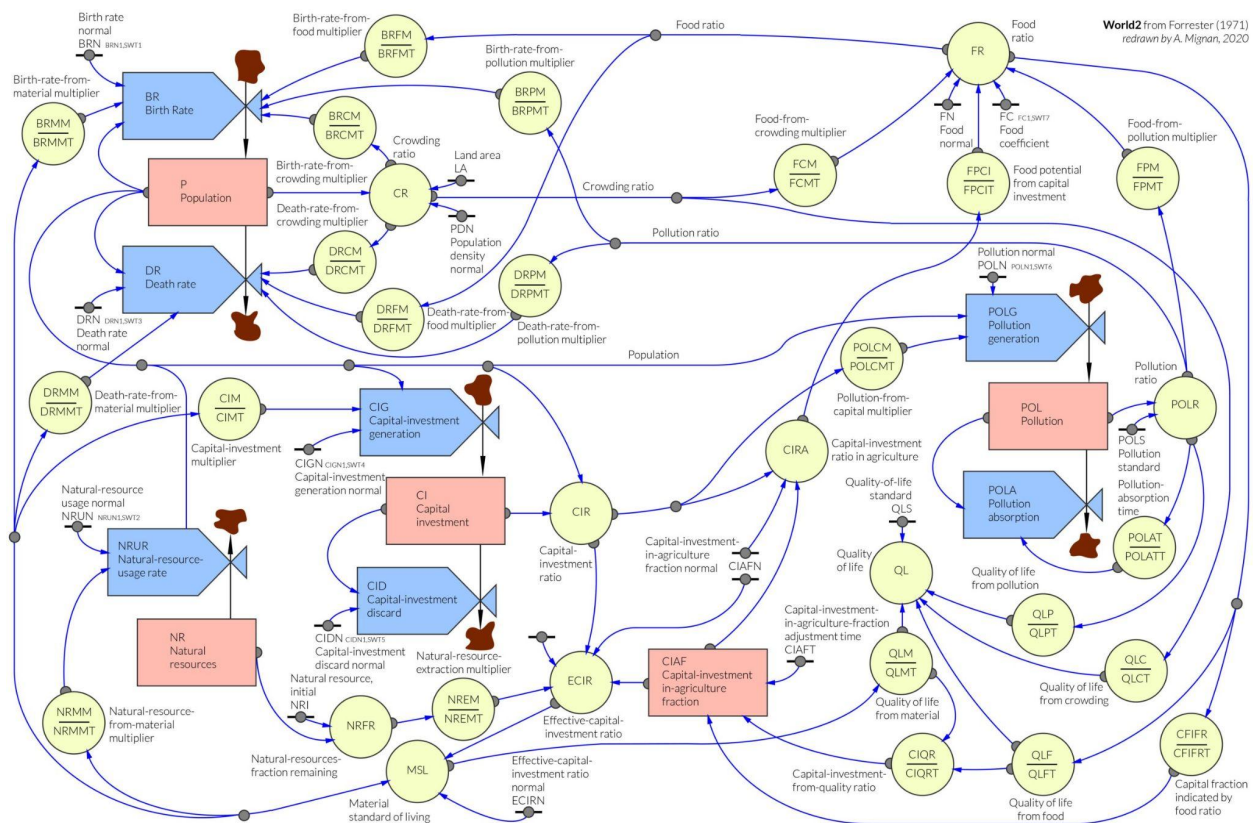


Fig. 5, Jay W. Forrester, *World2* model, base for all subsequent predictions of collapse such as *Limits to Growth*

The main case study in the seminar was Wright’s 1990 game called *SimEarth*, a life simulation video game in which the player controls the development of a planet. In developing *SimEarth*, Wright worked with the English scientist James Lovelock, who served as an advisor and his Gaia hypothesis of planetary evolution was incorporated into the game. Continuing the systems dynamics approach developed for *SimCity*, *SimEarth* was an attempt to model a scientifically accurate approximation of the entire Earth system through the application of customized

systems dynamics principles. The game modeled multiple interconnected systems and included realistic feedbacks among land, ocean, atmosphere, and life itself. The game's user interface even featured the "Gaia Window", in direct reference to the Gaia theory, which states that life plays an intimate role in planetary evolution and the regulation of planetary systems. One of the tutorial levels for the game featured a playable model of Lovelock's "Daisyworld" hypothesis, which postulates that life itself evolves to regulate its environment, forming a feedback loop and making it more likely for life to thrive. During the development of a life-detecting device for NASA's Viking lander mission to Mars, Lovelock made a profound observation, that life tends to increase the order of its surroundings, and that studying an atmospheric composition of a planet will be evidence enough of life's existence. Daisyworld is a simple planetary model designed to show the long-term effects of coupling and interdependence between life and its environment. Its original form was introduced as a defense against criticism that his Gaia theory of the Earth as a self-regulating homeostatic system requires teleological control rather than being an emergent property. The central premise, that living organisms can have major effects on the climate system, is no longer controversial.

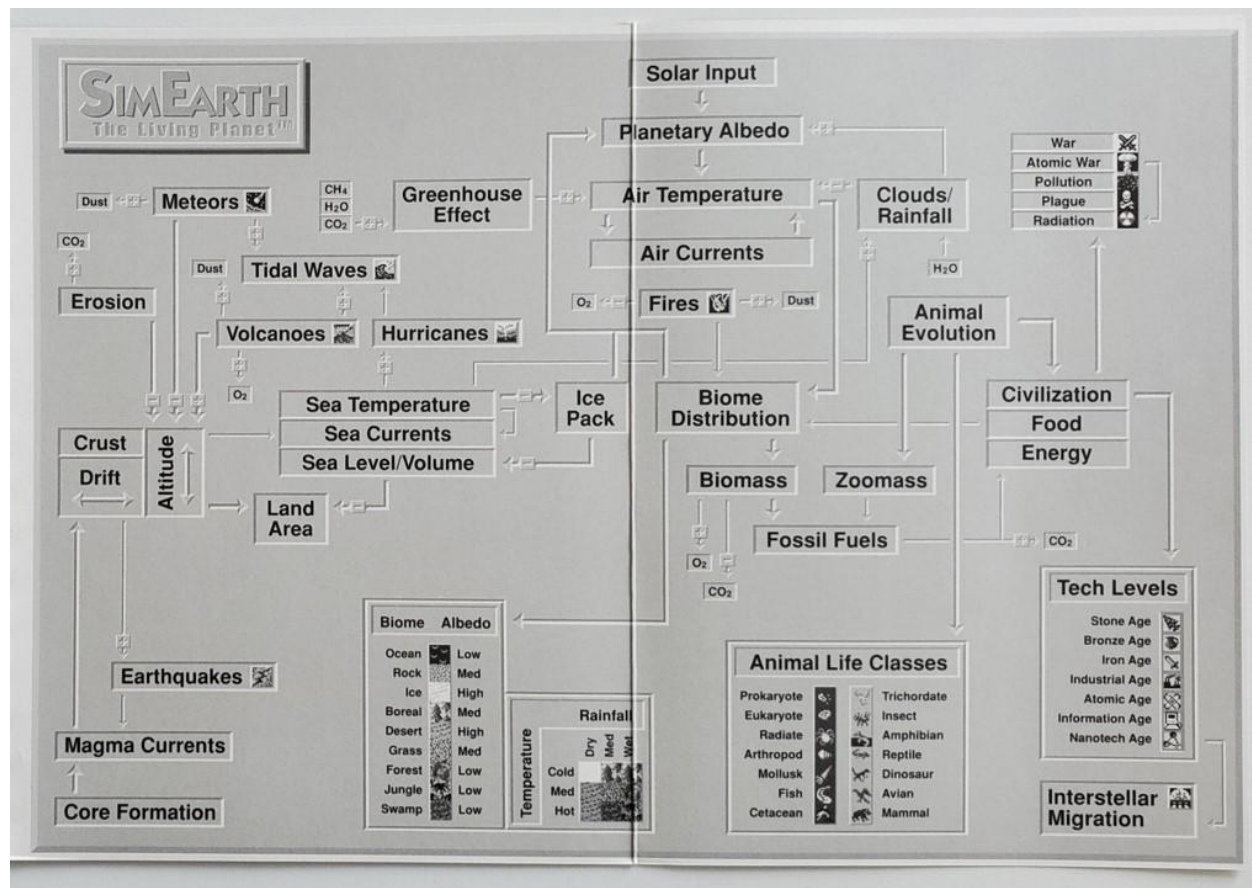


Fig. 6. SimEarth full planetary model

In SimEarth, the planet itself is alive, and the player is in charge of setting the initial conditions as well as maintaining and guiding the outcomes through the eons of time. Once a civilization emerges, the player can observe the various effects, such as the impacts of changes in

atmospheric composition due to fossil fuel burning or the temporarily expanding ice caps in the aftermath of a major nuclear war. SimEarth's game box came with a 212-page game manual that was at once a comprehensive tutorial on how to play as well as an engrossing lesson in Earth sciences: ecology, geology, meteorology and environmental ethics, written in accessible language that anyone could understand.

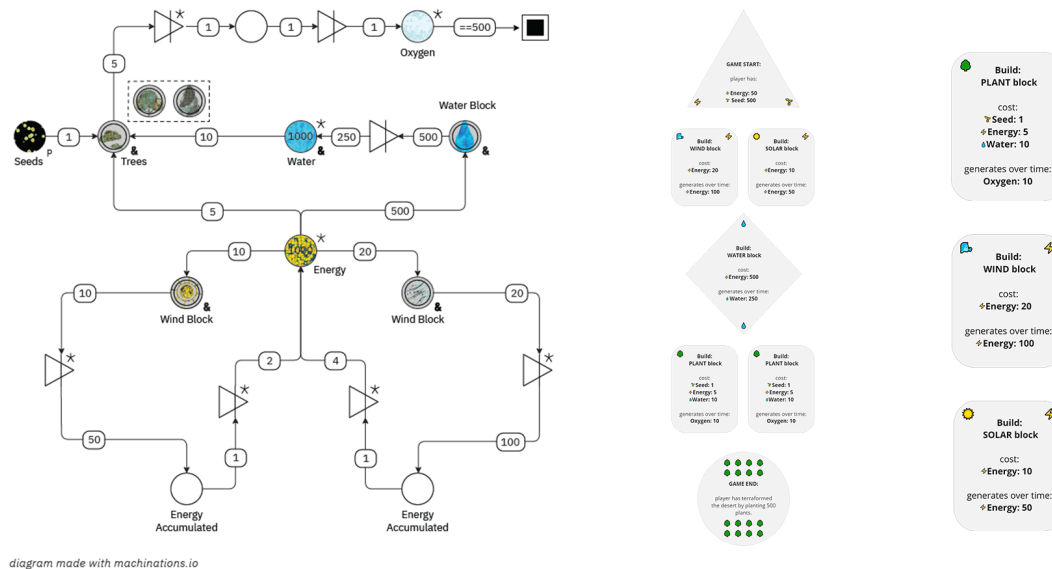


Fig. 7 Planet Garden simplified model and main game loop

SimEarth, and other serious simulation games in general represent the way that games could serve a function of public education while remaining popular entertainment. This genre also represents an incredible validation of claims that video games can be valuable artifacts of culture. Ian Bogost writes: “This was a radical way of thinking about video games: as non-fictions about complex systems bigger than ourselves. It changed games forever—or it could have, had players and developers not later abandoned modeling systems at all scales in favor of representing embodied, human identities.”¹⁵ Lessons that architectural design can learn from these games are many and varied, the most important one being that it is possible to think about big topics by employing models and systems while maintaining an ethos of exploration, play and public engagement.

In this sense, one could say that a simulation game format might be a contemporary version of Humboldt's illustration, with the added benefit of interactivity, but as we have seen, there is a more profound, crucial difference - this format goes beyond just a representation, beyond just a fiction, into worldmaking.

¹⁵ Ian Bogost, *Video games Are Better Without Characters*, The Atlantic (2015), <https://www.theatlantic.com/technology/archive/2015/03/video-games-are-better-without-characters/387556/>

As a result of this research, the students in the seminar utilized Unreal Engine to create version one (v.1) of Planet Garden, a multi-scalar, interactive, playable model of a self-sustaining, wind and solar-powered robotic garden, set in a desert landscape. The simulation was envisioned as a kind of reverse city builder, where a goal of the game is to terraform a desert landscape by deploying different kinds of energy-producing technologies, until the right conditions are met for planting and the production of oxygen. The basic game loop is based on the interaction between the player and four main resources: energy, water, carbon, and oxygen. In the seminar, we also created a comprehensive game manual.

The aim of the project was to learn how to model dynamic systems and explore how to utilize game workflows as ways to address urban issues. Planet Garden is projected to become a big game for the Getty exhibition, a simulation of a planetary ecosystem as well as the city for 10 billion people. We aim to model various aspects of the planetary city, and the player will be able to operate on multiple spatial sectors and urban scales. The player can explore different ways to influence the development and growth of the city and test many scenarios, but the game will also run on its own, so that the city can exist without direct player input. Our game utilizes the core design principles that have to do with system dynamics, evolution, environmental conditions, and change. A major point is the player's input and decision-making process, which influences the outcome of the game. The game will also be able to present conditions and consequences of this urban thought experiment, as something is always at stake for the player. The core of the simulation-as-a-model idea is that there are testable consequences of a design.

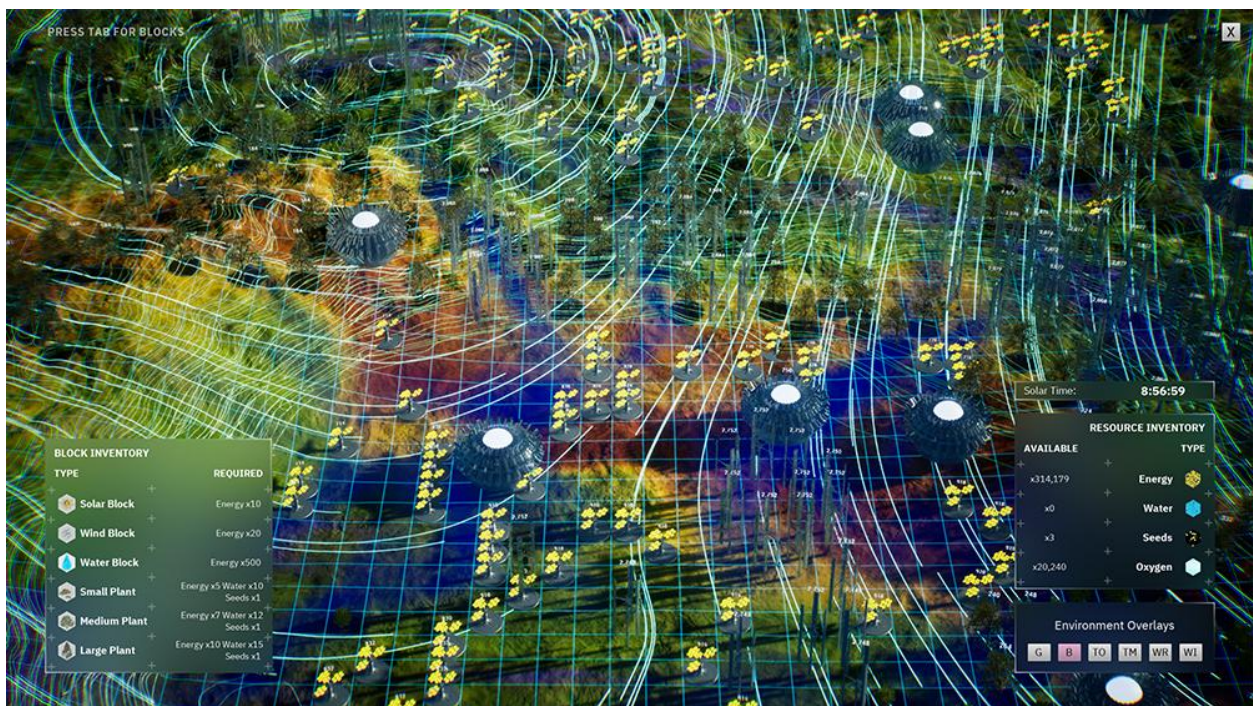


Fig. 8 Planet garden screenshot, late game state

