

Course Topic: RESPONSIVE ARCHITECTURAL SYSTEMS: ABIOGENESIS

Course Code: ARCH 684_004

Instructor: Philip Beesley

Day/Time: Monday 6:30-9:30 pm ARC 2026

Enrolment Cap: 16

Outline updated Sept. 22, 2018

This graduate seminar course will offer a series of readings of specialized aspects of responsive, interactive architecture, gathering a body of references that can be used to support advanced graduate study.

The contemporary study of *abiogenesis*, the transition between inorganic and organic life forms, provides potent material that can be applied to contemporary architecture. Geometries and organizing relationships for architecture can follow this investigation. Oscillating, undulating *quasiperiodic* organizations are revealed by new interpretations of physics and chemistry, forming hybrid relationships within multiple interconnected and interdependent systems. These relationships can guide emerging paradigms for design.

Ilya Prigogine, the mid-20th century physicist, proposed a set of paradigms that seem to question the stable world of Vitruvian architecture. We will follow a set of readings and design explorations related to the dynamic form-languages and interacting systems implied by Prigogine's theories. Prigogine sought understanding of how materials could interact in a dynamic, constantly evolving and self-organizing world. He proposed diffusion and dissipation as key terms. Readings from contemporary philosophy, cybernetics, and experimental life sciences will be included. These interdisciplinary readings can provide a context for designing complex interdependent systems within contemporary architecture.

The seminar will be conducted as orienting presentations and discussions lead by Philip Beesley followed by a series of readings led by students throughout the term. Students will be encouraged to explore the implications of the material in open-ended round-table discussions. Interdisciplinary methods of research will be supported, featuring short excerpts from key references and extending this material through active, shared reflections. Material from the Living Architecture Systems Group (LASG) group from Waterloo Architecture, Electrical and Computer Engineering, Psychology and Knowledge Integration will be included. Critique and extension of the themes embodied in LASG installations will be invited.

The varying topics within the seminar course can be refined in order to relate to individual thesis investigations, providing material for integration. No specialized experience in these multiple disciplines is required, but students should have strong interest in interdisciplinary exploration of complex systems within nature and technology.

Readings will include papers authored by:

- D'Arcy Wentworth Thompson
- Ernst Schrodinger
- Ilya Prigogine
- Gordon Pask
- Jack Szotak
- Craig England
- Rachel Armstrong
- Karen Barad

General requirements for individual presentations

Provide basic **expository** information that provides essential information about the researchers: what are their main arguments? Provide a **context** for this: what culture and history surrounds them? What sources do they draw on?

Illustrate and **demonstrate** examples from this material.

Examine the **implications** of the work: are there problems in this work? How have these ideas been received, and what kind of influence can be seen? Extend this with your own **reflections**: how does this relate to our seminar topic? How might this contribute to research around responsive architecture?

Provide a detailed reference list, organized by topic. Include links.

Read one or more key passages of your own choosing to the class.

Compose a short summary, and provide each seminar participant a physical copy.

Post a digital copy of your presentation line to the class Basecamp space, providing an ongoing reference that can be used for later architectural thesis research.

Evaluation

Your individual work will be evaluated in two ways:

- A. Seminar Presentation: based on quality, depth and ambition of your individual presentation: 50% of final grade
- B. Participation: based on attendance and quality of discussions contributed to the group throughout the course: 50% of final grade

Preliminary References

Note: these references are provided to provide initial reference, but they are not conclusive. Research and expand these references, and provide your own annotated list.

1. D'Arcy Wentworth Thompson, *On Growth and Form*

Assigned to: Michelle Dingley

Thompson, D. W., *On Growth and Form*, Cambridge University Press, 1917

Video links:

<https://www.youtube.com/watch?v=NA30IA96OSc>

<https://www.youtube.com/watch?v=x6b5UIGXqi4>

Introduction by Daina Taimina https://www.youtube.com/watch?v=kZxFoB6_IcU

Tesselation cartoon:

<https://www.bing.com/videos/search?q=d%27arcy+wentworth+thompson&&view=detail&mid=7F3F48B7339E9C6A98C67F3F48B7339E9C6A98C6&FORM=VRDGAR>

2. Erwin Schrödinger, *What is Life?*

Assigned to: Nicholas Frayne

Erwin Schrodinger, *What is Life: The Physical Aspect of the Living Cell; with Mind and Matter and Autobiographical Sketches*, Cambridge, Cambridge University Press, 1992

Lynn Margulis, *Symbiotic Planet: A New Look at Evolution* (Basic Books, Sciencewriters, Amherst, 1998)

E. I. Oparin, *Origin of Life*, trans. Sergius Morgulis, Macmillan, 1953 [1938]

A. G. Cairns-Smith, *Genetic Takeover and the Mineral Origins of Life* (Cambridge: Cambridge University Press, 1982).

A. G. Cairns-Smith, *Genetic Takeover and the Mineral Origins of Life* (University of Cambridge, 1982)

Stephane Leduc, *The Mechanism of Life* (Heinemann, London, 1914)

3. Buckminster Fuller, Synergetics

Assigned to: Kexin Tan and E.J. Sainte

R. Buckminster Fuller in collaboration with E. J. Applewhite, **Synergetics: Explorations in the Geometry of Thinking** Macmillan Publishing Co. Inc. 1975, 1979.

Camazine, Scott et al, *Self-Organization in Biological Systems* (Princeton University Press, 2001)

J. B. S. Haldane, *On Being the Right Size* (Oxford, 1985)

3. Ilya Prigogine, Dissipative Forms

Assigned to: Shanne Stines and Shabaan Khokhar

Ilya Prigogine, '**The 1977 Nobel Prize in Chemistry**,' Nobelprize.org. Nobel Media AB 2014,

http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1977/press.html

<https://ed.ted.com/lessons/what-is-entropy-jeff-phillips>

6. Jack Szotak, Abiogenesis

David Deamer and Jack Szotak, **The Origins of Life** (Cold Spring Harbor Perspectives in Biology) , Cold Spring Harbor Laboratory Press, 2010

Assigned to: Laila Abdalla and Nadia Shahed

Chemical origin of life on earth

<https://www.youtube.com/watch?v=PqPGOhXoprU>

Simulation of Miller-Urey Experiment

https://www.youtube.com/watch?time_continue=3&v=WHQn03ZiqKY

Abiogenesis summary video

<https://www.youtube.com/watch?v=c6LaMwRZUjw>

4. Gordon Pask, Early Developments in Interactive Architecture

Assigned to: Ilhan Ozdemir and Kathleen Fu

Gordon Pask, Paul Pangaro

<http://www.pangaro.com/pask/Pask%20Cybernetic%20Serendipity%20Musicolour%20and%20Colloquy%20of%20Mobiles.pdf>

Gordon Pask, **Micro Man** (MacMillan, 1982)

Valentino Braitenberg, *Vehicles: Experiments in Synthetic Psychology*, MIT Press, Cambridge, 1984

Marvin Minsky, *The Society of Mind* (Simon & Schuster, New York, 1985)

Pierre-Yves Oudeyer, Frederic Kaplan, and Verena V. Hafner, "Intrinsic Motivation Systems for Autonomous Mental Development," *IEEE Transactions on Evolutionary Computation* vol. 11, no. 2 (2007): 265–86. doi:10.1109/TEVC.2006.890271.

<https://www.youtube.com/watch?v=A-fxij3zM7g>

Braitenberg interview and models

<https://vimeo.com/52150443>
<http://www.pangaro.com/video/index.html>

7. Craig England, New Physics of Living Systems

Assigned to: Daniel Bassakyros and Rola El-Sayes

Jeremy England, '**Why Trees Don't Ungrow**', Aeon, 2018 <https://aeon.co/essays/does-the-flow-of-heat-help-us-understand-the-origin-of-life>

Gavin E. Crooks, '**Entropy production fluctuation theorem and the nonequilibrium work relation for free energy differences**', Phys. Rev. E 60, 2721, September 1999

8. Rachel Armstrong, Soft Living Architecture

Assigned to: Alex Vishakh

Rachel Armstrong, Soft Living Architecture: An Alternative View, Bloomsbury Visual Arts, 2018
<https://www.youtube.com/watch?v=LX8aT-Hb5FE>

9. Karen Barad, Intra-action and Agential Realism

Assigned to: Yina Li

Karen Barad, **Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning**, Duke University Press, 2007

Barad K. (1996) **Meeting the Universe Halfway: Realism and Social Constructivism without Contradiction**. In: Nelson L.H., Nelson J. (eds) Feminism, Science, and the Philosophy of Science. Synthese Library (Studies in Epistemology, Logic, Methodology, and Philosophy of Science), vol 256. Springer, Dordrecht

<https://alwaysalreadypodcast.wordpress.com/2017/07/24/barad/>

GOVERNING DETAILS

Class Communication and Organization Organize the class with a class representative. This structure can be used for providing critical feedback to the faculty and for coordinating evolving details through the term.

The course will use the ARCH 685 Beesley section of LEARN for formal submissions Enter the site by using your 'UWDir' ID and password. You will be asked to make digital submissions of assignments on that site. In parallel, Basecamp www.basecamp.com will be used for online threaded messaging and discussion. You will receive an invitation and login on commencement of the course. Ensure you have access to both LEARN and Basecamp.

Class Meetings: Lectures and class meetings will be held throughout the term from 6:30 pm to 9:30 pm on Mondays, excepting occasions as shown on the schedule and as announced during the term. Specific dates may be established as the term evolves, responding to class progress. Check your email late evening on the day before for updates on class arrangements.

Attend Lectures: Be in full attendance during class meetings and attend all reviews. Maintain focus: no texting, emailing, surfing during meetings and lectures.

Complete all parts of the work; submit your work on time. All assigned parts of the work must be completed. Punctual completion is required. Grade penalties will be applied to late submissions and chronic lateness may result in disciplinary review including refusal of acceptance. Late submissions must be accompanied by formal transmittal indicating reason for lateness. Penalties would be assessed at 5% per day. The first 'day' commences at the deadline and runs until midnight the same day. Subsequent 'days' begin at midnight each day and terminate the following midnight. Days include weekends and holidays.

Accommodation for illness; not for travel If you need to apply for accommodation of lateness or absence due for illness, make a formal application by using 'Verification of Illness'(VIF) forms or counselling letters, filed with the Architecture Office. Student travel plans are not considered acceptable grounds for granting alternative reviews and submission times.

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Director. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline,. For typical penalties check Guidelines for the Assessment of Penalties. Note: "Plagiarism, which is the act of presenting the ideas, words or other intellectual property of another as one's own. The use of other people's work must be properly acknowledged and referenced [...] The properly acknowledged use of sources is an accepted and important part of scholarship. Use of such material without complete and unambiguous acknowledgement, however, is an offence under this policy. "

References: www.uwaterloo.ca/academicintegrity/ www.adm.uwaterloo.ca/infosec/Policies/policy71.htm.
www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please contact the department's administrative assistant who may provide further assistance.

Appeals: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Students with Disabilities:

The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.

