



# Teaching and Learning Guide for: Substantivalism vs Relationalism about Space in Classical Physics

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## ***Author’s Introduction***

This article is about the nature of space, focusing on the question of whether it exists independently of matter and related questions about its geometric structure. One fascinating aspect of this debate is how it straddles the border between empirical science and philosophy. Since at least the time of Newton, it has been thought that various physical phenomena demonstrate some conclusion about the nature of space, but as I try to emphasize, the arguments are invariably suffused with philosophical presuppositions. This article examines these arguments in the context of classical physics. The article is designed to be used in a range of teaching settings. In an intro-level class, one could use just sections 1–3. They introduce the debate as it played out between Newton and Leibniz, and should be accessible to students with little or no previous exposure to the topic or to philosophy. In an upper-level undergraduate class, one could add sections 4–6, which describe how the debate has developed in the contemporary era. And in a research seminar, one could then add sections 7–9, which offer a critical analysis of the contemporary debate.

## ***Author Recommends***

**Brighouse, S. ‘Spacetime and Holes’. *PSA: The Proceedings of the Biennial Meeting of the Philosophy of Science Association 1 (1994): 117–25.***

—This paper develops “sophisticated substantivalism”, the view I discuss in section 8 of my article.

**Earman, J. *World Enough and Space–Time*. Cambridge, MA: MIT Press, 1989.**

—This is a classic text on the substantivalism vs relationalism debate.

**Field, H. ‘Can We Dispense with Space–Time?’ *PSA: The Proceedings of the Biennial Meeting of the Philosophy of Science Association 2 (1984): 33–90.***

—This contains an argument for substantivalism that complements the bucket argument.

**Huggett, N. *Space from Zeno to Einstein*. Cambridge, MA: MIT Press, 1999.**

—This is a collection of historical texts on the nature of space and time.

**Ismael, J. and B. van Fraassen.** ‘Symmetry as a Guide to Superfluous Theoretical Structure’. *Symmetries in Physics: Philosophical Reflections*. Eds. K. Brading and E. Castellani. Cambridge: Cambridge University Press, 2003. 371–92.

—This introduces a distinctive way of thinking about symmetry arguments.

**Maidens, A.** ‘Review of John Earman’s *World Enough and Space-Time*’. *British Journal for the Philosophy of Science* 43 (1992): 129–36.

—This contains one of the first statements of “sophisticated substantivalism”, the view I discuss in section 8 of my article.

**Maudlin, T.** ‘Buckets of Water and Waves of Space: Why Spacetime is Probably a Substance.’ *Philosophy of Science* (1993): 183–203.

—Here, Maudlin develops for the first time the view that I discuss in section 9 of this article.

**North, J.** ‘The Structure of Physics: A Case Study.’ *The Journal of Philosophy* 106 (2009): 57–88.

—This discusses and develops the method of using symmetry as a guide to structure.

**Sklar, L.** *Space, Time, and Spacetime*. Berkeley: University of California Press, 1974.

—Chapter 3 is a classic discussion of the substantivalism vs relationalism debate.

### **Sample Syllabus**

#### CLASS 1 INTRODUCTION AND THE BUCKET ARGUMENT

Dasgupta, S. “Substantivalism vs Relationalism About Space in Classical Physics”, sections 1–2  
Sklar, *Space, Time, and Spacetime*. pp. 161–173 and 182–191.

#### CLASS 2 LEIBNIZ’S ARGUMENTS

Dasgupta, S. “Substantivalism vs Relationalism About Space in Classical Physics”, section 3  
Selections from the Leibniz-Clarke Correspondence. Reprinted in Huggett, *Space from Zeno to Einstein*, pp. 143–159.

#### CLASS 3 SYMMETRY ARGUMENTS AND GALILEAN SPACETIME (FOR AN UPPER-LEVEL CLASS OR RESEARCH SEMINAR)

Dasgupta, S. “Substantivalism vs Relationalism About Space in Classical Physics”, sections 4–6  
North, “The Structure of Physics: A Case Study”, pp. 57–67.

#### CLASS 4 PROBLEMS WITH GALILEAN SPACETIME I: MODALITY (FOR A RESEARCH SEMINAR ONLY)

Dasgupta, S. “Substantivalism vs Relationalism About Space in Classical Physics”, sections 7–8  
Brighouse, “Spacetime and Holes.”

#### CLASS 5 PROBLEMS WITH GALILEAN SPACETIME II: EPISTEMOLOGY (FOR A RESEARCH SEMINAR ONLY)

Dasgupta, S. “Substantivalism vs Relationalism About Space in Classical Physics”, section 9  
Maudlin, “Buckets of Water and Waves of Space: Why Spacetime is Probably a Substance.”