Writing

• Select one of the following items and write a 500-600 word essay in response. Address the issues posed, but feel free to extend their scope.
• Using concise and clear sentences, incorporate symbols and illustrations into your text. Have an audience in mind. Focus on developing an explanation or argument. Using specific examples to illustrate a general idea or claim is often a helpful tactic. What are you trying to show and how are you trying to show it?
• Writing well is difficult and can be painful. For writing assistance, consult the style and content guide at the class website. There’s no required stylistic format; writing can range from technical to literary.
• Typed work is expected. Hand-drawn figures are acceptable.
• Submit to the class dropbox.
• You may work with a partner. Submit one paper for the group.

1) In On the Nature of Things\(^1\), Lucretius gives what’s called a “symmetry argument” against the fear of death. Discuss whether this is an appropriate description of Lucretius’s argument. What sort of symmetry is involved?

2) Achirality. Recall that a shape is chiral if you can’t superimpose its reflection on itself by rotating and translating it and achiral if you can. Two chiral shapes are homochiral if you can superimpose one on the other by applying rotations and translations. They’re heterochiral if you can superimpose them after first applying a reflection to one of them.

   a) Find an achiral object in two dimensions that’s not mirror-symmetric (that is, doesn’t have reflective symmetry). Does your object have any other symmetries? Find one in three dimensions.
   
   *Suggestion:* In two dimensions, an achiral object can, after being reflected in a mirror, be moved onto its original position by applying a translation or rotation. In other words, the object has the symmetry formed by the combination of the reflection and translation or rotation. Express what happens symbolically and then consider what kind of figure can have the symmetry in question.

   b) Can a mirror-symmetric object always be rigidly moved onto itself after being reflected in a mirror—not just the one with respect to which the object is symmetric?
   
   *Suggestion:* The two-reflections principle might be useful.

3) Gardner (New Ambidextrous Universe, Ch. 7, “Plants and Animals”) describes symmetry-breaking in organisms as driven by fitness considerations. For instance, front-back asymmetry follows from locomotion properties. But, can this work in the other direction: asymmetrical variations increase fitness—that is, fitness follows from the asymmetry?

4) As organisms undergo variation through reproduction, their characteristics are mostly inherited. Describe how inheritance is a kind of symmetry that’s an obstacle to the evolution of species. How is this obstacle overcome so that new species can appear?

5) Floating vs. swimming. Creatures that float in the sea (plankton) tend to be more symmetrical than those that propel themselves. What accounts for the different types and amounts of symmetry that these organisms possess? Why aren’t plants bilaterally symmetric?

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\(^1\) Available at [geomsymm.cnsm.csulb.edu/courses/303/lucretius.html](http://geomsymm.cnsm.csulb.edu/courses/303/lucretius.html)
6) Select or create a painting, drawing, or photograph. What features of the piece change and don’t change when it’s 1) reflected through a mirror (consider vertical, horizontal and diagonal mirrors) and 2) rotated about some point.

7) What happens to the symmetry of a 3-dimensional figure when it’s projected onto a 2-dimensional plane? It’s clear that the symmetry can decrease, but can it increase or remain the same? What if the figure is projected onto some other kind of surface—such as a sphere?

8) Find a work—graphic art, sculpture, piece of music, dance, or literature—and a transformation of it (construed in a broad sense) that leaves some property of the work unchanged. Try to avoid using familiar spatial transformations.

9) Give one or two *non-physics* examples of situations that realize the

\[
\text{input} \rightarrow \text{interaction} \rightarrow \text{output}
\]

model. Focus on where the symmetry occurs and how it arises. Also, how do symmetry considerations illuminate the process?

10) Consider the work *Building Blocks* by Chris Jordan. (Images appear below. For interpretative data, see [www.chrisjordan.com](http://www.chrisjordan.com).)

As you approach the piece, the apparent building blocks resolve into smaller building blocks. Discuss the kind of symmetry that the work *suggests* rather than explicitly realizes. In what ways doesn’t the work realize this symmetry? Design a simple piece—diagram, picture, sculpture that does realize the symmetry in question.

Figure 1: Full view (gallery piece is 16’ × 32’)

![Building Blocks image](image-url)
Figure 2: Zoom—one “block”

Figure 3: Zoom again

Figure 4: And again