

NATURE SERIES.

# HOW TO DRAW A STRAIGHT LINE;

A

LECTURE ON LINKAGES.

BY

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MEMBER OF THE COUNCIL OF THE LONDON MATHEMATICAL SOCIETY;  
AND LATE SCHOLAR OF TRINITY COLLEGE, CAMBRIDGE.

WITH NUMEROUS ILLUSTRATIONS.

London :  
1877.

Watt 1764

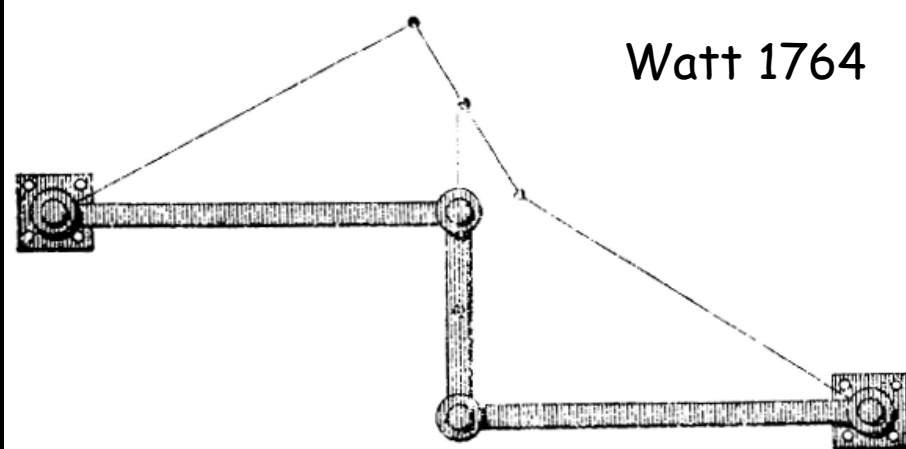
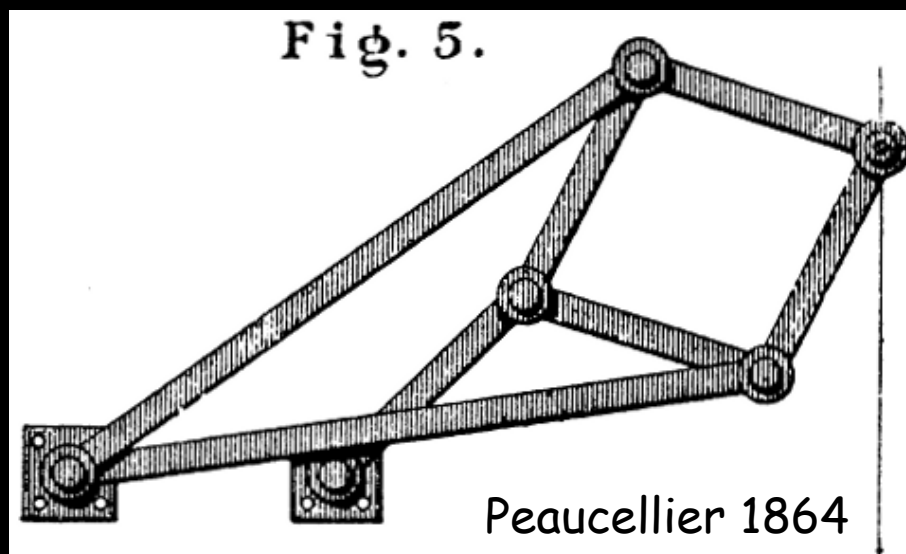


Fig. 2.

Fig. 5.

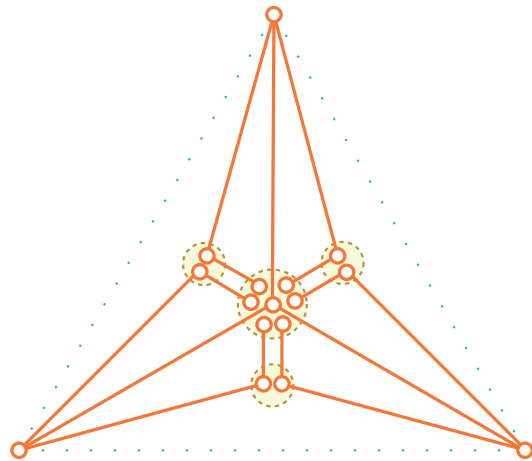
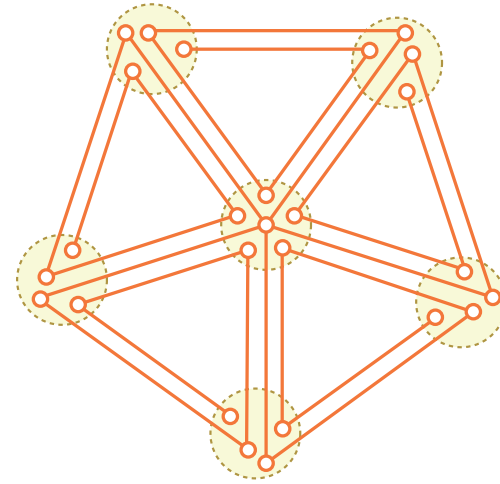
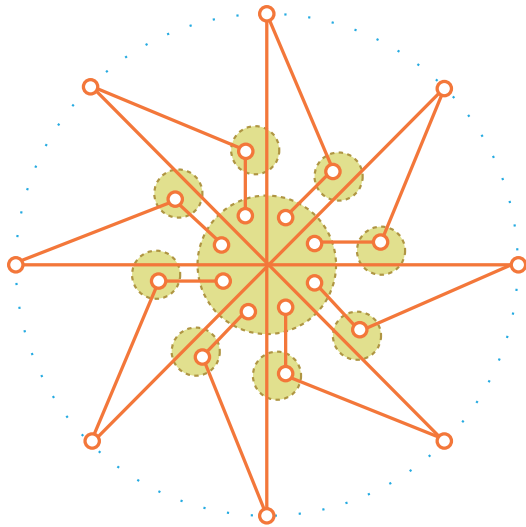


Peaucellier 1864

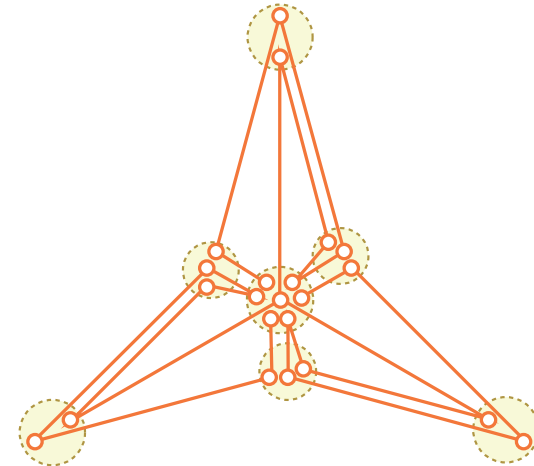
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Source: Kempe, A. B. *How to Draw a Straight Line*. MacMillan and Co., 1877. Co.

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**(A)**



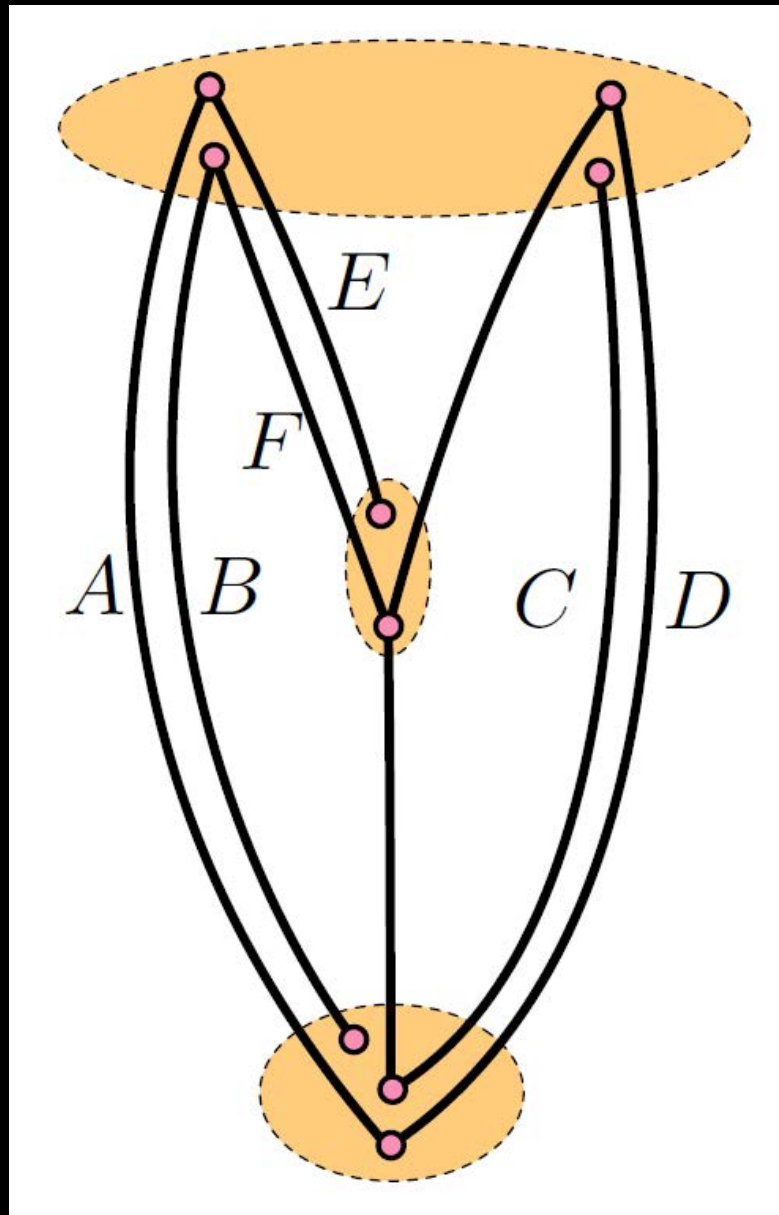
**(B)**

[Biedl, Demaine, Demaine, Lazard, Lubiw, O'Rourke, Robbins, Streinu, Toussaint, Whitesides 2002]

[Connelly, Demaine, Rote 2001]

Image by MIT OpenCourseWare.

See also <http://erikdemaine.org/papers/LockedTreeDAM/> and [http://erikdemaine.org/papers/InfinitesimallyLocked\\_LasVegas/](http://erikdemaine.org/papers/InfinitesimallyLocked_LasVegas/).



[Ballinger, Charlton,  
Demaine, Demaine,  
Iacono, Liu, Poon  
2009]

Courtesy of Brad Ballinger, David Charlton, Erik D. Demaine, Martin L. Demaine,  
John Iacono, Ching-Hao Liu, and Sheung-Hung Poon. Used with permission.

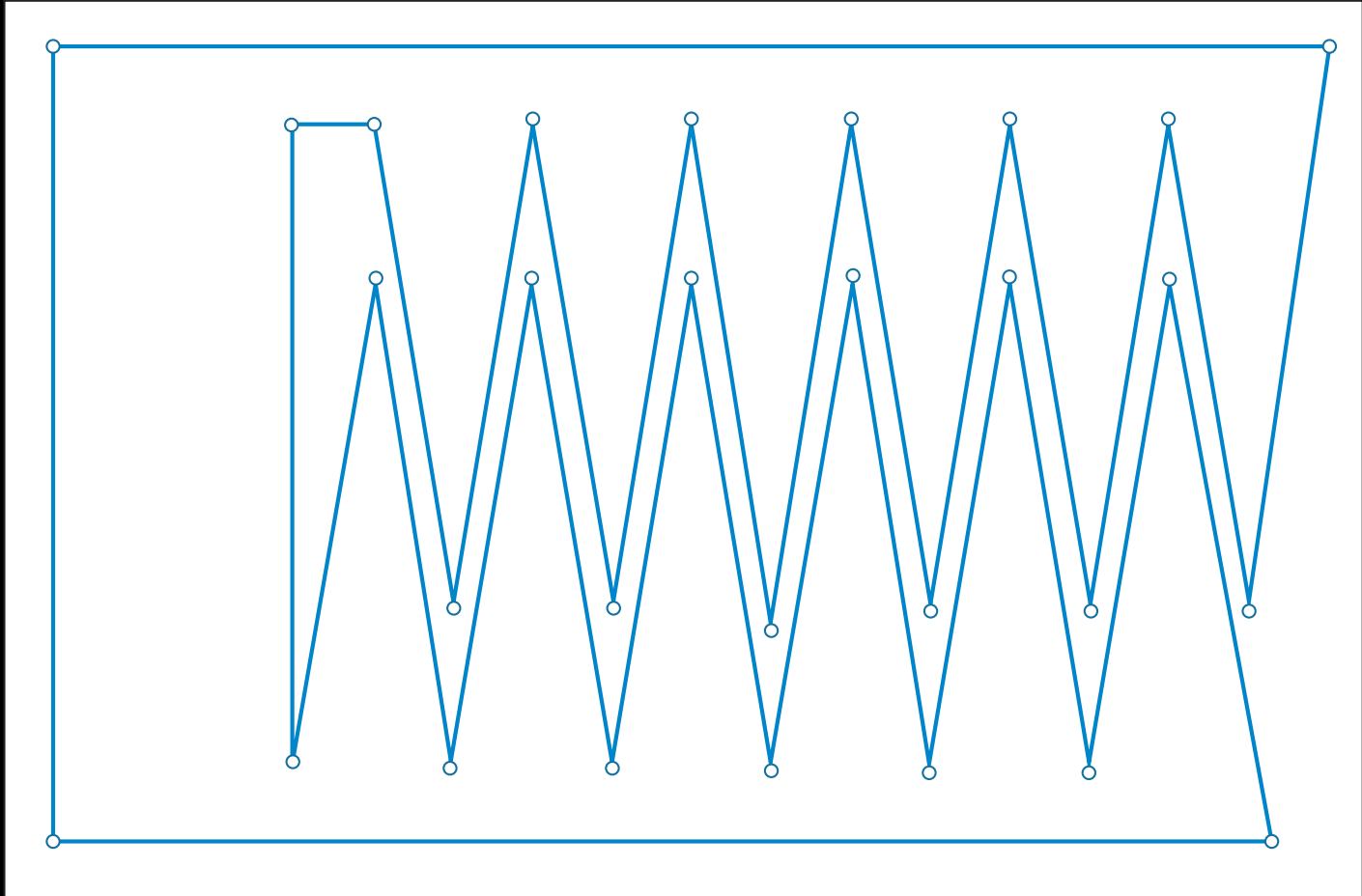
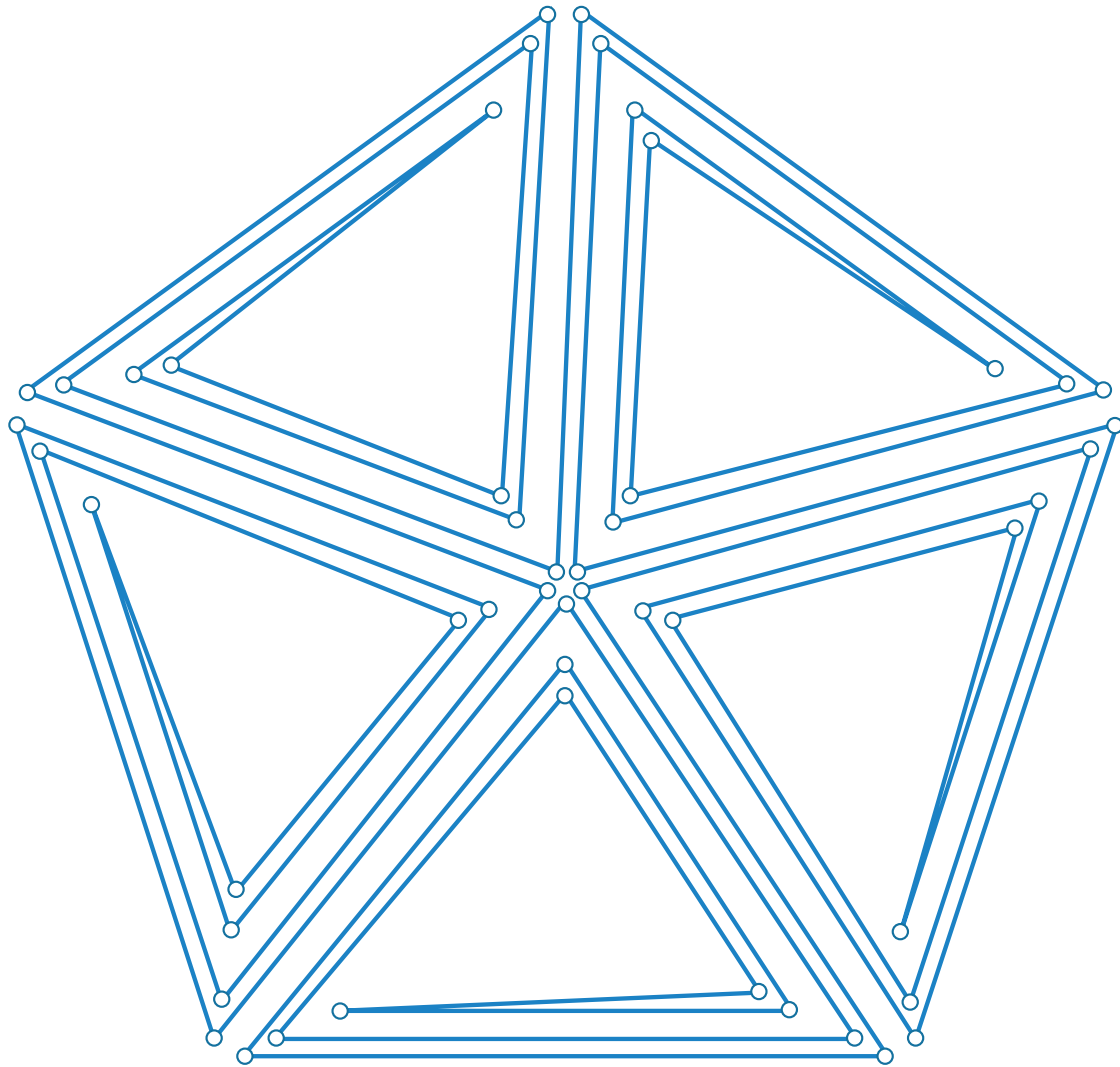


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Refer to: Cantarella, J., E. Demaine, et al. "An Energy-Driven Approach to Linkage Unfolding". *SCG '04 Proceedings of the Twentieth Annual Symposium on Computational Geometry* (2004): 134–43.

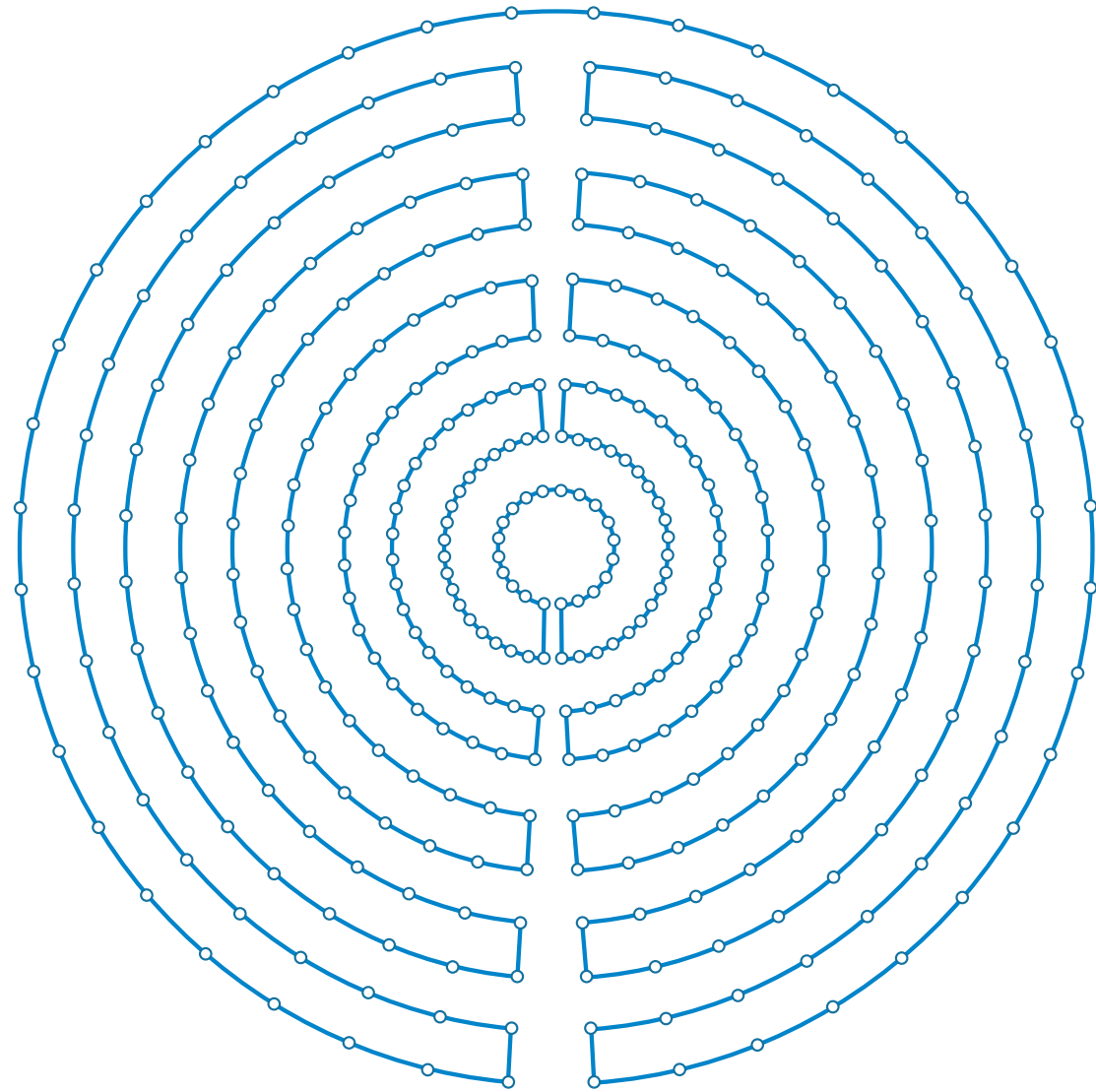
[Cantarella,  
Demaine,  
Iben,  
O'Brien  
2004]



[Cantarella,  
Demaine,  
Iben,  
O'Brien  
2004]

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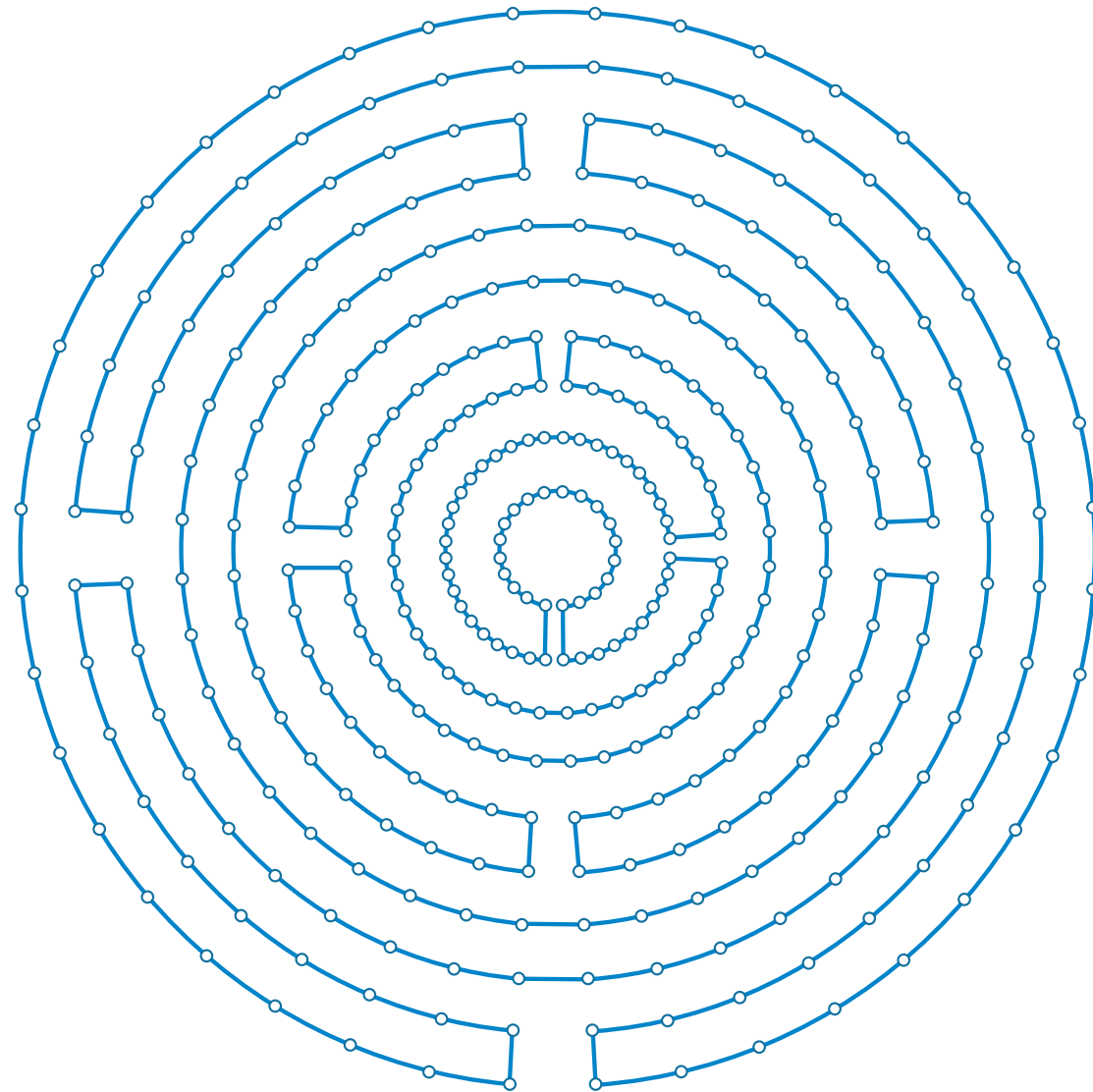
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[Cantarella,  
Demaine,  
Iben,  
O'Brien  
2004]

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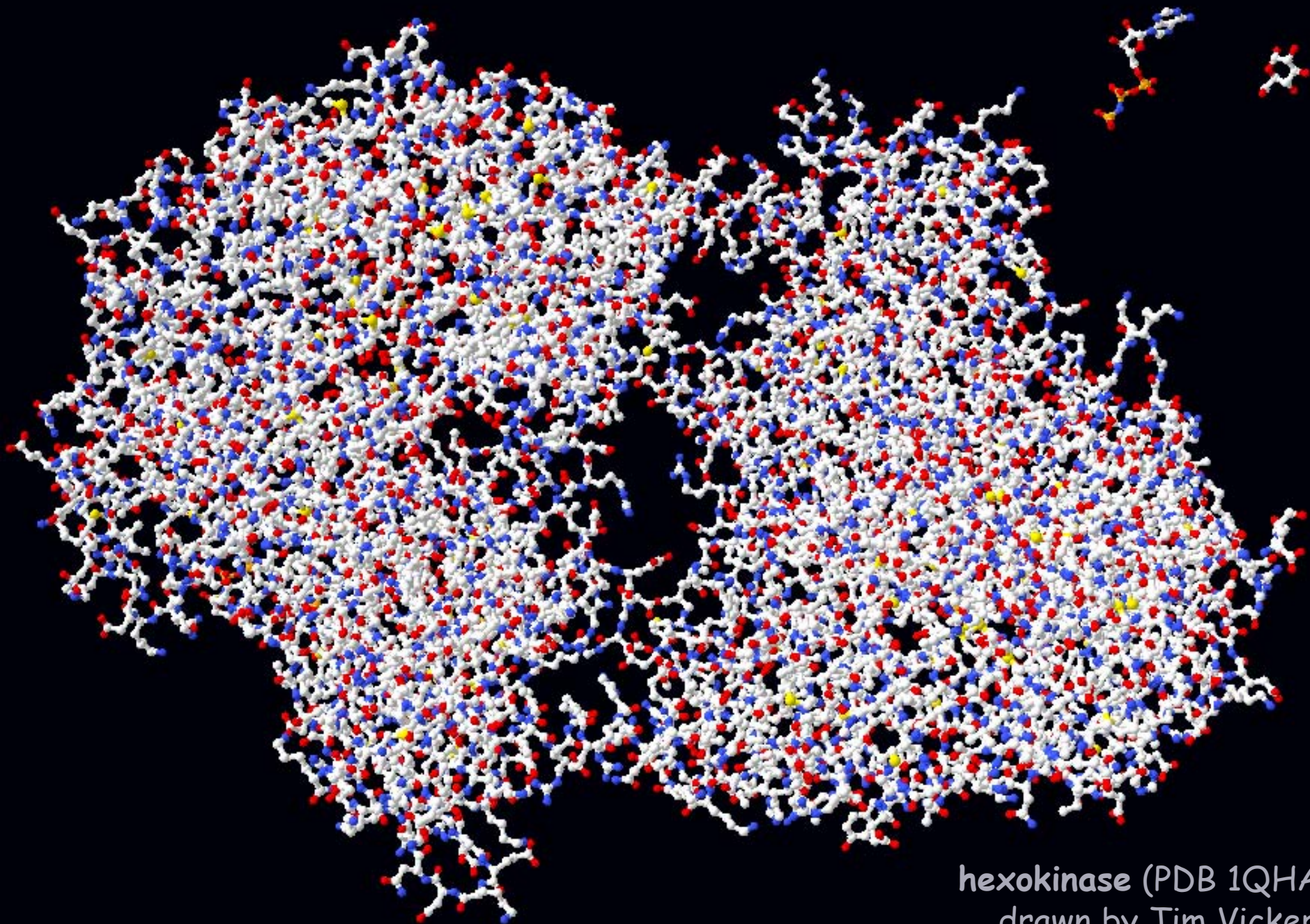
Refer to: Cantarella, J., E. Demaine, et al. "An Energy-Driven Approach to Linkage Unfolding". *SCG '04 Proceedings of the Twentieth Annual Symposium on Computational Geometry* (2004): 134-43.



[Cantarella,  
Demaine,  
Iben,  
O'Brien  
2004]

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Refer to: Cantarella, J., E. Demaine, et al. "An Energy-Driven Approach to Linkage Unfolding". *SCG '04 Proceedings of the Twentieth Annual Symposium on Computational Geometry* (2004): 134-43.



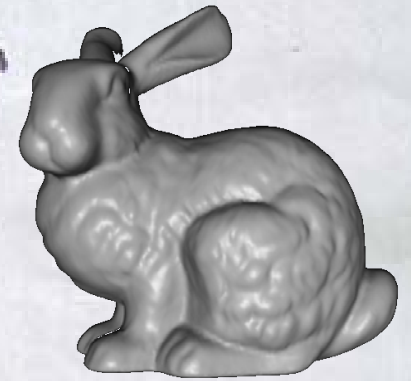
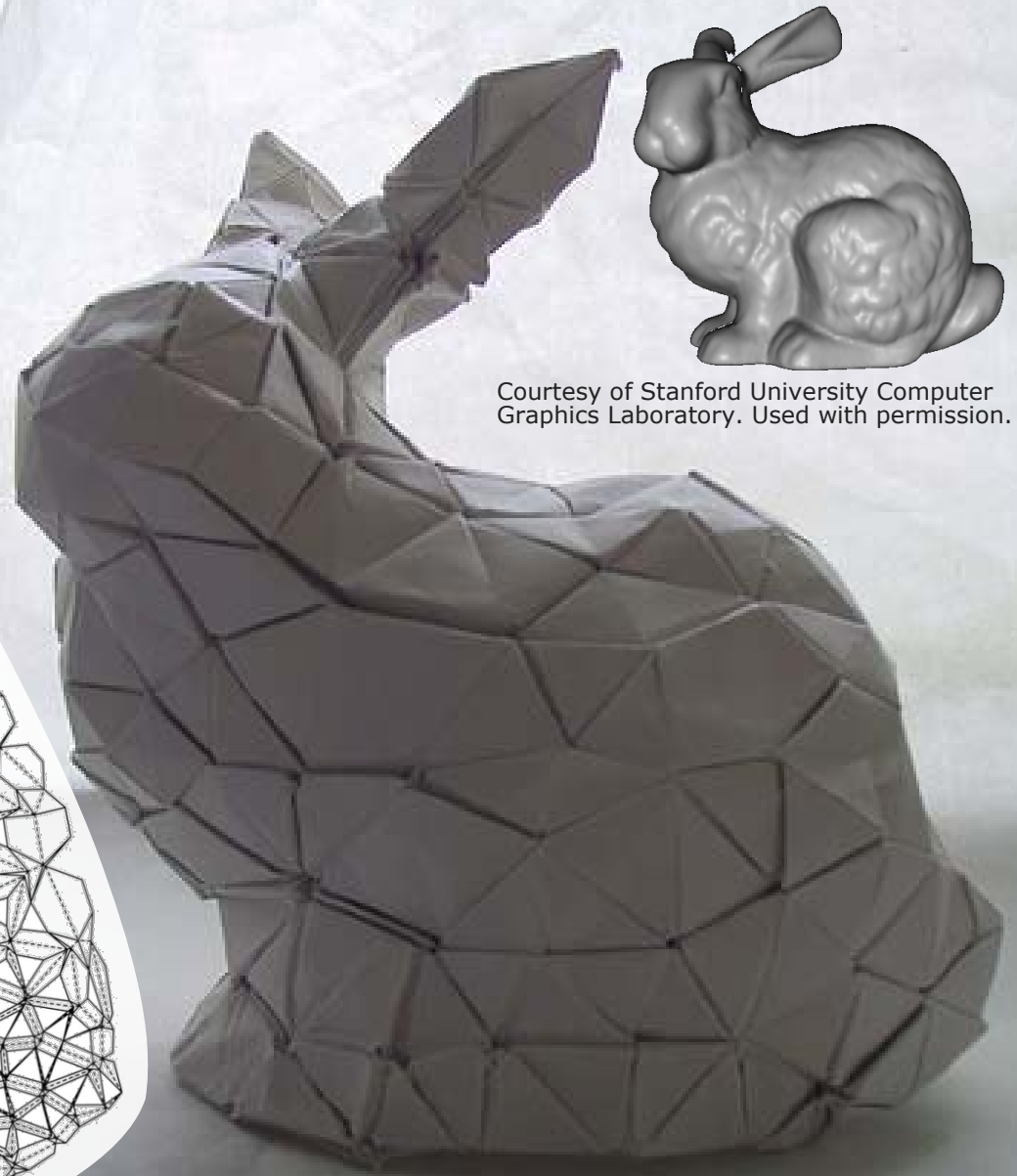
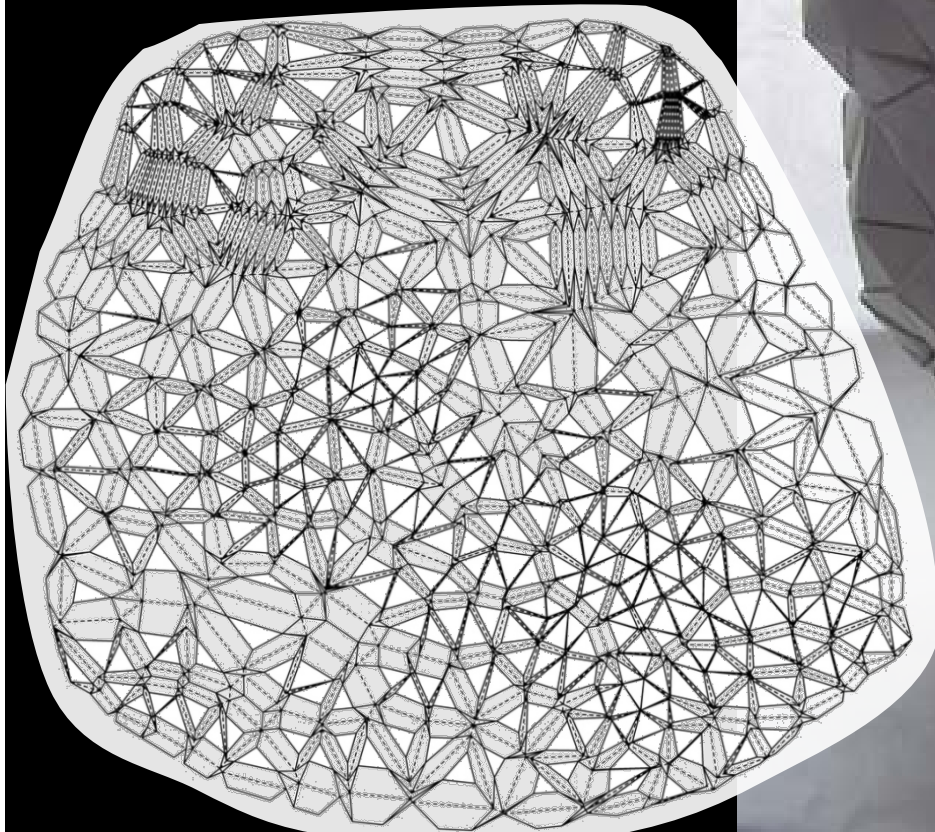
hexokinase (PDB 1QHA)  
drawn by Tim Vickers

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# Origamizer

[Tachi 2006;  
Demaine &  
Tachi 2010]



Courtesy of Stanford University Computer Graphics Laboratory. Used with permission.

Tomohiro Tachi

Courtesy of Tomohiro Tachi. Used with permission. Under CC-BY-NC.

Origami USA  
Convention  
2009



Joel Cooper



Brian Chan



Goran Konjevod



# Programmable Matter by Folding

multiple shapes, compound folds

"Computational Origami"  
Erik & Martin Demaine  
MoMA, 2008-

Elephant hide paper  
~9"x15"x7"





**"Natural Cycles"**  
Erik & Martin Demaine

JMM Exhibition of  
Mathematical Art,  
San Francisco, 2010





**D**as Sechst corpus/so das aufzhan wirt/hat es sechs gefierte/vnd zwey vnd dreyßig Dyangli che felder/so man das zûsamen leget.gewint es vier vnd zweynßig eck /vnd sechßig scharpfer seyten.

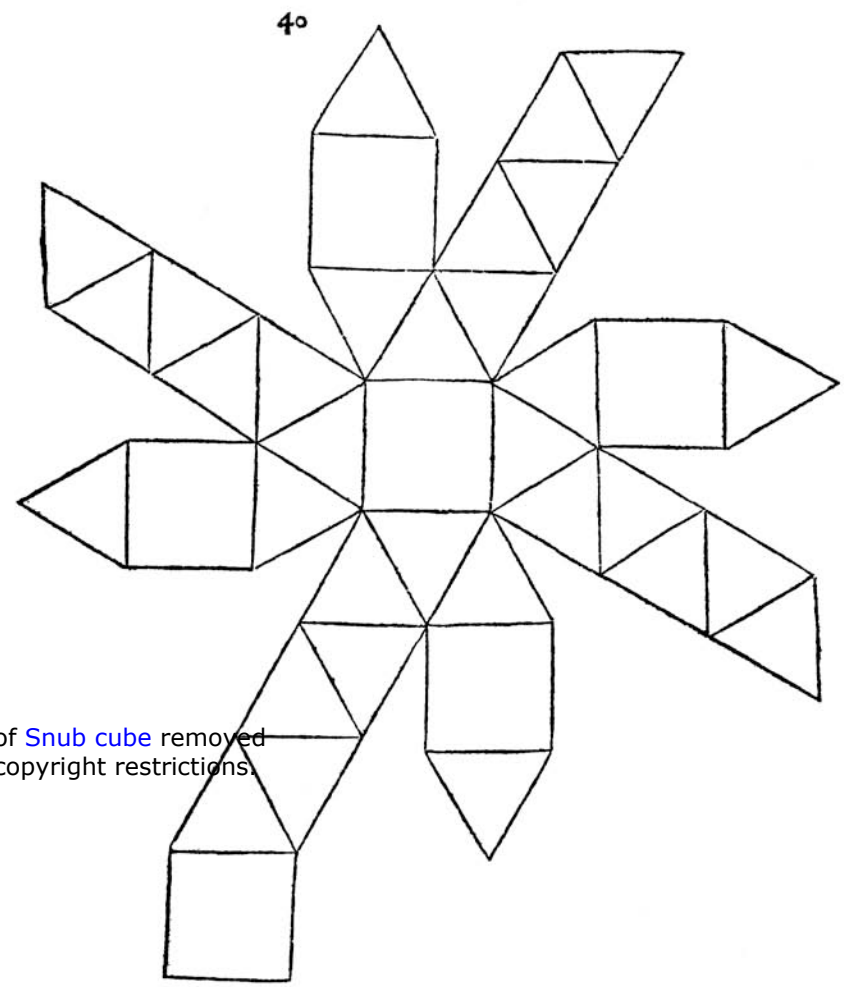


Image of [Snub cube](#) removed due to copyright restrictions.

**D**as Sibent vnd nach folget corpus/so es offen leyt/hat es sechs achte ecketter/vñ achte sechs ecketer /vnd zwelf vier ecketter felder/vñ so man das zûsamen leget/so gewint es achte vnd vierßig eck/vnd zwo vnd sibenzig scharpfer seyten.

Dürer's self-portrait and scan of Dürer's *The Painter's Manual* are in the public domain.

Albrecht Dürer (self-portrait)

The Painter's Manual [1525]

Snub Cube drawn by Cyp, licensed under Creative Commons Attribution-Share Alike 3.0 Unported

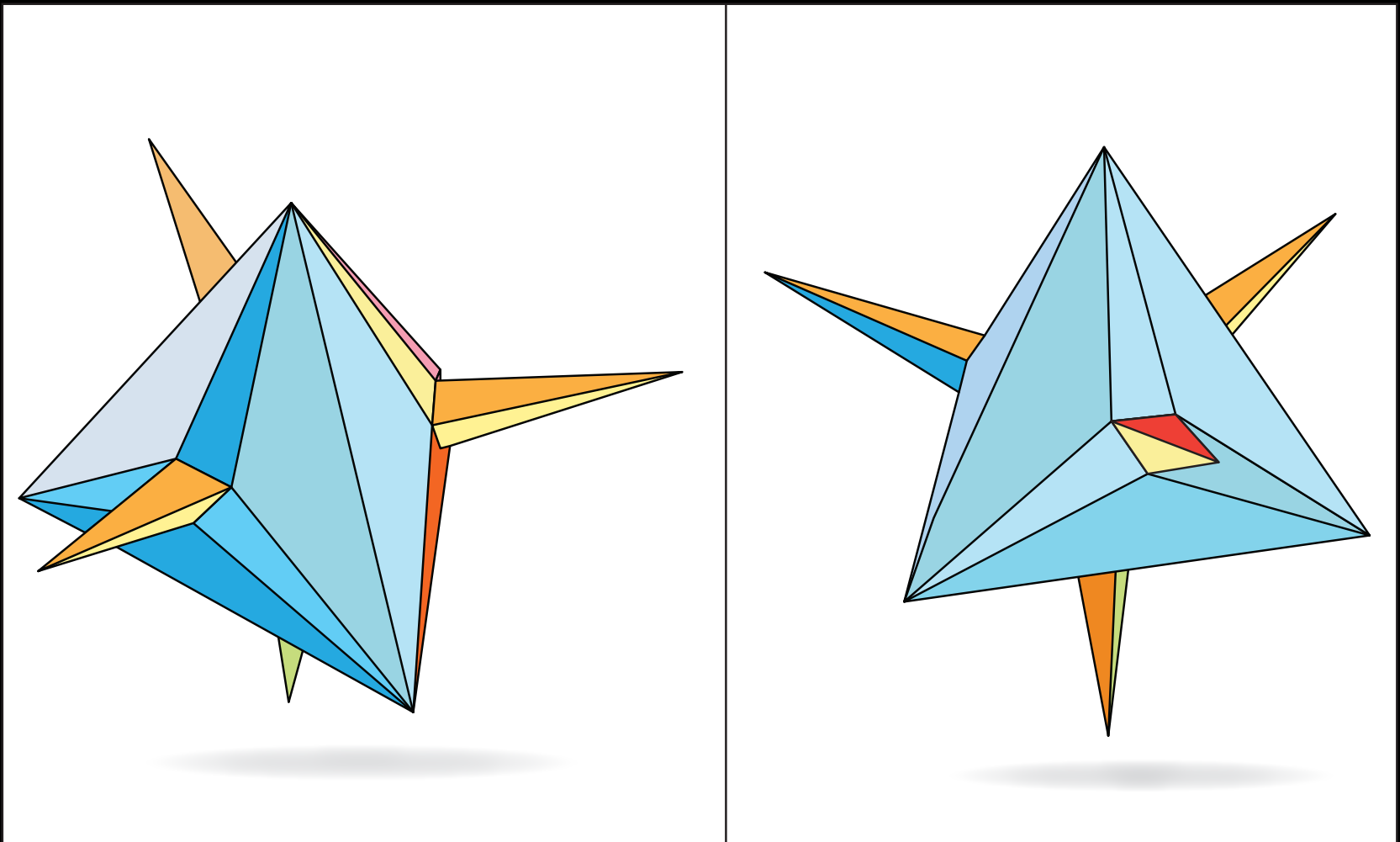
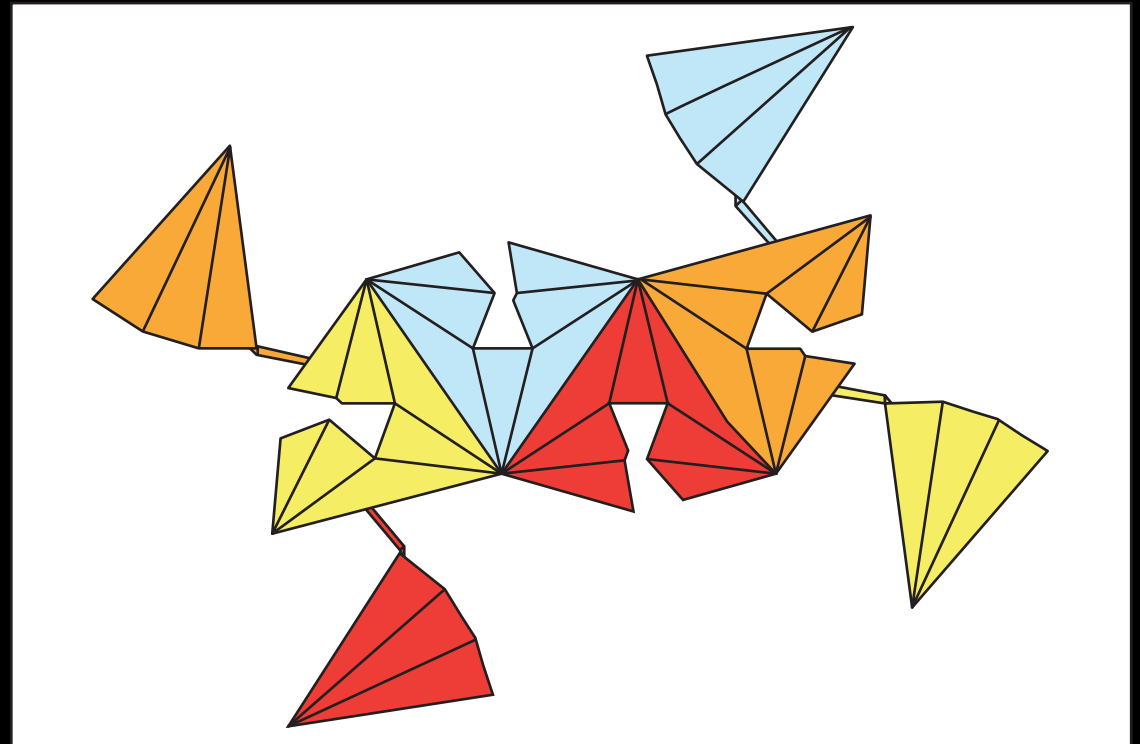
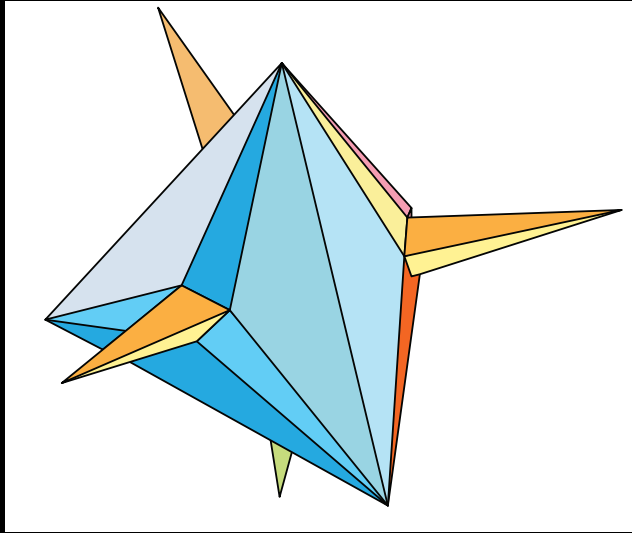


Image by MIT OpenCourseWare.  
See also <http://erikdemaine.org/papers/Ununfoldable/>.

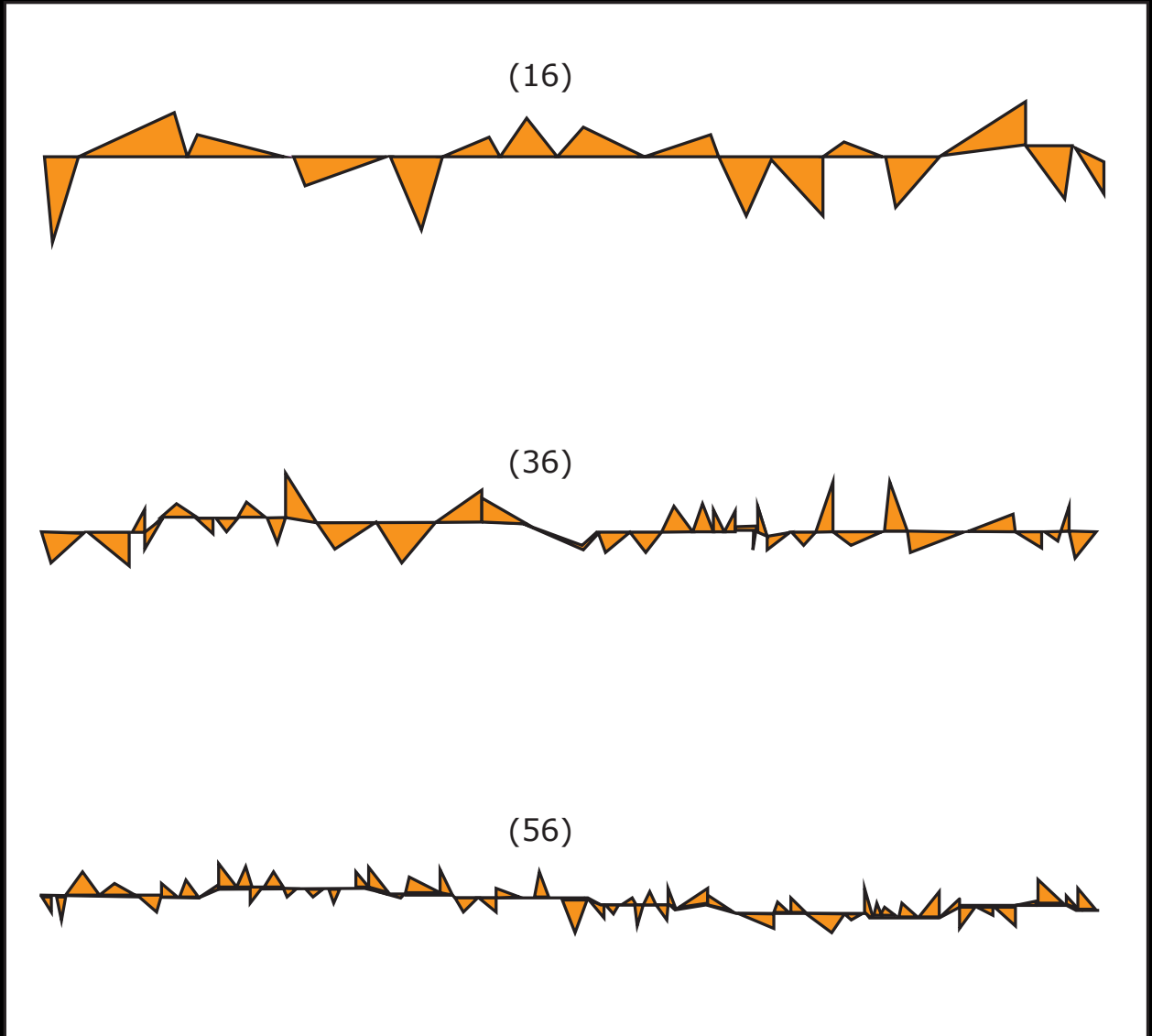
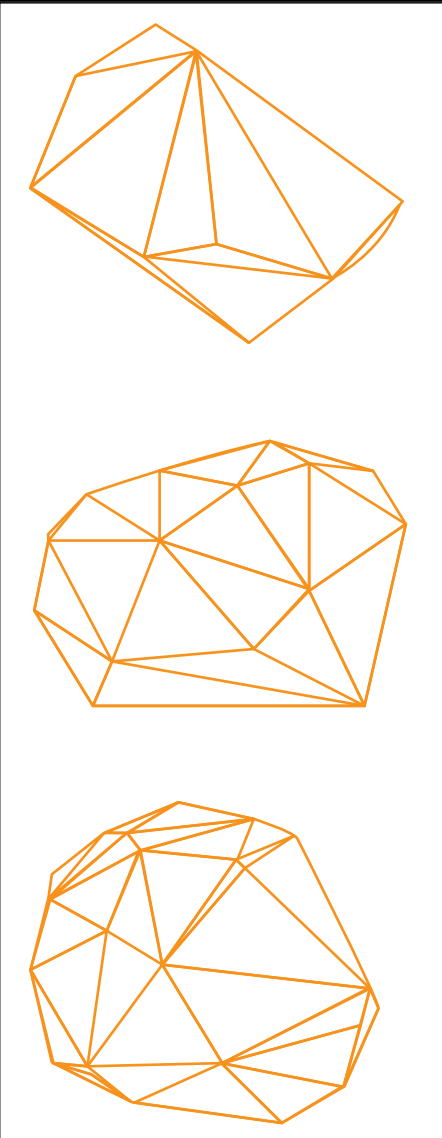
[Bern, Demaine, Eppstein, Kuo, Mantler, Snoeyink 2003]



[Bern, Demaine,  
Eppstein, Kuo, Mantler,  
Snoeyink 2003]

Images by MIT OpenCourseWare.  
See also <http://erikdemaine.org/papers/Ununfoldable/>.



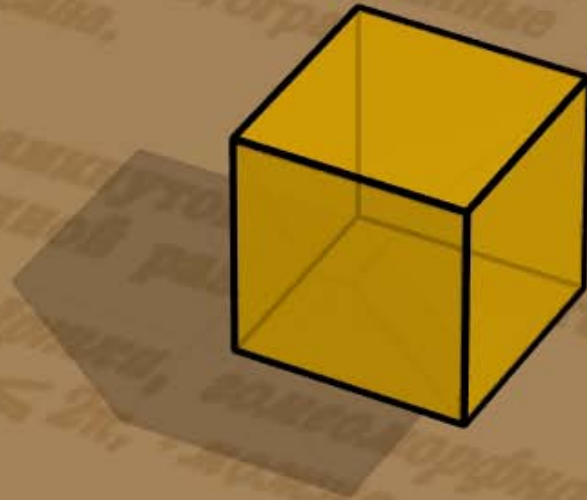


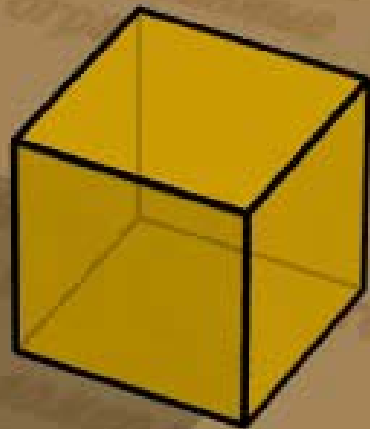
Images by MIT OpenCourseWare.  
See also [http://erikdemaine.org/papers/VertexUnfolding\\_Kuperberg2003/](http://erikdemaine.org/papers/VertexUnfolding_Kuperberg2003/).

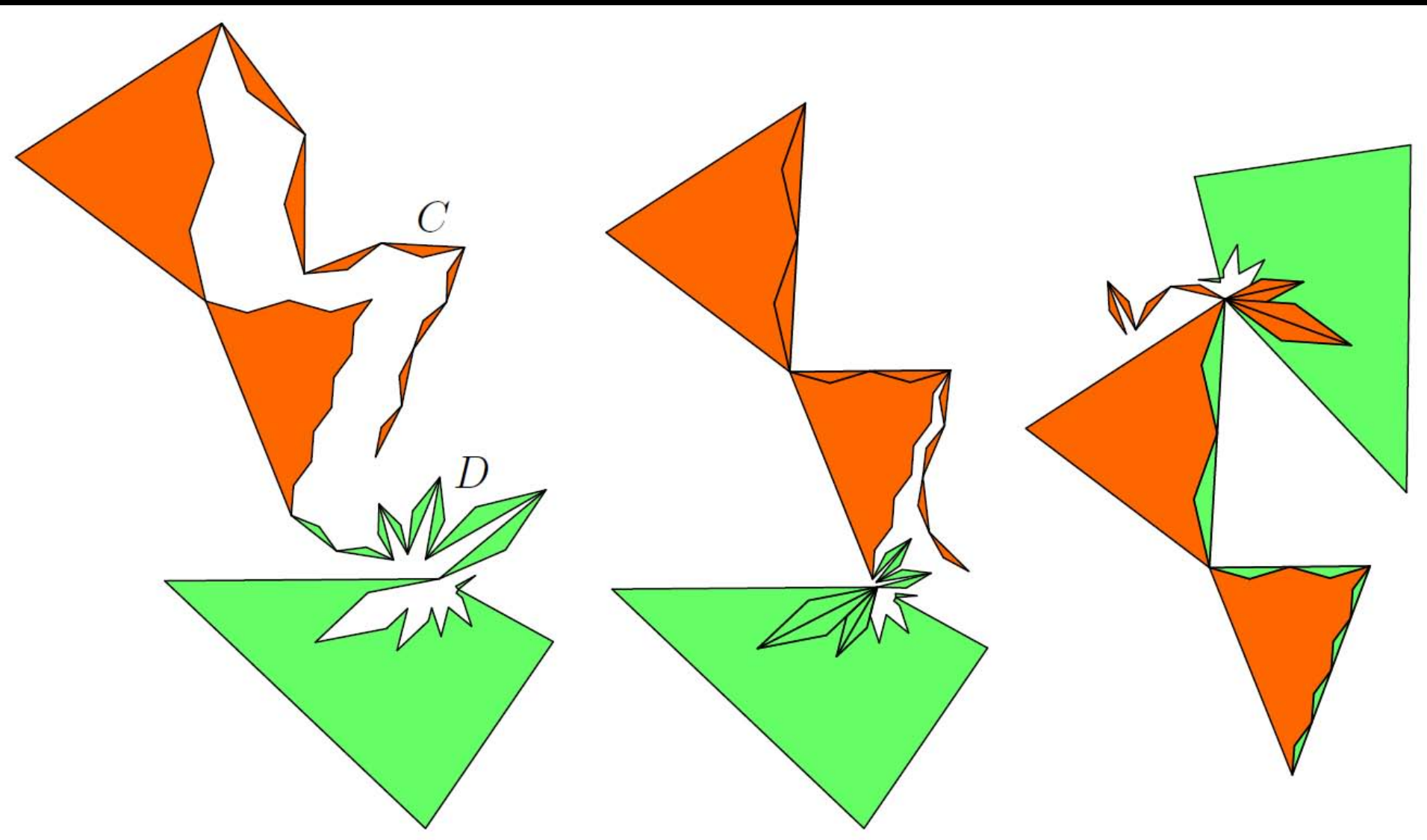
[Demaine, Eppstein, Erickson, Hart, O'Rourke 2003]

# Metamorphosis of the Cube

Demaine, Demaine, Lubiw, O'Rourke, Pashchenko 1999







Courtesy of Timothy G. Abbott, Zachary Abel, David Charlton, Erik D. Demaine, Martin L. Demaine, and Scott Duke Kominers. Used with permission.

[Abbott, Abel, Charlton, Demaine, Demaine, Kominers 2010]

# The Helium Stockpile

[Demaine, Demaine,  
Palmer 2006]



See also [http://erikdemaine.org/papers/HingedPolyforms3D\\_Leonardo/](http://erikdemaine.org/papers/HingedPolyforms3D_Leonardo/).

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6.849 Geometric Folding Algorithms: Linkages, Origami, Polyhedra  
Fall 2012

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