

# Periodic Graphics

A collaboration between C&EN and  
Andy Brunning, author of the popular  
graphics blog *Compound Interest*

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online

To see more of  
Bunning's work, go to  
compoundchem.com.  
To see all of C&EN's  
Periodic Graphics, visit  
cenm.ag/periodicgraphics.

## How do mussels stick to rocks?

PERIODIC  
GRAPHICS

Unlike many synthetic glues, adhesives produced by mussels and other marine animals can hold fast underwater. Here we look at how these organisms construct these biological glues and what makes them sticky.



### What are marine bioadhesives?

Some marine organisms, such as shellfish and barnacles, can anchor themselves firmly to hard surfaces, such as rocks and boat hulls. To do this, the organisms produce adhesives that stick even underwater.

### Examples of bioadhesives



#### Mussels

Make a glue from dissolved proteins and metal ions.



#### Oysters

Produce a cement from a mix of proteins and calcium carbonate.

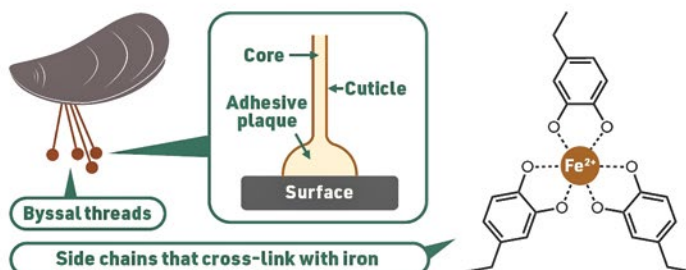


#### Limpets

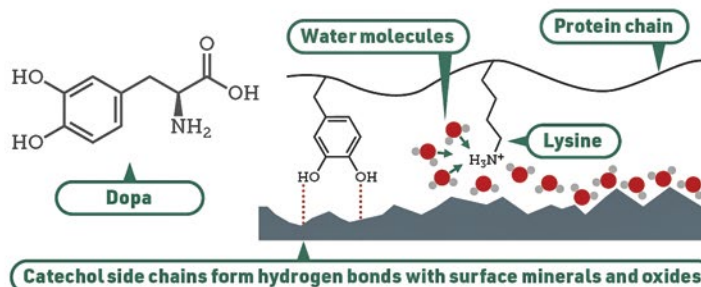
Secrete a sticky, protein-based mucus.

### How mussel bioadhesives work

Mussels create byssal threads, which have a collagen-based core and an outer cuticle formed from solidified glue proteins. These proteins harden when metal ions from seawater cross-link with amino acid side chains such as catechols.



Adhesive plaques on byssal threads stick to surfaces with the help of lysine and 3,4-dihydroxyphenylalanine (dopa) amino acids in glue proteins. Lysines displace cations bound to surface oxides and keep water from interacting with dopa's catechol side chains. The catechols can then form hydrogen bonds with minerals and oxides on surfaces.



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