

Latest News

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## Red Light, Green Light

## Researchers edge toward understanding color determination in bioluminescence

## **Rachel Pepling**



MAKING LIGHT Kato's team studied the enzyme behind Luciola cruciata's green glow.

Hiroaki Kato and colleagues at <u>Kyoto University</u> in Japan have shec some light on the molecular mechanisms behind fireflies' familiar green glow by crystallizing both wild-type and red mutant luciferases from a Japanese firefly (*Nature* **2006**, *440*, 372).

Although various forms of luciferase, the enzyme catalyst in

bioluminescence reactions, are known to emit different colors ranging from green to orange to red, the chemical mechanism behind color determination has remained a mystery.

In the bioluminescence reaction, luciferin, adenosine triphosphate, and magnesium react with molecular oxygen to produce an electronically excited oxyluciferin species. When oxyluciferin relaxes, it releases energy in the form of light. The authors suggest that the molecular rigidity of the excited state of oxyluciferin determines the color of light emitted. The color depends on the conformation of a single isoleucine side chain in the enzyme, they report.



On the basis of a structure of luciferase containing an intermediate analog, Kato's team suggests that this isoleucine rotates and closes the active site of luciferase, thereby enclosing excited oxyluciferin in a rigid pocket. When oxyluciferin relaxes in this high-energy environment, it gives off the yellow-green light of fireflies. In cases where the pocket does not form, such as in mutant luciferases lacking this isoleucine, energy is lost from the excited state and a red light is emitted instead.

Bruce R. Branchini, who studies firefly bioluminescence at Connecticut College, New London, calls the paper "very significant. By also crystallizing several mutants that emit different colors of light, the authors have made a significant step in identifying the structural features that control bioluminescence color in the firefly," he says. However, "additional research will be needed to more fully understand how firefly bioluminescence color is determined at the molecular level."

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