PRACTICAL BIOTECHNOLOGY

# Flash!
# Bacterial illumination

**PASSENGERS on board cruise liners are sometimes startled by an eerie phosphorescent glow emitted by seawater flush lavatories. The explanation lies in luminous bacteria, which require oxygen for their light-generating reactions. Luminescent bacteria are present in all marine environments and develop abundantly on the surface of decaying fish. Their presence can be a problem — most of the research on marine bioluminescence has been funded by the US Navy, embarrassed by glowing trails behind surface vessels, and more recently by bacterial interference with the laser light used for submarine communications.**

**The organism *Photobacterium phosphoreum* is well-suited to schools use, although a fresh culture must be obtained to observe bioluminescence. *Photobacterium* is able to thrive at room temperatures (20–30 °C), so does not need specialist incubation facilities. The bacterium's requirement for saline conditions means that it is unlikely to survive for long if accidentally spilt, and hence it is recommended by HMI for elementary work.**

**Students can grow *Photobacterium* to learn aseptic technique. Individual McCartney bottles of broth are a convenient means of culturing the organism, although greater volumes in a well-aerated fermenter look particularly spectacular!**

## Materials

Slope culture(s) of *Photobacterium phosphoreum*
Sterile sea water / yeast peptone broth (see recipe below)
Bunsen burners, wire inoculation loops and other basic microbiology equipment
Access to a dark room for viewing the cultures the next day

***Sea water / yeast peptone broth contains:***
3 g yeast extract and 5 g bacteriological peptone dissolved in 250 $cm^3$ of distilled water and 750 $cm^3$ of sea water (artificial sea water from one of the biological suppliers can be used).

## Practical details

For small-scale cultivation by individual students, dispense the broth in aliquots of 15 $cm^3$ into McCartney bottles and autoclave them at 121°C for 15 minutes.

Aeration is necessary for luminescence. This can be achieved by shaking the McCartney bottles — but they **must** be tightly-capped. Sufficient headspace must be left above the liquid in the bottles, of course.

Only actively-growing cultures will emit light. Maximum luminescence develops about 18 hours after inoculation.

Photographs of plates or flasks inoculated with *Photobacterium* can be taken using monochrome 125 ISO film at f2.0 for 100 seconds.

## Safety

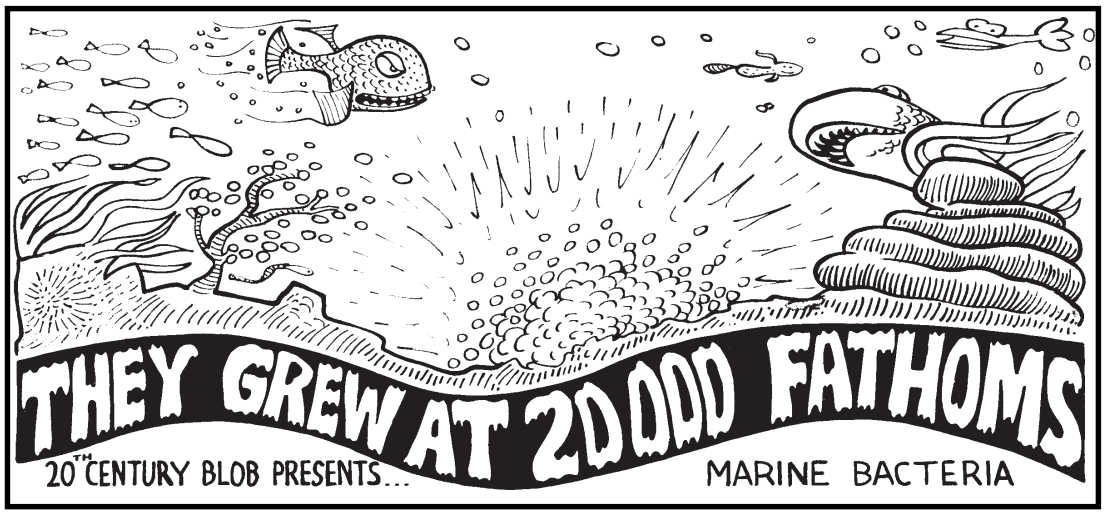
Standard microbiological safety procedures, including aseptic technique, must be observed by teachers, technicians and students when carrying out this work.

Teachers are referred to *'Microbiology. An HMI guide for schools and further education'* (1990) HMSO and *'Topics in Safety'* (Revised edtn., 1988) Association for Science Education. Education authorities and school and college governing bodies may also issue additional safety guidelines.

## Additional Information

Herring, P. (1984) 'Lights in the night sea', *New Scientist*, 23 February, pp. 45–48.

Britton, G.C. (1973) 'Bioluminescence', *School Science Review*, 56, (196) 541–545.




Cartoon by Colin Brown

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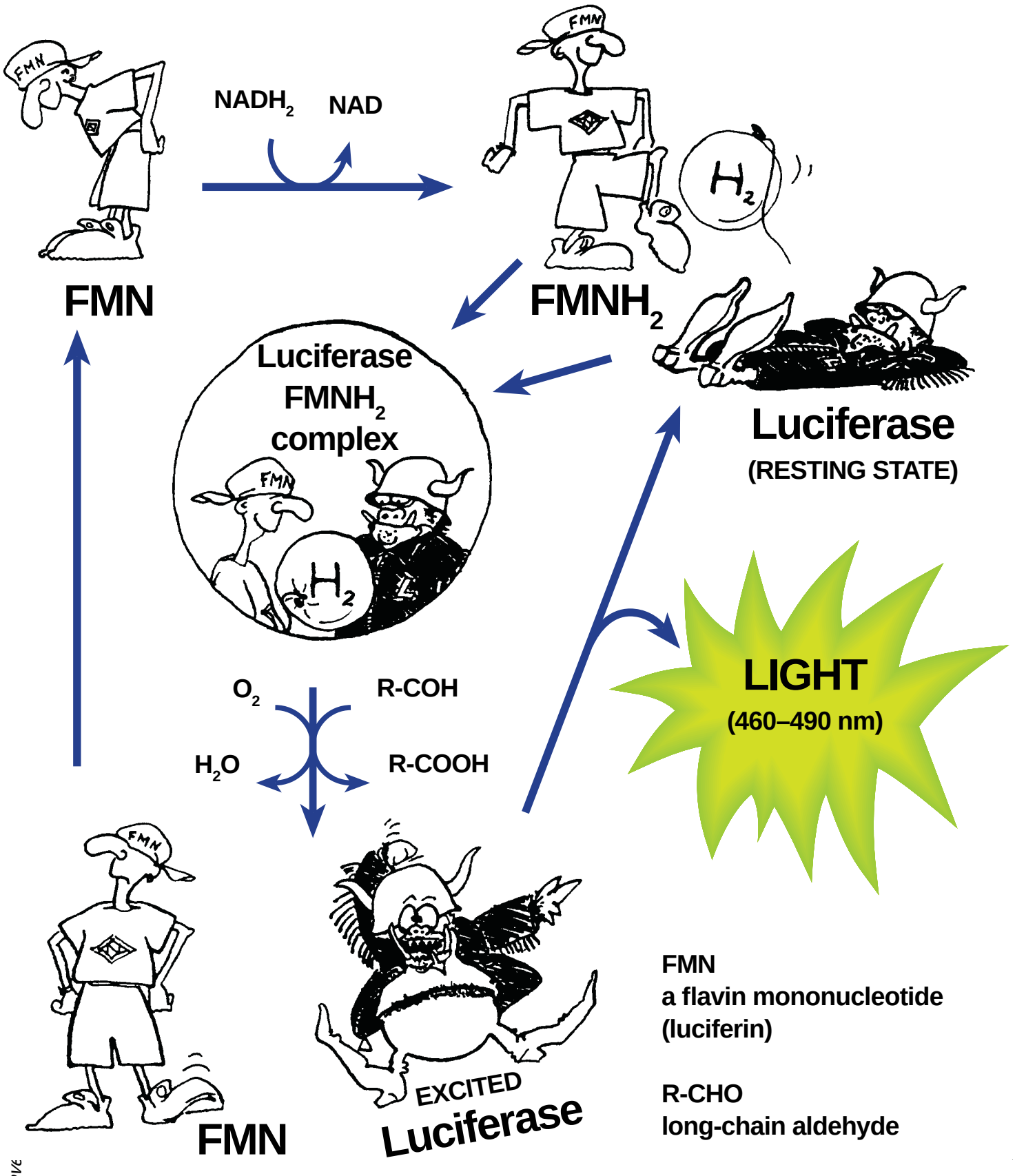


**FMN**
**a flavin mononucleotide (luciferin)**

**R-CHO**
**long-chain aldehyde**

*Cartoon by Paul Steve*

**The reactions thought to be involved in the generation of light by bacteria. These are a offshoot of the electron transport chain.**