

6. ANY QUESTIONS?

Feel free to call us and leave a question on our answering machine: (801) 585-3128. We'll contact you as soon as we can.

To learn more about bioluminescence and the Night Life creatures, look in any encyclopaedia under "Bioluminescence" or "Dinoflagellates." Also try "Fireflies," "Plankton," and "Flashlight Fish."

A good book for younger readers is Nature's Living Light, by A. and U. Silverstein, published by Little, Brown & Co.; 1988.

Plus, check back issues of *National Geographic* for articles about bioluminescence and the Night Life creatures: Nov. 1978, July 1971, July 1970, July 1962, July 1960, May 1958, Nov. 1953, and May 1951.



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LIVING SEA CREATURES

thrill you with brilliant blue

LIGHT!

After years of research, a unique
Bioluminescence Science Kit

NIGHT LIFE!™

INSTRUCTIONS

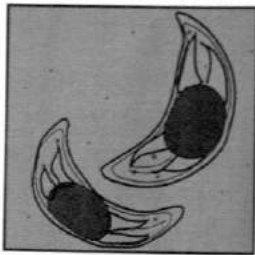
1. WHAT IS NIGHT LIFE™?

Night Life is a miniature ocean containing thousands of tiny sea creatures called "Pyrocystis lunula." The name is Latin for "little crescent-shaped fire cell." Under a microscope the creatures look like tiny crescent moons. And as for the "fire cell" part, *Pyrocystis lunula* have a special trait: at night they light up, sending off flashes of brilliant blue light! For centuries, sailors and fishermen in certain areas of the world have looked overboard at night and admired this light, which is called **bioluminescence** (living light).



Pyrocystis lunula use sunlight, carbon dioxide from the air, and minerals in their seawater environment to live and multiply. They're actually primitive plants (**algae**). Because the *lunula* give off oxygen, they help all of Earth's creatures, including us humans, to breathe.

Your *Pyrocystis lunula* algae are part of a large family of living creatures known as **Dinoflagellates**. The name has nothing to do with dinosaurs; dinoflagellates are about 100,000 times smaller than dinosaurs, and live on the surface of the ocean. In fact, you need a microscope to see the individual organisms clearly. (To simplify things, we'll call the dinoflagellates "dinos" for short.)



2. SEND IN YOUR COUPON!

The live sea creatures in Night Life need light every day; they can't be wrapped or stored. So we have to send them to you by fast mail. Send the flask-shaped coupon to us right away. You'll receive your live organisms 10-15 days later.

*Adult guidance is recommended for younger children. Night Life contains living organisms — Do not ingest or touch to eyes, skin or food. Wash hands thoroughly after contact.

3. SETTING UP*

The Night Life ocean environment is a clear flask with an orange cap on the top. The flask contains some special seawater with food the dinos need in order to grow and multiply. After you send in the coupon, you'll receive a plastic bag containing your living creatures. Then, follow these steps:

A. Carefully unscrew the plastic cap from the flask.

B. Take the plastic bag containing your living dinos and gently shake it several times. Now cut off a top corner of the bag and pour the liquid into the flask. Screw the orange cap back on and make sure it's tight.



C. Put the flask near a window where the dinos can get bright light during daylight hours or near a bright lamp that can be left on during the day.

D. Be sure Night Life's temperature stays between 50° and 75°F, or the dinos may die!

NOTE: Your dinos are a bit tired from being cooped up, so they won't shine right away. Let them rest for a day or two and then, at night, when it's really dark, shake the flask. You'll see a beautiful blue biolu-

minescent glow! If you take good care of your dinos, you'll be able to enjoy this "living light" every night.

4. CARING FOR NIGHT LIFE™

Your Night Life creatures need very little care, but they do require:

- light during the day
- darkness at night, except when you're caring for them
- moderate temperatures (10-23°C, 50-75°F)
- gentle conditions: don't shake or stimulate them too much
- air: loosen the cap at least five minutes each day to provide fresh air, the more the better



As your dinos grow and multiply, they'll use up the nutrients (food) in the seawater. Three months from the time you start them out they'll have multiplied by 10 or even 100 times! But there's only a certain amount of nutrients in the seawater, so you'll need to provide fresh nutrients every three months (see enclosed order form). Without nutrients, your dinos will be unhappy and will eventually die. Instructions on how to feed Night Life will come with the nutrients.

NOTE: Don't add water or anything else to Night Life, as it may hurt the dinos. These organisms require clean sea water that has had certain minerals added to it. If you add anything else, you will probably ruin their fragile environment, and they'll die.

5. OBSERVING NIGHT LIFE™

The time to watch your Night Life light up is at night, since the dinos eat and rest during the day. Around dinner time, put Night Life to bed by putting them in a dark place. After they've been there for two to three hours, try the following activities:

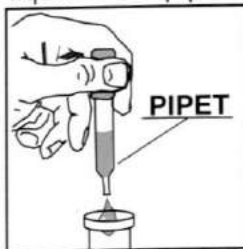
- Tap gently on the flask and they'll respond by giving off light. You'll see some points of light coming from the sides of the flask where the dinos like to attach themselves. To create patterns of light, screw the cap on tightly and lightly wave or shake the flask.

After a few minutes of this the dinos will be tired, so loosen the cap a full turn and let them rest until tomorrow.

- In the dark, take the plastic pipet and draw up some water from the flask into it. Squeeze the bulb of the pipet and keep it squeezed, then put the pipet in the flask. Now release your



grip on the bulb. As the water flows up the pipet you will see blue light produced by the dinos. Squeeze the bulb again and the liquid in the pipet will be pushed back into



the flask, sending the dinos shining back into their home. (Make sure you do put them back in the flask; they'll die if they're outside the Night Life environment too long.)

- Take the piece of blotter paper and put it in the small round plastic dish. Now take the pipet again, and (in the dark) put a few drops of Night Life on the blotter paper. Wow! As each drop hits the paper, it lights up! After you have a few drops of solution on the blotter paper, tap or shake the dish. What happens? (When you're done, throw away the paper and wash out the dish.)

NOTE: Always remember to put the cap back on the flask (loosely, so air can enter), and put the flask in the light during the day so the dinos can continue to thrive and multiply.



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DOA (dark on arrival)*

Shaking the bag of organisms in the dark during their dark cycle should increase the intensity of light emission. If not, there are several possibilities:

Concerning their light/dark cycle:

The organisms follow a circadian rhythm and only emit light during their dark phase. To allow you to view the light emitted from the dinos during daylight hours, we maintain our cultures on an alternate cycle. That is, the dinos are illuminated at night and kept in the dark during the day.

Thus, the organisms should be all charged up and ready to glow when you receive them. Shake them they will activate their bioluminescent chemicals to produce blue light.

Should your organisms be DOA (Dark on Arrival) they may have reset their biological clocks. Make sure they are in their dark phase by re-establishing their light/dark cycle. Keep them on an alternate light cycle so that they'll be ready for a flashy daytime class experiment.

Details for maintaining dinos on an alternate cycle are provided in the Everything you Wanted to Know about document section 5.

Establish a day/night cycle for 2 days. If the organisms don't emit light - even though you've agitated them until *you're* blue in the face - give us a call.

*** Use the DOA flow chart on the back of this page to determine the reason your *P. lunula* colony is dark.**

DOA (dark on arrival)

EXIT

Colony does not Luminesce or is very dim.

It is possible that the culture is not dense and will require some time to "grow out." Cell density and light intensity go hand in hand. Dense cultures will produce bright light.

Please refer to the listed sections of your "Teachers' Kit Tips" document before calling for assistance.

What is its light/dark cycle?

Sections 6 of I Saw the Light and Section 5 of Everything ...

Luminescence can only be observed during the dark cycle, and it is **brightest** during the middle of your colony's dark cycle.

How long was the package left unopened?

Sections 1 of Everything ...

The culture requires light to survive. Long-term light deprivation will not kill it, but suppresses light output.

What was the temperature in your area when you received the colony?

Section 3 of Everything ...

If below 0°C or above 30°C then the colony may have died during shipping.

Did your colony luminesce when you first received it?

Sections 5 and 6 of I Saw the Light

If you shake it in a **lit** room, you will suppress light output. **Test your colony in a dark room** after it has been in the dark for 2 hours.

Is the storage temperature appropriate?

Section 3 of Everything ...

Temperatures below 5°C and above 30°C will be detrimental to the health of your dinos

Is it receiving adequate lighting?

Section 1 of Everything ...

Optimum conditions include 12 hours of light on a regular cycle of light and dark

Section 12 and 13 of I Saw the Light

What is the color of your colony?

Should be reddish-tan. Green indicates algae contamination. Call us for a replacement.

Information on Bioluminescence

General Information:

- Joanne Barkan, Creatures That Glow, Doubleday (picture book for children), 1991.
- "Bioluminescence" Encyclopedia Britannica
- "Biological Luminescence," W.D. McElroy and H.H. Seliger, Scientific American pp. 76-89, Dec. 1962.
- "Marine Bioluminescence," K.H. Nealson and C. Arneson, Oceanus **28** (3) (1985), 13-18.
- "Bioluminescence," McGraw Hill Encyclopedia of Science and Technology. A.P. Neary and C.S.J. Walpole, "Bioluminescence - Chemical Light," Science Progress **70** (1986), 145.
- E.N. Harvey, Bioluminescence, Academic Press, 1952.
- P.J. Herring, Bioluminescence in Action, Academic Press, 1978.
- P.J. Herring, A.K. Campbell, M. Whitfield, and L. Maddock, Light and Life in the Sea, Cambridge University Press, 1990.
- "Luminescence," Chapter 13 in J.A.C. Nicol, Biology of Marine Animals, J. Wiley Publ, 1967.
- "Living Light", A.K. Campbell, Trends in Biochemical Sciences **11** (1986), 104-108.
- "Beyond the Fathoms of our Imagination," National Wildlife (1992), pp. 22-27.
- "Jellyfish do more with Less," J. and A. Rudloe, Smithsonian Magazine (1991), pp. 101-111.
- "Bioluminescence in the Sea," Naval Research Reviews **45** (1993) #2 - entire issue (write to Code OPARI, Office of Naval Research, Arlington, Virginia, 22217-5000.
- National Geographic Magazine, Nov. 1978, July 1971, July 1970, July 1962, July 1960, May 1958, Nov. 1953, and May 1951.

Video:

- David Attenborough, "Talking to Strangers," a program in The Trials of Life series: available from Ambrose Video, 1290 Avenue of the Americas, Suite 2245, New York, NY 10104. The *last 15 minutes* of this video is on bioluminescence.

More Advanced Information:

- J.W. Hastings, "Biological Diversity ... of Bioluminescent Systems," Journal of Molecular Evolution, **19** (1983), 309-321.
- P.B. Tett, "Marine Bioluminescence" Oceanography and Marine Biology Annual Review **11** (1973), 89-173.
- J.W. Hastings and J.G. Morin, "Bioluminescence," in C.L. Punser, ed., Neural and Integrative Annual Physiology, Wiley-Liss (1991), pp. 131-170.
- P.J. Herring, "...Bioluminescence of Fishes," Oceanography and Marine Biology Annual Review **20** (1982), 415-470.
- R.E. Young, "Oceanic Bioluminescence," Bulletin of Marine Science, **33** (1983), 829-845.

More Advanced Information (continued):

J.G. Morin, "Coastal Bioluminescence," Bulletin of Marine Science 33 (1983), 787-817.

N.B. Marshall, "Bioluminescence: Light from Life," chapter 10 in Developments in Deep Sea Biology, Blandford Press.

A.K. Campbell, Chemiluminescence, VCH Publ., 1988.,

Bioluminescence in Action, P.J. Herring, ed., Academic Press, 1978.

Bioluminescence in Progress, F.H. Johnson and Y. Haneda, eds., Princeton, University Press, 1966.

Fireflies:

"Bioluminescent Communication in Insects," J.E. Lloyd Annual Review of Entomology 16 (1971), 97.

(1968), "Rhythmic Synchronous Flashing of Fireflies," J. and E. Buck, Science 159 1319-1327.

"Synchronous Fireflies," J. and E. Buck, Scientific American 234 (5) (1976), 74-85.

"A Dim Future for Glow-Worms," A. Wootton, Country Life 150 (1971), 604-605.

"Like a Fiery Cloud," B. Holmes, Exploratorium Quarterly, Summer, 1991, 4-7.

National Geographic:

Vol. 118 No. 1, July 1960, "Puerto Rico's Bay of Fire," pp. 120.

Vol. 154 No. 5, Nov. 1978, "Flashlight Fish of the Red Sea," pp. 719.

Vol. 122 No. 1, July 1962, "Fireflies, Wing-Borne Lamps of the Summer Night," pp. 48.

Vol. 122 No. 1, July 1971, "The Secrets of Nature's Night Lights," pp. 45.

Vol. 138 No. 1, July 1970, "Nature's Toy Train, the Railroad Worm," pp. 56.