

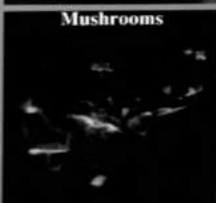
EXPERIENCE BIOLUMINESCENCE IN YOUR HOME!

Galaxsea™

Bioluminescent Plankton



Firefly



Mushrooms



Glowworm

BIOLUMINESCENCE IS LIGHT MADE BY LIVING ORGANISMS SUCH AS FIREFLIES, GLOWWORMS, AND MANY DEEP SEA FISH.

IN THE POUCH BELOW LIVE THOUSANDS OF BIOLUMINESCENT PLANKTON. WHEN SHAKEN AT NIGHT THEY PRODUCE AN INCREDIBLE BLUE LIGHT.

JUST PLACE THE POUCH IN A WELL-LIGHTED ROOM IN YOUR HOUSE. GALAXSEA™ REQUIRES NO SPECIAL CARE—ONLY LIGHT.

Contains Living Organisms That Require Light

- Place Immediately in Well-Lighted Room
- Do Not Wrap or Cover
- Keep at Room Temperature

Galaxsea™

Bioluminescent Plankton

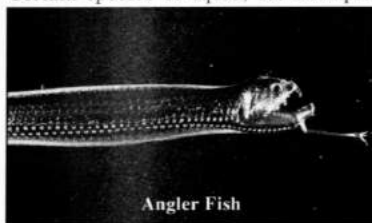
BIOLUMINESCENCE

Bioluminescence is found among many types of plants and animals: there are bioluminescent species of bacteria, plankton, fungi, jellyfish, worms, crustaceans, insects, and fish. Bioluminescence comes in different colors and intensities and is expressed in myriad ways: as flashes, as a sustained glow, as secretions. But how and why is bioluminescence produced? What is responsible for this breathtaking phenomenon?

Usually, bioluminescence occurs when two substances—luciferase and luciferin—are combined. Most bioluminescent organisms make these substances themselves and store them separately, combining them to create light. Sometimes, however, bioluminescent organisms rely on the light of others: the flashlight fish uses the light of millions of tiny bioluminescent bacteria, which it keeps in cavities underneath its eyes. Since bioluminescent bacteria glow constantly, the flashlight fish controls its bioluminescence by opening or closing lids over the cavities. Although the basic chemistry of bioluminescence is understood, we still have much to learn. There are hundreds of varieties of luciferin and luciferase and the reactions they undergo differ in subtle but important ways. When we turn our attention to why organisms produce bioluminescence, our task is no simpler.

Sometimes, bioluminescence is used by predators. Certain deep sea fishes, for example, use bioluminescence to attract their prey. The deep sea angler fish hangs

a glowing lure in front of its mouth. When a smaller fish comes to investigate, the angler fish strikes. Other times, bioluminescence is used to thwart predators. Certain species of squid, for example,



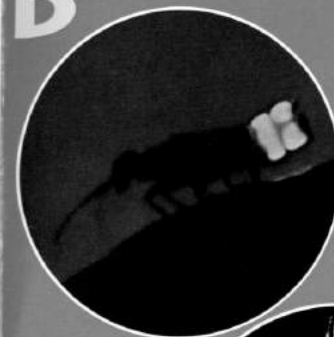
Angler Fish

secrete a glowing cloud to confuse their enemies. Certain deep sea fishes use bioluminescence to camouflage themselves. They have light-producing organs on their sides and undersides; by matching the intensity of sunlight penetrating from above, they are able to conceal their shadows from predators below them.

Many animals use bioluminescence for communication. Fireflies use bioluminescence in their mating rituals. Males and females flash back and forth in distinctive patterns to advertise their readiness to mate. In some parts of Southeastern Asia, male fireflies team up and flash together, making whole trees flash on and off. The marine mollusk *Cypridina noctiluca* also uses bioluminescence for mating. Males swim through the water and leave puffs of light behind them, forming beautiful patterns. These patterns and the flash patterns of fireflies are analogous to bird calls and, like bird calls, may provide information about the fitness of each partner as a potential mate.

As yet, we know little about the reasons organisms produce bioluminescence. Many bioluminescent organisms have yet to be studied; many have yet to be discovered.

BIOLUMINESCENCE



Firefly



Seastar

FROM FIREFLIES TO SEASTARS, BIOLUMINESCENCE IS ONE OF THE MOST BEAUTIFUL AND MYSTICAL INVENTIONS OF NATURE. GALAXSEA™ IS A POUCH OF SEAWATER IN WHICH LIVE THOUSANDS OF BIOLUMINESCENT PLANKTON—WHEN SHAKEN AT NIGHT, THEY PRODUCE AN ENCHANTING BLUE LIGHT. IN THE WILD, THIS ABILITY HELPS THEM DEFEND THEMSELVES AGAINST PREDATORS. IN YOUR HOME, IT WILL DELIGHT AND ASTOUND YOU—WHATEVER YOUR AGE—AND FILL YOU WITH ADMIRATION FOR THE BEAUTY AND DIVERSITY OF LIFE ON OUR PLANET.

These plankton, *Pyrocystis lunulae*, are easy to maintain, and with proper care, will live for four months or more in the polyethylene pouch—longer if they are transferred to another container and given nutrient supplements (details inside).

Galaxsea™ is a trademark of Protein Solutions, Inc.
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390 Wakara Way, Rm. 31
Salt Lake City, UT 84108
(801) 585-3128

ABOUT PYROCYSTIS LUNULA

The plankton contained in your plastic envelope are called *Pyrocystis lunula*. The prefix *Pyro* comes from an ancient Greek word for fire; *lunula* is a Latin word meaning "little crescent." The name is apt. *Pyrocystis lunula* lights up and is crescent-shaped. *Pyrocystis lunula* is a member of a phylum called the dinoflagellates. Dinoflagellates live almost everywhere in the ocean and make up a vital link in the ocean food chain. Different species of dinoflagellates get energy in different ways: some species get energy through photosynthesis, as plants do; some get energy by ingesting other organisms, as animals do; and some get energy in both ways. *Pyrocystis lunula* gets its energy through photosynthesis alone and therefore needs light and carbon dioxide.

The activities of *Pyrocystis lunula* are regulated by a biological clock which alters its life processes throughout the day. *Lunula* only produces light when its biological clock tells it that it is night. Therefore, *lunula* does not light up during the day, even if it is dark. You can reset your *lunula* colony's biological clock by exposing it to light at night and keeping it dark during the day.

Lunula's bioluminescence deters predators by making them visible to their enemies at night. When a predator swims through a patch of *lunulae*, it disturbs them and causes them to flash. The sudden bright light exposes the predator to its own predators. In this way, *lunula's* bioluminescence helps *lunula* defend itself.

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CARING FOR GALAXSEA™

LIGHT CONDITIONS

- *Pyrocystis lunula* requires a regular light-dark (day-night) cycle. Put your colony in a well-lighted room, but not in direct sunlight.
- The more light your plankton are given, the more they will multiply and the brighter they will glow.
- Because of their biological clock, *Pyrocystis lunula* produces light only when it is in its night cycle. If you want your colony to produce light during the day, put it on an alternate cycle by giving it light at night and keeping it dark during the day. A colony requires 4-5 days to adjust to a new cycle.

TEMPERATURE CONDITIONS

- Keep your colony at room temperature, (65-70°F). It should not be exposed to temperatures of more than 80°F.

RESPIRATION

- Your *lunula* colony requires regular gas exchange. The polyethylene envelope in which it lives permits the diffusion of essential gasses into and out of the seawater medium. No special care is necessary if the colony is kept in its original container.

AGITATION

- The more you shake your colony, the more energy it uses. If you shake your colony to the point of exhaustion it will take it a few days to reach full intensity again.

DISPOSAL

- If you want to discard your plankton, cut open the polyethylene envelope and pour them down the drain, flushing them down with water. Throw the

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empty envelope into the trash.

SAFETY

- Adult guidance is recommended for young children. Although the Galaxsea envelope is strong, be careful with it around sharp objects. If the envelope should break and the solution spill, be careful not to ingest it or get it into your eyes. Wash if any contact occurs.

EXTENDING THE LIFE OF YOUR COLONY

- The seawater medium that your *lunula* colony lives in will eventually become depleted of the mineral nutrients that the colony requires. To extend the life of your colony it is necessary to supply it with nutrients regularly (about once every four months). Nutrients can be ordered (see order form). You may also wish to order a sterile container.

MORE ON BIOLUMINESCENCE

We developed this product because we wanted to share our fascination with bioluminescence. If you would like more information about bioluminescence and our other products (including kits for teachers and kits for science fair contestants), or if you have a story about bioluminescence, please write or call.

Protein Solutions, Inc.
Science Education Innovators
390 Wakara Way, Rm. 31
Salt Lake City, UT 84108
Hotline: (801) 585-3128

We welcome your questions and suggestions.

Photos by Peter Herring, Peter Hinchcliffe, Ivan Polunin, Paul Zahl, Frieder Sauer, Animals Animals, Oxford Scientific Films, Photoresearchers and Bruce Coleman Ltd. All rights reserved.

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Galaxsea™

Bioluminescent Plankton

With periodic nutrient supplements, your Galaxsea™ *lunula* colony can live for years. Order fresh nutrients and a sterile container using the order form below.

ORDER FORM

Quant	Product	Cost/Unit	Total
	Galaxsea™	\$8.95	
	Lunula Colony™ Sterile Containers	\$2.50	
	Nutrient-Fortified Seawater Solution	\$4.00	
	Night Life™ Lunula Colony™ Science Education Kit	\$14.95	
Subtotal			
Shipping & Handling Fee			\$5.00

Utah residents please add 6 1/4% sales tax

- Please send me information on other bioluminescence-related products.
- Please send me a list of books and articles about bioluminescence.

ADDRESS

Name _____
Street _____
City _____ State _____
Zip _____ Telephone () _____

Send check or money order payable to
Protein Solutions Inc. to

Protein Solutions Inc.
Science Education Innovators
390 Wakara Way, Room 31
Salt Lake City, UT 84108
(801) 585-3128

If you have any comments or questions,
please write or call.

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.

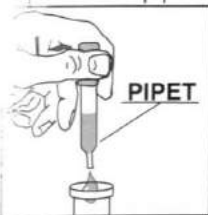
After a few minutes of this the dinos will be tired, so loosen the cap a full turn and let them rest until tomorrow.

- 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



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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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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.



Notice: Night Life, Lunula Colony, Lunula Nutrients, and Science in the Dark are all trademarks of Protein Solutions, Inc. Patents in preparation. All material in this manual and in the Night Life kit copyright ©1993 Protein Solutions Inc., 390 Wakara Way, Rm. 31, SLC, UT, 84108; (801) 585-3128.

7

LIVING SEA CREATURES

thrill you with brilliant blue

LIGHT!

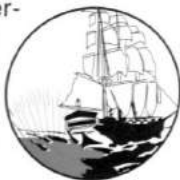
After years of research, a unique
Bioluminescence Science Kit

NIGHT LIFE!

INSTRUCTIONS

1. WHAT IS NIGHT LIFE™?

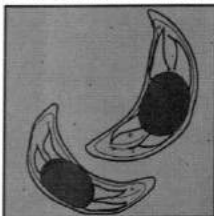
Night Life is a miniature ocean containing thousands of tiny sea creatures called "Pyrocystis lunula." The name is Latin for "little crescent-shaped fire cell." Under a microscope the creatures look like tiny crescent moons. And as for the "fire cell" part, *Pyrocystis lunula* have a special trait: at 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).



1

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.

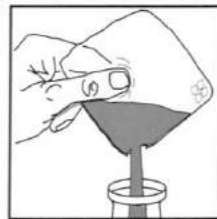
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3. SETTING UP*

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-

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

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.

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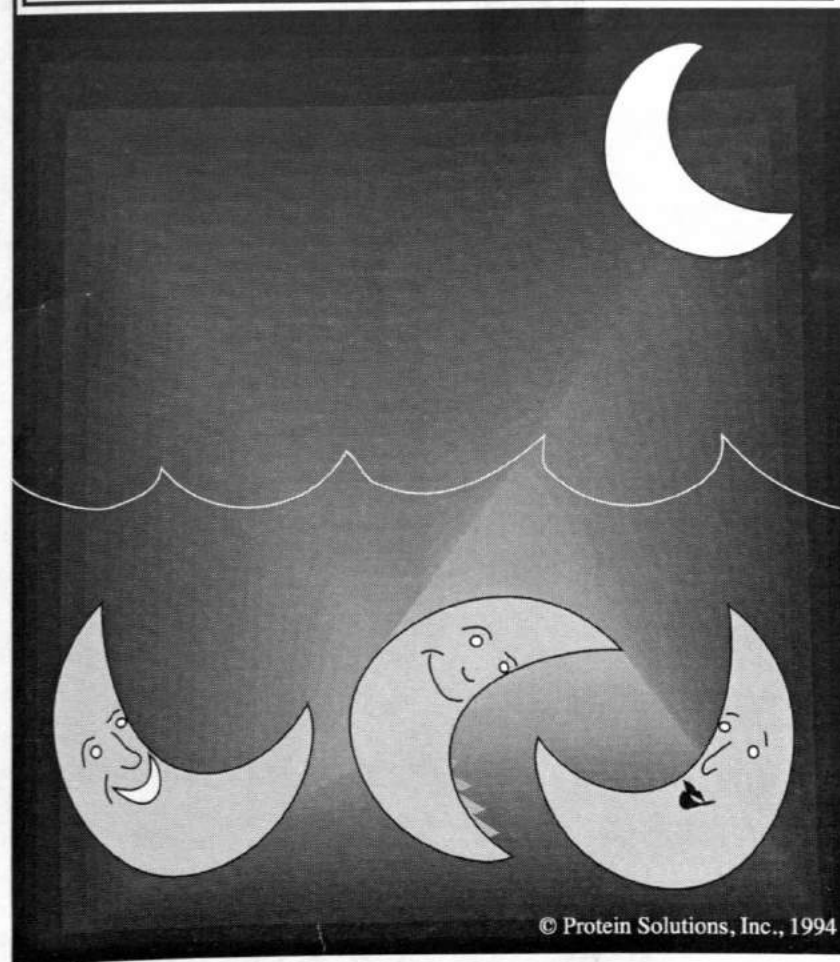


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350 West 800 North, Suite 218
Salt Lake City, Utah 84103
Phone/FAX (801) 596-2675

Protein Solutions, Inc.

Science Education Innovators

1995 Catalog

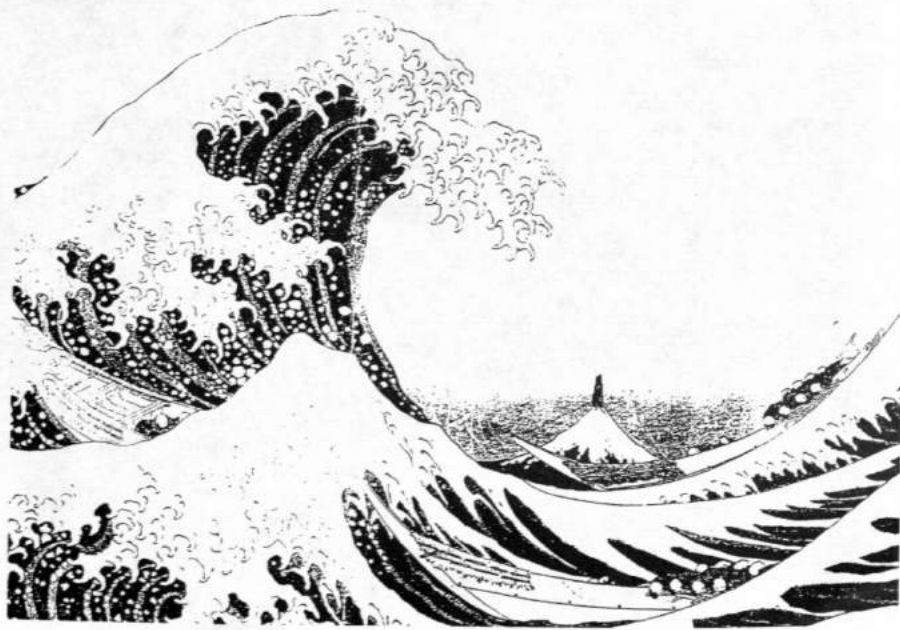


© Protein Solutions, Inc., 1994

Bioluminescence is light made by living things. The most common example is the firefly. However, there are hundreds of other living things that make light. Protein Solutions, Inc. (PSI) specializes in a tiny marine plankton called *Pyrocystis lunula*, a dinoflagellate. It is an algae, a microscopic plant that lives in temperate oceans all over the world. The light it makes is often mistaken for phosphorescence. We use these beautiful algae to bring science into the home and classroom in an affordable, easy way. Our goals are to make the different branches of science -- chemistry, physics, and biology -- work together in real life.

LIVING SEA CREATURES MAKE BEAUTIFUL BLUE LIGHT

Our bioluminescence kits may be ordered in one of two ways. If you order a kit with a *coupon*, you are required to mail the coupon back to us to receive your living Colony. If you order a kit with *Colony included*, your kit will arrive with live Colony. If you have any questions about the difference, please call 1-800-476-8564 before ordering. Thank you.



*** ORDER FORM ***

#	PRODUCT	PRICE	QTY	TOTAL
100	Night-Life [®] Kit/Coupon	\$20		
101	Night-Life [®] Kit/Live Colony	\$20		
120	Night-Life [®] Teachers/Coupon	\$50		
121	Night-Life [®] Teachers/Live Colony	\$50		
122	Additional N-L [®] Teacher Manuals	\$ 3		
123	Additional N-L [®] Student Masters	\$ 3		
130	Night-Lab [™] Kit	\$50		
140	Recycling/Culturing Kit/Live Colony	\$ 7		
141	R/C Kit without Colony	\$ 3		
150	Dancing Dinos [™]	\$ 5		
160	Biolum. Demo Kit/Live/20 bags	\$40		
161	Biolum. Demo Kit/Live/40 bags	\$60		
200	Galaxsea [®] Live Colony	\$ 7		
300	Firefly T-Shirt L or XL	\$22		
301	Seastar T-Shirt L or XL	\$22		
SUBTOTAL				
YOUR STATE SALES TAX				
SHIPPING AND HANDLING FEE				\$5
TOTAL				

SHIP TO:

NAME: _____
 ADDRESS: _____
 CITY: _____ STATE: _____ ZIP: _____
 PHONE: () _____ FAX: () _____

Make check or money order out to:

Protein Solutions, Inc.
 350 West 800 North, Suite 218
 Salt Lake City, Utah 84103-1441
 Phone/FAX (801) 596-2675.

PRODUCTS UNDER DEVELOPMENT

TECHNURIOS.TM Curious materials and devices using "intelligent" polymers. Announcement: March, 1995.

LABLESS LAB[®] in Polymer Materials is a system of unique materials and explorations developed for bringing polymers and plastics into physical and chemical science classrooms. The laboratory is completely self contained, including all materials, equipment, and information needed to directly discover and experience key concepts. Announcement: March, 1995.

FRIENDLY PHOTONSTM A Luminescence Kit. Announcement: March, 1995.

GENERAL INFORMATION

Address: Protein Solutions, Inc. (PSI)
350 West 800 North, Suite 218
Salt Lake City, Utah 84103

Phone: 1-801-596-2675 or 1-800-476-8564

Hours: Monday-Friday, 9:00-5:00 Mountain Time

FAX: 1-801-596-2675

SHIPPING INFORMATION

Once we receive your order, it leaves our lab the next Monday or Tuesday. The majority of our orders are shipped U.S. mail unless you request otherwise. Live Colony is sent by first class mail. **OVERNIGHT AND 2-DAY DELIVERY ARE AVAILABLE. PLEASE CALL FOR PRICING.**

We will accept school purchase orders by mail or FAX only. Call in purchase orders are not accepted. All school orders must have a school official's signature and title.

All claims for missing items or damaged goods must be made within 10 working days of receiving them. If returning an item, please use the original package if possible and include all paper work.

ORDERING LIVE KITS VERSUS COUPON KITS

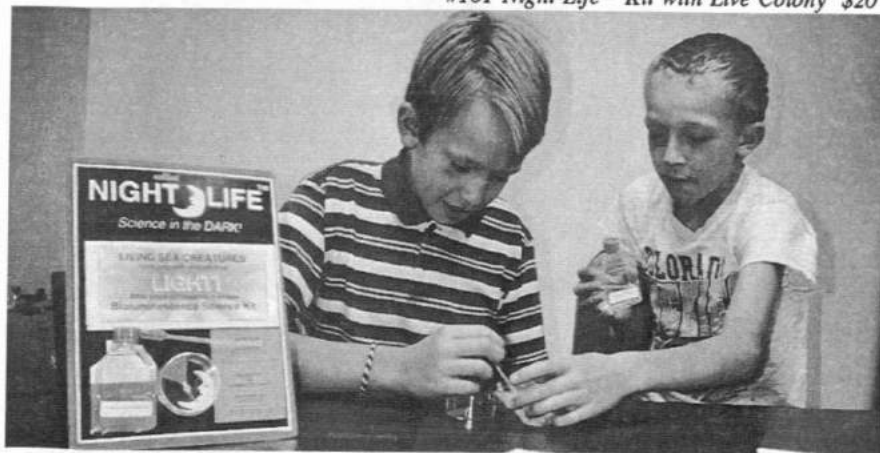
If you are ordering Live Colony, make sure you are ready to use it. All shipments containing live materials must be opened immediately upon receipt. If you are a school and your orders arrive at a warehouse, make arrangements to have your living materials handled. **WE ARE NOT RESPONSIBLE FOR LIVE SHIPMENTS THAT ARE LEFT UNATTENDED.**

NIGHT-LIFE[®]

Night-Life[®] is PSI's **Science in the Dark** educational kit. The kit contains actual lab components -- tissue culture flask with nutrients, Petri dish, pipet, blotter paper and clear, easy to follow instructions. Recommended for ages 10-16 as well as for teachers and other adults. Ideal for Science Fair projects.

#100 Night-Life[®] Kit with Coupon \$20

#101 Night-Life[®] Kit with Live Colony \$20



NIGHT-LIFE[®] **TEACHER'S KIT**, for teaching **Science in the Dark**.

Illuminate your classroom with these unique sea creatures. Spark interest and pique curiosity as you teach *biology, chemistry, physics, earth science* and *ecology* with bioluminescent phytoplankton. The Teacher's Kit contains everything you need for 10 student groups to perform several suggested explorations. Materials include professional Petri dishes, pipettes, test tubes, blotter paper, individual colonies, a teacher's manual and a master student manual. We can also make kits to order for different class sizes.

#120 Night-Life[®] Teacher's Kit with Coupon \$50

#121 Night-Life[®] Teacher's Kit with Live Colony \$50

#122 Additional Night-Life[®] Teacher's Manual \$ 3

#123 Additional Night-Life[®] Student Masters \$ 3

NIGHT LABTM **Kit**. Make your own Night Lab.

Build your own culture area. Ideal for adjusting the dinos for "daytime" luminescence. If you want, we will supply all materials; all you will need is a utility knife or scissors. If you prefer to use your own materials (available at hardware stores, write us for **FREE** instructions.

#130 Night LabTM Kit, with construction materials & instructions \$50

RECYCLE/CULTURING KIT, for growing your own lunula culture.

Grow your own bioluminescent colony using a recycled clear soda or polyethylene milk container. Kit includes everything you need: salt/nutrient packet to make your own sea water, starter colony, and instructions. All you need is a clean, clear soda bottle or a translucent polyethylene milk container to create a miniature ocean, propagate your colony, and help the environment all at the same time.



#140 Recycle/Culturing Kit with Live Colony \$ 7

#141 Recycle/Culturing Kit without Colony \$ 3

DANCING DINOS™

No pet rocks here, these are living creatures you can keep at home or in the office, and they require no feeding -- our original ocean in a bag concept. You will receive our bioluminescent phytoplankton in their own sealed ecosystem. With minimal care these dinoflagellates should luminesce for 3 - 6 months.

#150 Dancing Dinosaurs™ \$ 5

BIOLUMINESCENCE DEMONSTRATION KITS

This kit is suggested for use in demonstrations to small groups, as in science workshops, seminars, or classroom and museum presentations. The kit contains 10 or 20 Dancing Dino™ bags which can be passed out or thrown into the audience (*in the dark!*) for dramatic effect. Also included is information and references on bioluminescence in general and dinoflagellates (phytoplankton) in particular. The number of bags depends on your requirements. Call and let us help you design your scintillating presentation.

#160 Bioluminescence Demo Kit Live Colony 10 bags \$40

#161 Bioluminescence Demo Kit Live Colony 20 bags \$60



GALAXSEA®

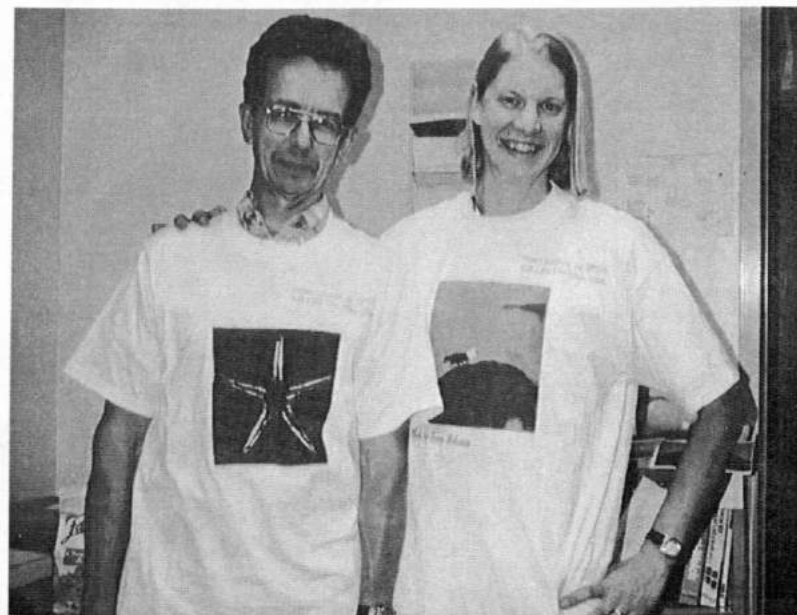
Bring home the exciting world of bioluminescence with these tiny phytoplankton in a sealed ecosystem. This living product includes a beautiful color insert with information about bioluminescence and instructions on care. This product cannot be wrapped or covered. Galaxsea® must be exposed to normal room light for 8-14 hours every day, with temperatures in the range of 50-75° F.

#200 Galaxsea® Live Colony \$ 7

BIOLUMINESCENCE: LIFE MAKING LIGHT GLOW IN THE DARK T-SHIRT (Large or Extra Large only)

#300 Firefly \$22

#301 Seastar \$22

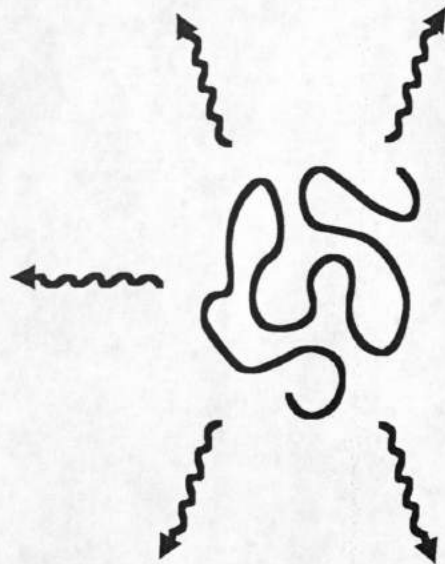




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Professor of Bioengineering
University of Utah
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Applying Nature's Molecular Machines



Protein Solutions, Inc.
Science Education Innovators

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Labs & Delivery Address:
390 Wakara Way, Room G3
University of Utah Research Park
Salt Lake City, Utah 84108

Protein Solutions, Inc. (PSI)

6009 Highland Dr.
Salt Lake City, UT 84121
801 277-1259

Background

Proteins are biological macromolecules (biopolymers) present in all living organisms. Over 5000 different proteins are present in nature, each performing special, selective tasks. The function of different proteins include:

- structural and mechanical support
- light detection (vision)
- light generation (bioluminescence)
- chemical reactions (enzyme catalysis)
- specific recognition and sensing (antibodies)
- motion (muscles)
- transport
- transduction (receptor complexes).

With the exception of antibodies used in biosensors and silk for textiles, proteins have not been used for engineering applications. Given modern technology, processes, and techniques, specific proteins are now readily available in quantities suitable for commercial engineering application.

Objectives

PSI is a small biotechnology/engineering firm developing unique engineering devices and consumer products based on protein and interface technologies. PSI's goal is to develop a family of devices for unique applications to demonstrate the feasibility and applicability of proteins as key components of engineering devices. It is expected that the technology and experience developed by PSI will serve as the foundation for new generations of engineering devices and microsystems. In addition, PSI is developing protein machines for a range of consumer products for sport, toy, and food markets. PSI expects to work with larger, more established firms with marketing expertise in these product areas.

Funding

Initial funding for PSI is provided by its founders. The company has contracted with the University of Utah for fundamental research and development studies in bioluminescence and microactuation. No additional funding is sought at this time, although a small pool of stock has been set aside for preferred investors- the stock will be available in late 1988 and in 1989. Major stockholders are the three directors and the University of Utah Research Foundation.

Personnel/Officers

Joseph Andrade, President and Director, is Professor of Bioengineering, Materials Science, and Pharmaceutics at the University of Utah. Dr. Andrade is internationally known for his work on protein adsorption, biomaterials, and immunosensors. He has prepared five books and over 100 technical papers and has twenty years of experience on proteins and bio-interfacial science and engineering.

Peter Gerity, Vice President and Director, is assistant Dean for Community and External Relations for the College of Engineering, University of Utah and is President of AMS, Inc., an international company for agribusiness products and technology. Dr. Gerity has a PhD in Histochemistry and has twenty years of experience in biotechnology and biochemical engineering.

Dr. James McRea, Director, serves as vice president of Baron Technologies, a medical device company involved in import and export between the United States and Pacific Rim nations. Dr. McRea's PhD is in Pharmaceutics. He was the founding president of Biomaterials International (now Albion Instruments) of Salt Lake City. Dr. McRea has extensive experience in small company creation and new product development.

Further Information

No further written information is available at this time.

Fame or Fortune?

Local science education company needs several biology students to develop experiments and materials for teachers, to help author professional education journal papers, and to do product marketing.

Hours: 10-20 hours/week during the summer, beginning July 1.

Pay? **Bad News** - no \$ available - this is a small, underfunded company.

Good news! - payment in stock and stock options. If company makes it - you win!

Leave a message at 585-3128 (day) or call 277-1259 (evenings) to set up an interview; mail resume to:

J. Andrade

Protein Solutions, Inc.

390 Wakara Way, Room 63

Salt Lake City, Utah 84108

* *Ut Chron 10/12 (12-13 1991)*

NIGHT-LIFE™

SCIENCE IN THE DARK

Motivate! Discover! using living bioluminescent cultures— they produce LIGHT at night!

Brilliant blue bioluminescence attracts and motivates kids to observe, experiment and learn—a terrific motivator!

Teacher/Student reactions:

"The kids just loved it—absolutely thrilled."

"This works wonders—the kids are mesmerized."

"Prettiest color blue I've ever seen."

"Tremendous possibilities in the classroom."

NIGHT-LIFE™ lives and grows with little maintenance, needing only light and air.

A UTAH PRODUCT • A UNIQUE CHRISTMAS GIFT Now available at:

Gregory's Toys & Adventures

NIGHT-LIFE™

Science in the Dark

Motivate! Discover! using living bioluminescent cultures.

Brilliant blue bioluminescence attracts & motivates kids to observe, experiment, and learn - a terrific motivator!

NIGHT-LIFE™ lives and grows with little maintenance, needing only light and air. They emit a brilliant blue light when tapped or shaken.

Introductory kits are \$19.95 + \$5 shipping = \$24.95 each

Send your check or purchase order to:

Protein Solutions, Inc. (PSI)
Science Education Innovators
390 Wakara Way, Rm. 63
Salt Lake City, Utah 84108
(801) 277-1259 (evenings)

February/March 1992

NSTA Reports

Photo
Biolum-Photo
(16)
16 December 1992
Protein Solutions
(2)

Professor J.D. Andrade
University of Utah Research Park
Salt Lake City, Utah 84108
U.S.A

Dear Dr. Andrade,

Please accept my sincere apology for the long silence. Do you remember me. I am a curator of the Yokosuka City Museum. I am studying luminous insect. I met you when you visited our museum. I read your letter from Dr. Kanie few days ago. I understood your request. Fortunately, the pictures of the firefly (maybe Genji-firefly, *Luciola cruciata*) and luminous mushroom (maybe *Mycena lux-delli*) are taken by me, so I can send it if you would like to have them. Please use my pictures for your instruction booklet for teach. I hope your work is successful and am happy to help where I am needed.

Your sincerely
With best regards

Dr. Nobuyoshi Ohba
(curator)
Nobuyoshi Ohba
Yokosuka City Museum
95 Fukadadai, Yokosuka
238 Japan

The Cleaning Machine

Another Protein Solutions, Inc. Product Concept!

Cleaning is generally an unpleasant, thankless, and often ineffective task. It usually requires scrubbing, rubbing, and uncomfortable bending and contortions. Imagine a cleaner that can be applied from a distance and will clean- all by itself- with no supervision, rubbing, or concern. It will clean in inaccessible places- in cracks and corners and hard-to-reach places. Imagine a tiny cleaning machine that will wiggle its way into the smallest crack or crevice, do its own rubbing, and do its own agitation and mixing.

PSI is developing microcleaning machines; little biodegradable particles with their own built-in biological motor and fuel, and with their own built-in detergent and other cleaners. They're applied in water by sponge, mop, brush, or spray- and then they go to work on their own! In many cases you don't even need to wash them off. Different formulations will be available for different and special cleaning jobs.

For further information, contact

Protein Solutions, Inc.
6009 Highland Drive
Salt Lake City, UT. 84121

March 31, 1985

The Cleaning Machine

Development Program

<u>TASK</u>	<u>TIME</u>	<u>COST</u>
1. Cilia/Flagella at Interfaces	12-18 months	\$50,000 (via U. of Utah)
<ul style="list-style-type: none">•Best sources of cilia and/or flagella•Attachment to surfaces- especially silica or UV degradable plastics; surface modification, immobilization, stability•Behavior of immobilized cilia/flagella- direct observation- optimal conditions- stability- lifetime		
2. Fluid Mechanics of Immobilized Cilia/Flagella	12-18 months	\$50,000 (via U. of Utah)
<ul style="list-style-type: none">•Magnitudes of motion- motion of microparticles through solution and along surfaces. Motion of fluid over a ciliated or flagellated surface. Interfacial hydrodynamics. Interfacial mixing and agitation. Lifetime/duration of activity. Solutions and chemical requirements for activity		
3. Chemical Delivery	12-18 months	\$50,000 (via U. of Utah)
<ul style="list-style-type: none">•Delivery of ATP and other fuel sources•Delivery of Detergents/Surfactant/cleaning agent without deterioration of flagella/cilia action•Directionality and gradient of delivery		
4. Cleaning Efficiency	6 months	\$25,000
<ul style="list-style-type: none">•Standard tests for other formulations•ASTM-like tests		
5. Residuals/Potential Problems		
<ul style="list-style-type: none">•Residues, biodegradation, toxicity, organism growth		

For further information, contact

Protein Solutions, Inc.
6009 Highland Drive
Salt Lake City, UT. 84121

March 31, 1988



White Eagle
TOXICOLOGY LABORATORIES

2003 LOWER STATE ROAD, DOYLESTOWN, PENNSYLVANIA 18901 • 215 348 3868 • FAX: 215 348 5081

June 18, 1992

Mr J.D. Andrade
Protein Solutions Inc
390 Wakara Way, Room 65
University Research Park
Salt Lake City UT

Dear Mr Andrade:

Enclosed is the final report of the acute study of Pyrocystis Lunula in rats.

Thank you for allowing us to perform the study for you.

Best regards,

ES
Edward Schwartz V.M.D., Ph.D.
Fellow, Academy of Toxicological Sciences
Vice President, Research

~~5 copies~~
2

WHITE EAGLE TOXICOLOGY LABORATORIES
2003 LOWER STATE ROAD
DOYLESTOWN PA 18901

ACUTE TOXICITY STUDY OF
PYROCYSTIS LUNULA IN RATS
(STUDY NO. 92332)

SPONSOR:
PROTEIN SOLUTIONS
SALT LAKE CITY, UT

STUDY INITIATION DATE: MAY 14, 1992

REPORT PREPARED:

Julie Cranney 6/18/92
JULIE CRANNEY, B.S.

REPORT APPROVED:

ES Schwartz 6/11/92
EDWARD SCHWARTZ, V.M.D., Ph.D.
STUDY DIRECTOR

WHITE EAGLE TOXICOLOGY LABORATORIES

WHITE EAGLE TOXICOLOGY
LABORATORIES

ACUTE TOXICITY STUDY OF
PYROCYSTIS LUNULA IN RATS

1. Purpose of Study:
The purpose of this study was to assess the systemic toxicity of PYROCYSTIS LUNULA when given orally to rats as a single bolus dose and observed for 2 weeks thereafter.
2. Test System:
 - 2.1 Species: RAT (*Rattus norvegicus*)
 - 2.2 Strain: Sprague-Dawley
 - 2.3 Supplier: Ace Animals, Inc
Boyertown, PA
 - 2.4 Age/Weight: males 9 weeks/ 281-293 gms;
females, 13 weeks/ 204-222 gms
 - 2.5 Number: 10 (5 Males, 5 Females)
 - 2.6 Justification For Test System:
The rat was selected on the basis of accumulated historical data and experience with this species.
 - 2.7 Justification For Route of Administration:
The oral route is the expected route of potential exposure.
 - 2.8 Acclimation: Rats were acclimated to laboratory conditions for one week prior to dosing.
3. Animal Husbandry:
 - 3.1 Housing: Rats were housed individually in hanging stainless steel cages.
 - 3.2 Environmental Conditions: Room temperature was maintained at 74± 8°F and humidity at 52± 20%. Temperature and humidity were monitored daily. The light cycle was 12 hours light and 12 hours dark.
 - 3.3 Food: Purina Certified Rodent Chow #5002 (or acceptable substitute)- was provided ad libitum except for 16 hours prior to dosing during which time the animals were fasted.

WHITE EAGLE TOXICOLOGY LABORATORIES

3.4 Water: Supplied ad libitum.

3.5 No contaminants are known to be in the diet or water that could be expected to alter the outcome of this study.

4. Animal Identification:
Each rat was uniquely identified by means of ear tag. Each animal cage was labeled to indicate study number, animal number and sex.
5. Test Article:
 - 5.1 Identity: Pyrocystis Lunula (phytoplankton culture)
 - 5.2 Storage Conditions: Ambient conditions
 - 5.3 Handling Precautions: Routine laboratory precautions
6. Study Design:
All rats were administered a single oral dose of 5 ml/kg, observed daily for two weeks and then necropsied. The dose for each animal was calculated based upon the body weight value measured just prior to dosing.

All animals were observed at least twice daily (once daily on weekends and holidays) for 14 days following dosing for changes in behavior and appearance and mortality. On the day of dosing all animals were observed for signs just prior to dosing immediately following dosing and at approximately 0.25, 0.5, 1, 3 and 5 hours after dosing.

Body weights were determined on the day of assignment, day of dosing, day 7, and just prior to necropsy (Table 1).

Fourteen days after dosing all animals were necropsied following sacrifice by exsanguination after anesthetization with thiamylal sodium.
7. Quality Assurance:
This study was conducted in compliance with the Good Laboratory Practice Regulations (21 CFR 58) and the Animal Welfare Act of 1970 for the care of animals.
8. Data and Record Retention:
All raw data generated and all records accumulated during the performance of this study will be retained at White Eagle Toxicology Laboratories archives for a period of 10 years.
9. Personnel:

Edward Schwartz - study director	
Julian Cranney	Cheryl Williams
Stanley Sekelewski	Sherrri Boone
Aleksander Zajac	Andras Koser
Lisa Wilkoski	

WHITE EAGLE TOXICOLOGY LABORATORIES

ACUTE TOXICITY STUDY PYROCYSTIS LUNULA IN RATS

TABLE 1
BODY WEIGHTS - GRAMS

AN# /SEX	DAY-1	DAY 0*	DAY 7	DAY 14
285M	311	284	359	402
286M	315	281	380	421
287M	315	287	379	413
288M	311	281	366	401
289M	320	293	379	418
290F	220	204	249	256
291F	223	205	254	276
292F	240	220	266	293
293F	225	206	240	259
294F	243	222	260	268

* Fasted body weight

10. Results:

10.1 Clinical Observations:

No rats died during the study. The only notable clinical sign was the occurrence of slightly soft or mucoid yellowish stools in two animals. This was noted for rats no. 287 (male) and 294 (female) 5 hours after dosing and then again on day 8 for no. 287 only.

10.2 Body Weights: Body weights were not affected throughout the study.

10.3 Gross Pathology:
All organs and tissues of all animals appeared normal upon gross examination at necropsy.

11. Conclusion:

Pyrocystis Lunula was well tolerated when administered orally to male and female rats as a single bolus dose of 5 ml/kg.

Under the conditions of this study, the LD₅₀ of the Pyrocystis Lunula solution is \geq 5 ml/kg.

JDA called Julie Cranney on 6/26/82:

"not related at all to dosing"

"NOT UNCOMMON TO see that in rats"

"only a soft stool"

Levitation Engineering 1

9/3/98 Ideas in Madrid

The Bird - or Land-Bird

Sort of a skate-board but large sail and wheels - with built in flywheel and solar cell or manual charging. Wear a solar jacket or cape.



COMBINATION of steering but can also handle like skate board

food able Mech pump created to activate flywheel



study - battery - solar generator radio!

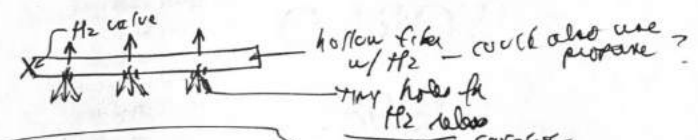
Plug to solar jacket or cape to use solar PV to recharge flywheel/battery

Note old railroad cars - crank to activate wheels - probably w/c flywheel

Also possible to use hydrogen generating storage, and combustion system for micro engines to power wheels directly and/or to activate flywheel like phytoplankton - hydrogens some curtains??
skateboard-like steering system
flywheel brake presents total Madrid of able

Old levitation idea (LEI - Levitation Energy Inc) 9/3/98 Reports Madrid, Madrid

Artificial buoyancy - levitation clothes - take load off joints - levitation fabrics/fibers
reaction - reaction law - thrust - generate gas in one direction => reaction (thrust) in other



Art idea - "buoyancy" belt
hi. P air - release slowly like balloon - recharge with hand air pump - use hand pump to compress ~~recharge~~ pants or clothes - sort of buoyancy ~~padding~~ pants or clothes - substrate for cape or crutches.
Does not work with weight - bearing balloon
Also with harness to take at of hip for test
Can adjust degree of lift - can and cartilage recovery/healing!

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YOUNG & MOYLE (1892-1934)
MOYLE & MOYLE (1934-1971)

March 29, 1990

Mr. Joseph D. Andrade
6009 Highland Dr.
Salt Lake City, UT 84121

Re: Light Ideas, Inc.

Dear Joe:

Enclosed please find an original and two copies of Articles of Incorporation of Light Ideas, Inc. Please have the documents executed before a Notary Public and return the original and one copy back to this office for filing with the State of Utah.

If you have any questions or comments, please advise.

Very truly yours,

MOYLE & DRAPER, P.C.


E. Jay Sheen

EJS/jf
Enclosures

Not submitted or executed.

ARTICLES OF INCORPORATION

LIGHT IDEAS, INC.

The undersigned, natural persons 18 years or older, acting as incorporators of a corporation under the Utah Business Corporation Act, adopt the following Articles of Incorporation.

ARTICLE I - NAME

The name of the corporation is LIGHT IDEAS, INC.

ARTICLE II - DURATION

The period of its duration is perpetual.

ARTICLE III - PURPOSES

The purposes for which the corporation is organized are: (1) to research, develop, manufacture and market bioluminescent consumer products worldwide; (2) to conduct any business relating thereto; and, (3) to transact any lawful business for which corporations may be incorporated under the Utah Business Corporation Act. In aid of its purposes, the corporation shall have power to engage in and do any lawful act concerning its business for which corporations may be organized under the Utah Business Corporation Act, including but not limited to the following:

- (a) entering into any lawful arrangement for sharing profits, a union of interests, reciprocal association or cooperative association with any legal entity or individual for the carrying on of any business;

(b) participating in any general or limited partnership for the carrying on of any business;

(c) leasing, selling, exchanging and trading real and personal property, either tangible or intangible;

(d) conducting business anywhere in the world in any form and through any type of entity; and,

(e) guaranteeing the obligations of others with or without consideration.

ARTICLE IV - STOCK

The number of shares of stock which the corporation is authorized to issue is 100,000 shares having a par value of \$.01 per share. All stock of the corporation shall be of the same class, common, and shall have the same rights and preferences. Fully paid stock of the corporation will not be liable to any call and shall be non-assessable.

ARTICLE V - PRE-EMPTIVE RIGHTS

A shareholder shall have no pre-emptive rights to acquire any stock of the corporation.

ARTICLE VI - INITIAL CAPITALIZATION

The corporation will not commence business until it has received assets with a value of at least \$1,000 for the issuance of its shares of stock.

ARTICLE VII - INITIAL OFFICE AND AGENT

The address of the corporation's initial registered office and the name of its initial registered agent are:

<u>Name of Agent</u>	<u>Address of Registered Office</u>
Joseph D. Andrade	6009 Highland Dr. Salt Lake City, UT 84121

ARTICLE VIII - DIRECTORS

The number of directors constituting the initial Board of Directors of the corporation is three. The names and addresses of persons who are to serve as directors until the first annual meeting of shareholders, and until their successors are elected and qualify, are:

<u>Names</u>	<u>Addresses</u>
Joseph D. Andrade	6009 Highland Dr. Salt Lake City, UT 84121
James C. McRea	1345 EAST EMERSON AVE 1876 East 2700 South Salt Lake City, UT 84106 84105
Peter F. Gerity	7549 So. Country Manor Rd. Salt Lake City, UT 84121

The number of directors may be changed from time to time by amendment of the By-Laws, but there shall be not more than 25 nor less than three directors.

ARTICLE IX - INDEMNIFICATION

No director of the corporation shall have any liability to the corporation or its shareholders for monetary damages for breach of fiduciary duty, except that this Article

100,000
.01 =
\$1000
OK ?
← ?

from
PSI ?

IX shall not eliminate or limit the liability of a director (a) for any breach of the director's duty of loyalty to the corporation or its shareholders, (b) for acts or omissions not in good faith or which involve intentional misconduct or a knowing violation of law, (c) for actions specified under Section 16-10-44 of the Utah Business Corporation Act, or (d) for any transaction from which the director derived an improper personal benefit.

The corporation shall, to the fullest extent permitted by the Utah Business Corporation Act, indemnify all directors, officers, employees and agents of the corporation whom it shall have the power to indemnify under the Utah Business Corporation Act against all expenses, liabilities, costs and damages as covered by the Utah Business Corporation Act. The corporation shall have the right to advance expenses to its directors, officers, employees and agents to the full extent permitted by the Utah Business Corporation Act. This right of indemnification or advancement of expenses shall continue as to a person who has ceased to be a director, officer, employee or agent of the corporation, and shall inure to the benefit of the heirs, successors and administrators of those persons. The indemnification and advancement of expenses provided by this Article IX shall not be exclusive of any other rights to which those seeking indemnification or advancement may be entitled under any By-law, agreement, vote of shareholders or of disinterested directors or otherwise. The corporation shall have the right to purchase and maintain insurance on behalf of its directors, officers, employees or agents to the full extent permitted by the Utah Business Corporation Act.

Neither the amendment or repeal of this Article IX nor the adoption of any amendment to the Articles of Incorporation inconsistent with this Article IX shall eliminate or reduce the protection afforded by this Article IX to a director or officer of the corporation as to any matter which occurred, or any cause of action, suit or claim which but for this Article would have accrued or arisen, prior to any amendment, repeal or adoption.

ARTICLE X - INCORPORATORS

The name and address of each incorporator is:

<u>Names</u>	<u>Addresses</u>
Joseph D. Andrade	6009 Highland Dr. Salt Lake City, UT 84121
James C. McRea	1345 EAST EMERSON AVE 1876 East 2700 South Salt Lake City, UT 84106 84105
Peter F. Gerity	7549 So. Country Manor Rd. Salt Lake City, UT 84121

DATED this ____ day of April, 1990.

CONFIDENTIAL- DO NOT DUPLICATE
OBJECTIVES AND BUSINESS PLAN-DRAFT

Light Ideas, Inc. (LII)
6009 Highland Drive,
Salt Lake, Utah 84121

SUMMARY/ABSTRACT:

Light Ideas, Inc.. (LII) was founded in March, 1990 to develop, produce, and market unique light-emitting materials, devices, and novelties for the toy and child education markets.

LII's light emission technology is based on natural bioluminescence processes, the same chemicals and processes used by fireflies, light-emitting algae and plankton, and other organisms. LII has acquired the rights to use the bioluminescence technology and expertise of Protein Solutions, Inc. (PSI) for application to toy and child education products. PSI has developed the means and methods to produce the raw materials required for such products in quantities and costs which permit profitable products.

LII will contract exclusively with PSI for the research and development necessary for rapid and efficient product development. LII is a wholly owned subsidiary of PSI. PSI is, of course, eager to assist in the development and growth of LII.

LII is focusing its efforts on bioluminescent solutions, inks, and paper for products in the children's toy and novelty markets. The first products are targeted for limited distribution and testing by summer, 1991.

Light Ideas, Inc... expects to enter into marketing and distribution agreements with large retail chains and with existing firms with national and international distribution skills in the various product areas.

LII is seeking capital for its initial product development activities. Initial investment has been provided by the Founders and by Protein Solutions, Inc. (PSI). LII seeks \$1,113,132 to fund the 12 month effort required for the pre-production and test marketing of its first two products: Night Buddy and Night Paper.

The Founders are Joe Andrade, Peter Gerity, and Jim McRea. Andrade and Gerity are on the faculty of the Univ. of Utah Dept. of Bioengineering. Andrade, Gerity, and McRea have experience in the launching and management of biotechnology and medical device companies

A demonstration of bioluminescence and its product potential is given on the next page:

Night Toys, Inc. (NTI)
Night-Light Products, Inc. (NLPI)
Bright Ideas, Inc. (BII)
Light Ideas, Inc. (LII)
6009 Highland Dr,
Salt Lake, Utah 84121

*Other
Names
Considered*

BIOLUMINESCENCE DEMO

The plastic packet below contains a dried powder which contains all of the biochemical components necessary for bioluminescence. To see the beautiful blue light (other colors are also available!), just moisten your finger with some tap water, then go into a very dark room, wait a few minutes with the lights off, open the plastic packet, and touch your finger to the powder. You should see a metallic blue light. Experiment! Put the glowing paste on your wall, on the counter, on your arm. Now you can imagine the product potential!

THE COMPANY;

The company is Light Ideas, Inc... (LII). The product is light - natural, colorful - without bulbs, batteries, wires, or other light sources - unencumbered, portable, simple.

A wide range of animals and certain plants have the ability to produce light. Light produced by natural organisms is called bioluminescence. It is not fluorescence. It is not phosphorescence. It does not need any external source of light or energy.

Man is a visual animal. He responds to images. Almost any thing which produces color and motion is of immediate interest - especially for children. Light fascinates - the moon, the stars, colored lights, phosphorescent objects, and the "black" light exhibits in museums.

LII can produce light on demand - for a wide variety of unique, innovative products. Our only competition is chemiluminescent light sticks, which lack the flexibility, versatility, efficiency and control available with bioluminescence. Our materials are obtained entirely from biological sources, are nontoxic, and biodegradable.

LII works closely with Protein Solutions, Inc. (PSI), which has an ongoing research and development effort on bioluminescence. PSI is using its own funds, Federal grants and contracts, and a close relationship with the University of Utah to develop a more complete understanding of practical bioluminescence. PSI is establishing production facilities to provide the raw materials needed for light emitting coatings and other products. PSI is the owner of LII, will be LII's exclusive vendor of proprietary raw materials, and will work closely with LII to develop and produce current and future bioluminescent products and devices.

LII will keep its manpower, equipment, and space needs to a minimum by contracting with PSI for all research, development, and product prototyping. LII's activities and resources will be fully focused on marketing, product engineering, and production of products for the children's markets.

THE PEOPLE:

LII will be initially staffed by PSI's experienced technical and management team.

Joe Andrade is a founder of LII and also serves as President of PSI and is its major stockholder. Joe is now Professor and Chairman of the University of Utah's Department of Bioengineering and was formerly dean of its College of Engineering (1983 - 87). He has over 20 years of experience in working with proteins, polymers, thin films, coatings, and optical devices.

Peter Gerity is a cofounder of LII and a cofounder of PSI. He serves on the Boards of both companies. Peter also serves at PSI as Vice President, Materials Production. He has had experience in the agricultural chemical and biotechnology industries, including the development, construction, and operation of facilities for biochemical production and sales.

James McRea is an experienced medical products company founder and manager. He is responsible for licensing and marketing. He is also a cofounder of both LII and PSI.

Jin-Nan Lin is a protein chemist/polymer materials scientist who will work at LII as head of biochemical engineering. He is also on the faculty of the University of Utah. Jin-Nan received his PhD under Joe Andrade's direction from the University of Utah in 1988 and has worked on proteins at interfaces for biosensor applications.

Phil Triolo is a bioengineer (Ph.D.) who received his graduate education at the University of Utah, working with Professors Sung Wan Kim and Joe Andrade. Phil has 10 years of engineering and product

development experience in the hospital products and pharmaceutical industries, including one and one-half years working together with McRea. He will be responsible for the engineering, packaging, and regulatory aspects of LII's activities.

PRODUCTS, INDUSTRY, MARKETS:

NIGHT-BUDDY, the living night light, will be LII's first product. Imagine a container with a half quart of water in the shape of a friendly animal. Now imagine that the liquid in this "animal" bioluminesces -- glows brightly -- at night, producing a warm, friendly face and glow for a child's bedroom or bathroom. NIGHT-BUDDY is a personal, living friend and companion. The glowing solution is a stable culture of small, almost invisible, microorganisms which bioluminesce at night (conveniently, they don't even try to light up by day!). The culture would be reconstituted periodically -- or it could be disposed and replaced by a new, bright NIGHT-BUDDY. Just add water, cap, and enjoy.

LII may also develop BUDDY "accessories". BUDDY could be a doll with clothes and other peripherals.

The research and development necessary for the rapid, cost effective development on NIGHT BUDDY will be done by exclusive contract with PSI.

BUDDY will be marketed as a night light substitute and as a pet substitute. Market surveys will be conducted of the night light, pet rocks, and small pet markets.

The products are so unique that there is no equivalent competition. The products should be displayed and marketed so as to take full advantage of their unique bioluminescent properties. Imagine a group of kids crowding around to see a NIGHT-BUDDY display!

NIGHT PAPER and NIGHT PADS will be LII's next set of products -- visualize a child in the darkness of his or her room (illuminated only by the presence and warm glow of her NIGHT-BUDDY!) -- the child is finger painting-- she wets her finger or brush with NIGHT-PAINT (an especially formulated and proprietary water-based solution), touches it to the paper, and a blue light appears as her brush or finger draws or writes across the page. The light persists for several minutes to as long as 20 minutes (depending on LII's proprietary paper formulation and also depending on the humidity). The light will reappear with another brush stroke. NIGHT-PAPER and NIGHT-PAINT for night artists.

Think of what you could do with a bored, restless kid in a dark restaurant or concert hall!

NIGHT-PADS will incorporate the biochemicals required for bioluminescence right in the paper, using appropriate additives and stabilizers. The paper would be activated by our NIGHT-PAINT.

One can consider many variations on this theme.

LII's exclusive contract with PSI will include the research and development work necessary for NIGHT PADS, NIGHT PAPER, AND NIGHT PAINT products.

The Market? -- Although it is hard to accurately project the full market, because the product is so unique, it should do well in the following established market segments: water colors, finger paints, paint by water books, Magic Slates, Etch-A-Sketch, Glo Slates, etc. Preliminary market surveys and projections are underway.

FUTURE PRODUCTS?

LII will develop additional products for the children's markets. PSI will continue its exclusive contract to develop and improve bioluminescence in response to LII's needs and input, for example, different colors, greater brightness, longer life, on and off capabilities, etc.

PRODUCT DEVELOPMENT:

LII has been established to capitalize on the children's market utilizing the bioluminescence technology of Protein Solutions, Inc.(PSI). LII will keep its manpower, equipment, and space needs to a minimum by its exclusive contracts with PSI for all research, development, and product prototyping. LII's activities and resources will be fully focused on marketing, product engineering, and production.

CAPITAL NEEDS -- FIRST 12 MONTHS:

Labor (Salaries and Benefits)		
Marketing Manager	25%	\$30,000
Office Manager	100%	\$40,000
Lab Supervisor	25%	\$15,000
Engineer	50%	\$40,000
Total Labor		\$125,000

Space: 2500 sq ft at \$15/sq ft/yr \$37,500

Equipment	
Office (word processor, copier, etc.)	\$25,000
Engineering and production	\$40,000
Travel	\$10,000
Supplies	
Office	\$15,000
Lab	\$20,000
Engineering	\$30,000
Outside Services	
Patent	\$15,000
Market Research	\$25,000
Engineering	\$40,000
R and D contract with PSI	\$731,132
Total Capital Needs	\$1,113,632

MANAGEMENT, OWNERSHIP, INCENTIVES:

Stockholders: LII is currently a wholly owned subsidiary of PSI.
Investors: Investment capital is now being sought. It is expected that major investors will acquire a significant equity position in LII.

Officers: LII's initial officers are the same as that of PSI.
Stock Incentives: Stock has been set aside for key individuals involved in the start up and development of LII.

INITIAL BOARD OF DIRECTORS AND OFFICERS:

J. Andrade
P. Gerity
J. McRea

jda:4/10/90



Light Ideas, Inc

2

August 16, 1990

Dr. J.W. Hastings
Harvard University
Department of Cellular and
Developmental Biology
16 Divinity Avenue
Cambridge, MA 02138

Dear Woody:

Thank you for arranging for me to stop by your lab on Friday, August 10th to pick up some gonyaulax polyedra. I met Dr. Till Roenneberg who gave me some useful advice about the culture of gonyaulax, and shared with me your video tape on the daytime swarming behavior of these organisms.

When I visited you in april we discussed briefly a science communications course which I was then teaching, and you indicated an interest in seeing the materials for that course. I apologize for having been so delinquent in getting those to you. They are enclosed.

Four of the students in that course continued with it during this current summer quarter, and we have outlined a book dealing with the topic of effective technical communication to disinterested audiences.

I am in the process of forming a small company, possibly to be called Light Ideas, Inc., whose objective would be to utilize bioluminescence as a science learning and teaching tool. As we discussed briefly in April, the major objective would be to provide appropriately packaged and engineered cultures of non toxic bioluminescent organisms which students could easily observe and learn various principles of biology, biochemistry, and biophysics.

The product ideas and the teaching materials associated with them are still in the very early stages. A business plan is presently being formulated; the current draft is enclosed. Your comments and critique would be very helpful to us.


Department of Bioengineering
2480 Merrill Engineering Building
Salt Lake City, Utah 84112
(801) 581-8528
FAX: 801-581-8692

I hope that you would agree to be a member of our Scientific Advisory Board, and to generally provide advice and consultation as appropriate. We would want to provide stock in the corporation as a compensation for your assistance.

I am afraid I have no details or specifics at this time, but I expect the project to develop over the next several months and could provide additional details at that time.

Thank you very much for your assistance and interest. I look forward to continuing our discussions.

Sincerely,


J.D. Andrade, Ph.D.
Professor and Chair

mm/16a3

cc: J. McRea
P. Gerity

encls:

Nite-Glow

Nite-Glow is an especially formulated, biotechnological product for distribution to anglers, fishermen, and other sportsmen. It may also be applicable for biologists, zoologists, animal ecologists, and related professionals. It is also applicable as a toy or novelty for entertainment in the dark.

The product applies bioluminescence, the phenomenon of light emission from glow-worms, fireflies, and marine organisms. The biochemicals responsible for bioluminescence have been purified, modified, and especially formulated to enhance light characteristics. The product provides a long-lasting, pleasant, uniform glow which is useful in the attraction of fish, insects, and other organisms for collection, hunting, and scientific purposes.

Nite-Glow is formulated as a 2-part coating. Part A is a spray aerosol, applied first to the application and allowed to dry. Part B is then "painted" onto the object or surface previously sprayed, and also allowed to dry. The coating can be stored in the dry state. Exposure to water or a very humid atmosphere activates the coating and results in light emission, which will last for 30 to 60 minutes, depending on thickness, humidity, temperature, and other factors. The coating can then be washed off with water, leaving the original surface unmodified and undamaged. The coating process may be repeated if desired.

Although Nite-Glow is non toxic and biodegradable, it must not be taken internally or exposed to the mouth, nostrils, eyes, skin, etc.

Recommended applications include:

Fishing Lures: Coating your favorite lure with Nite-Glow can be expected to enhance your catch, particularly for night fishing or for fishing in murky or dark waters. The coating should be reapplied after 30 to 60 minutes in the water.

Insect Attractant: Many insects are attracted to light. Nite-Glow may be helpful for collectors and exterminators to concentrate and collect insects. Best results can be expected at night in the absence of competing electric light sources.

Bird Attractant: Some birds feed on fireflies and glowworms, and are generally attracted to light. Nite-Glow can be incorporated into bird traps or other collection devices to aid in the collection and study of birds.

Skin-Glow/Radiance: You can be truly radiant- so radiant that you glow in the dark! Skin-Glow is a cosmetic which produces its own radiance- its own light. It's appreciated best in very dark situations. Don't use it in sensitive areas- we recommend it on cheeks, forehead, arms, legs, and ear lobes. Enjoy!

Nite-Draw: A companion product especially formulated for paper. You can coat your own paper or purchase precoated Nite-Paper. You then write or draw on Nite-Paper with a water pen. The water "ink" contains one of the biochemicals required for light production. One can imagine a new generation of games for the dark- and entertainment for children and adults who can't sleep! A great way to doodle in a dull concert or movie!! Expect a multi-color version soon.

Other Nite-Glow products and enhanced formulations are under development.

For further information, contact

Protein Solutions, Inc.
6009 Highland Drive
Salt Lake City, UT. 84121

The Cleaning Machine

Another Protein Solutions, Inc. Product Concept!

Cleaning is generally an unpleasant, thankless, and often ineffective task. It usually requires scrubbing, rubbing, and uncomfortable bending and contortions. Imagine a cleaner that can be applied from a distance and will clean- all by itself- with no supervision, rubbing, or concern. It will clean in inaccessible places- in cracks and corners and hard-to-reach places. Imagine a tiny cleaning machine that will wiggle its way into the smallest crack or crevice, do its own rubbing, and do its own agitation and mixing.

PSI is developing microcleaning machines; little biodegradable particles with their own built-in biological motor and fuel, and with their own built-in detergent and other cleaners. They're applied in water by sponge, mop, brush, or spray- and then they go to work on their own! In many cases you don't even need to wash them off. Different formulations will be available for different and special cleaning jobs.

For further information, contact

Protein Solutions, Inc.
6009 Highland Drive
Salt Lake City, UT. 84121

March 31, 1988

The Cleaning Machine

Development Program

<u>TASK</u>	<u>TIME</u>	<u>COST</u>
1. Cilia/Flagella at Interfaces	12-18 months	\$50,000 (via U. of Utah)
<ul style="list-style-type: none">•Best sources of cilia and/or flagella•Attachment to surfaces- especially silica or UV degradable plastics; surface modification, immobilization, stability•Behavior of immobilized cilia/flagella- direct observation- optimal conditions- stability- lifetime		
2. Fluid Mechanics of Immobilized Cilia/Flagella	12-18 months	\$50,000 (via U. of Utah)
<ul style="list-style-type: none">•Magnitudes of motion- motion of microparticles through solution and along surfaces. Motion of fluid over a ciliated or flagellated surface. Interfacial hydrodynamics. Interfacial mixing and agitation. Lifetime/duration of activity. Solutions and chemical requirements for activity		
3. Chemical Delivery	12-18 months	\$50,000 (via U. of Utah)
<ul style="list-style-type: none">•Delivery of ATP and other fuel sources•Delivery of Detergents/Surfactant/cleaning agent without deterioration of flagella/cilia action•Directionality and gradient of delivery		
4. Cleaning Efficiency	6 months	\$25,000
<ul style="list-style-type: none">•Standard tests for other formulations•ASTM-like tests		
5. Residuals/Potential Problems		
<ul style="list-style-type: none">•Residues, biodegradation, toxicity, organism growth		

For further information, contact

Protein Solutions, Inc.
6009 Highland Drive
Salt Lake City, UT. 84121

March 31, 1988

CONTRACT R AND D PROPOSAL

From: PROTEIN SOLUTIONS, INC. (PSI)

P.I. J.D. ANDRADE

Co-PIs P. GERITY, J-N LIN, P. TRIOLO

To LIGHT IDEAS, INC (LII)

Title Research, Development, Engineering, and Pre-Production for NIGHT-BUDDY, NIGHT-PADS, and NIGHT-PAPER Products

Duration 12 Months

Topics/Investigators

Culture Optimization/Collection:	Gerity
Stability and Reconstitution	Lin
Safety and Toxicity	Triolo
Paper and "Paint"	Lin
Device Design and Engineering	Triolo
Testing and Quality Control	Triolo
Licensing and Marketing	McRea

PROPOSAL

PSI will survey, acquire, collect, and culture dinoflagellates and small crustaceans (such as Cypridina). Culture and growth conditions will be optimized.

Cultures will be harvested at different times and under different conditions. Their light activity, duration, and stability will be evaluated. The collected organisms will be dried (freeze-dried, if necessary), and used as a powder. The dry powders will be reconstituted and the light activity and duration will be evaluated. Various additives, stabilizers, and enhancers will be evaluated. An optimal dry powder formulation will be selected and used for the PAPER and PAINT studies. A wide range of papers will be evaluated.

The various cultures will be examined and analyzed for the presence of other organisms and chemical products. Safety and toxicity assessments will be performed. The inactivation of the cultures in normal public waste water will be evaluated.

Engineering design of several BUDDY containers will be done, including a study of designs which maximize BUDDY's brightness. The production feasibility of these designs will be evaluated. This work will be closely coordinated with LII's market assessments and product needs.

As the work progresses, PSI will work closely to train LII personnel and to generally optimize the transfer of technology needed to develop successful products.

Monthly progress reports will be submitted. Quarterly progress reports and "milestones" will be reported.

Budget	
Salaries and Benefits	183,610
Travel	14,500
Equipment	115,000
Supplies	90,000
Services	40,000
Total Direct Costs	443,110
Indirect Costs (65% of Direct Costs)	288,021
Total Costs	731,132

Budget Justification

Personnel: Andrade will be responsible for the overall direction and supervision of the project. Other professional personnel tasks and responsibilities are listed on the cover page.

Travel: Gerity, Lin, Andrade, and the biology technician will travel to key labs involved in the growth of bioluminescent organisms. Trips to national and international bioluminescence conferences are also expected.

Equipment: Necessary lab and engineering equipment items include:

photometer/spectrometer
vacuum drier/lyophilizer
refrigerators and freezers

computer/CAD work station
Lab balances, pH meters
Temperature baths and monitors
Water analysis /ion meters/conductivity
Water purification

Supplies: The following general categories are needed:

Culture media/filters/chemicals
Biochemicals
Purification columns and monitors
Glassware/plasticware
Electronic parts/hardware
Office supplies

Services: External services to be provided include:

Chemical analysis and testing
Toxicity and safety testing
Culture and organism acquisition
Literature searches and surveys
Materials analyses
Equipment maintenance

Indirect Costs: The 65% indirect cost rate will provide for adequate research space, administrative services, office services and management, general corporate management, existing library and reference sources, consultants and special advisors, and public relations.

CONFIDENTIAL

SPIN OFF COMPANIES
Protein Solutions, Inc., (PSI)
6009 Highland Drive
Salt Lake City, Utah 84112

Future PSI technologies and spin off companies.

Figure A illustrates PSI's plan for the long range development of protein-based technologies directed to larger and larger consumer product markets. A brief description of each of the possible spin off companies mentioned in Figure A is given below:

Light Ideas Inc. (LII): LII should be formed within the next three to nine months to manufacture and market bioluminescence based products for the education and children's markets. These have been described in detail in the PSI Business Plan. LII may wish to expand its product line to include applications of bioluminescence in the sports, adult, novelty, and emergency lighting markets, although it is likely that these more specialized markets would be more appropriately addressed by separate, focused corporate entities, owned in whole or in part by LII and PSI.

Radiance Coatings Inc.: After the bioluminescence technologies have been developed and refined, application to cosmetics and skin care products will be developed. PSI may work with another corporate partner in this endeavor, or may attempt to form a separate spin off, possibly to be called Radiance Coatings or Radiance Cosmetics. The development of cosmetics requires a considerable amount of testing and regulatory approvals and may be somewhat expensive. LII will develop Night Paint products using the "dry technology" described briefly in the PSI business plan. The extension to cosmetics should be straightforward and is likely to be very successful.

Protein Sensors, Inc.: PSI's founders have considerable experience in the application of proteins as sensing devices, primarily for the measurement of biochemicals for medical diagnostics applications. The unique ability of certain proteins to bind specifically and sensitively a variety of chemicals enables them to be used as highly specific chemical sensors. Although this is a wide and developing area in the medical diagnostics market, PSI's approach to these opportunities would be through the consumer products route. It is highly likely that PSI would be able to discover and develop specific proteins for specific heavy metals, for example, which could be used as sensors for metals in drinking water and for food contamination, such as due to lead glazes on imported ceramics. There is considerable interest in the development of protein-based sensors for monitoring of toxic chemicals in waste waters. PSI's bioluminescence technologies are also directly applicable to the sensing of chemical changes in drinking and waste waters. Although these markets are developing very rapidly, PSI will have unique technologies available with which to address some of those market opportunities.

Protein Actuators, Inc.: From its founding, PSI has been interested and involved in the micromotion processes displayed by certain proteins, particularly the actin-myosin system responsible for

motion of muscles and the dynein kinesin system responsible for much of the other motion in biology.

PSI has also had a strong interest in the application of flagella, the whip-like appendages on many cells which enable them to move. These flagella are energized by simple biochemicals and through protein conformational changes, produce micromotion. By organizing and arranging these proteins in appropriate geometries and by coupling their motions in series and in parallel, biology manages to obtain motions ranging from angstroms to feet. The harnessing of these motions, the ability to duplicate such processes in and on various consumer products, would literally revolutionize a number of major industries. One simple possibility is to utilize flagella or flagella-like structures in foods or in wash detergents to produce self-agitating, self-mixing properties. One could imagine washing clothes, for example, without washing machines or agitators. One can imagine no longer having to stir your coffee or your tea. The opportunities in the food and cleaning industries would be enormous.

It is also interesting that the first organisms which PSI has chosen to apply for its bioluminescence activity are dinoflagellates, the plankton algae which contain two flagella. It is clear that PSI will be studying the flagellar aspects of these organisms with a long range view of understanding flagella in order to apply them to protein-based actuation and mixing products.

Protein Devices: PSI's founders already have activity in the application of proteins as electrical and optical devices. In fact, one can think of PSI's bioluminescence activities as the application of proteins as photon generation systems, i.e. as light sources. They have also done work on the electrochemical properties of proteins, including electron transfer processes of proteins at electrode surfaces. This ties directly with the previous company description, Bioenergy Systems, because the electron transfer processes in proteins are basic and integral to the process of photosynthesis.

Bioenergy Systems: Energy is an enormous industry. There is considerable interest and growing need to develop energy systems and energy transduction mechanisms which would greatly reduce the need for conventional electricity generation, the burning of fossil fuels, or the construction of additional nuclear power plants.

The ultimate energy source has always been solar, but solar has found it difficult to compete economically with the more popular and readily available sources of energy. PSI's bioluminescence products are based on the algae which exist on the surface of the sea, the marine plankton, and particularly the subset of that group known as the dinoflagellates. These are among the simplest organisms known. They are protozoa, single celled organisms, and they have the ability to convert sunlight through the process of photosynthesis into materials and energy. The dinoflagellates, in addition to being PSI's bioluminescent organisms, and being the initial source of its work dealing with flagella, will also be the source of its early work and experience dealing with photosynthesis and bioenergy conversion.

It is important to point out that bioluminescence is often considered to be the inverse of photosynthesis. In bioluminescence one

uses chemical energy to produce light; in photosynthesis one uses light energy to produce chemicals in which most of the energy is stored in chemical bonds. The stored chemical energy can then be tapped or released as needed by the organism. Thus PSI's experience with bioluminescence will directly apply to its long range interests in photosynthesis and bioenergy conversion.

The expectation is that with the rapidly growing understanding of basic bioenergetic processes, and particularly of photosynthesis, PSI will be able to harness and to apply various components of the photosynthetic apparatus used by plankton .

Summary:

As PSI begins to understand and obtain experience with these processes, it is likely that they will conceive of other inventions and products with very large market potentials.

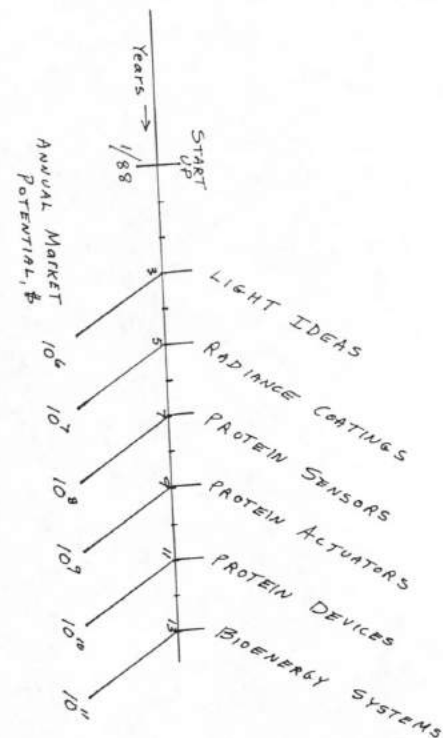
These very brief descriptions clearly indicate the coupled nature of PSI's short and long range activities. Although at any one time PSI will be focused on a very specific product-oriented technology, it is clear that each of these technologies is coupled to other technologies in a way which will lead to a growing and deeper technological basis, which will allow PSI to develop and grow into larger and larger market areas. The integrated interdisciplinary science approach which PSI is taking towards its very first product, bioluminescence for educational purposes, also characterizes its operating philosophy and long range goals. PSI's unique breadth and vision, coupled with its ability to focus on specific technologies and products, provides a very special corporate culture which will be very difficult to match or to copy.

Further Information:

Contact: J.D. Andrade
6009 Highland Drive
Salt Lake City, Utah 84121

Telephone 801-581-4379 (University office)
801-277-1259 (home, evenings)

6/6/90



PSI Companies

Cleaning Machines, Inc. (CMI)

Sportsmen Concepts, Inc. (SCI)

Skin Concepts, Inc. (SKI)

Night Entertainment, Inc. (NEI)

SOLUTIONS, INC
(PSI)

