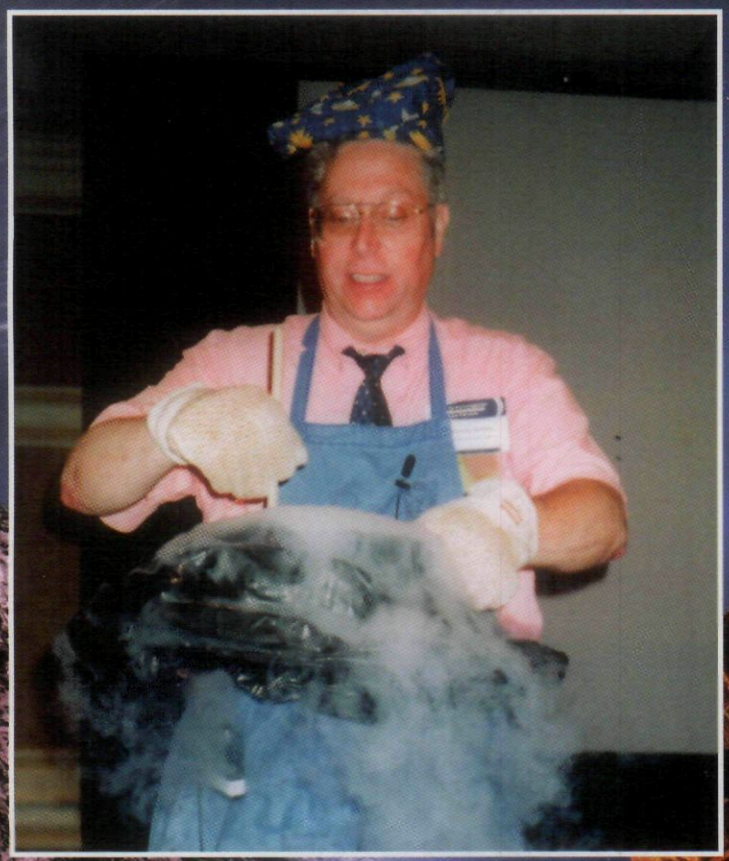

MAKING MO

DEL COMETS

HAS IT REALLY BEEN 20 YEARS?



For more than two decades students and teachers have used a popular recipe to create comets in their classrooms.

by Dennis Schatz

An artist's concept of the Deep Impact spacecraft's July 2005 encounter with Comet Tempel 1 provides a glimpse of the craft and Comet before impact. Illustration courtesy of NASA/JPL/UMD. Inset: The author mixes together a comet's ingredients.

There were five of them, all nicely lined up on the edge of the workbench in our garage. Colin and I had labored the past hour, trying to find the perfect combination of water, dry ice, and dirt, so that our model comet would look like a dirty snowball—the classic description for a comet. Was it better to use hot water, cold water, or ice cubes mixed in water? Should the dry ice be crushed or in little chunks? These were the major scientific questions we pursued.

It was 1985, and the world was getting ready for the return of Halley's Comet. As a museum educator and father, I was excited: not because the view of the comet was going to be spectacular like in 1910, but because my two sons (Colin aged ten and Evan aged seven) could be among the lucky few to see it twice. Colin was happy just to be mixing water, dry ice, and dirt together to see what we got.

The results of the experiment were clear. Equal amounts of cold water and crushed dry ice worked the best. Add a couple of scoops of dirt, plus a smidgen of ammonia and corn syrup, and you have the closest thing to an astronomical object that you can create on Earth.

Shopping for Ingredients

Little did I know from this inauspicious beginning that *Make a Comet* would become one of the most popular and replicated astronomy demonstrations in the country. I have to admit the inspiration for making a comet was not mine. Credit goes to a suggestion in a *Sky & Telescope* article that included using a gallon of motor oil as the organic material in the model comet.

"My son Colin and I labored to find the perfect combination of water, dry ice, and dirt for our model comet."

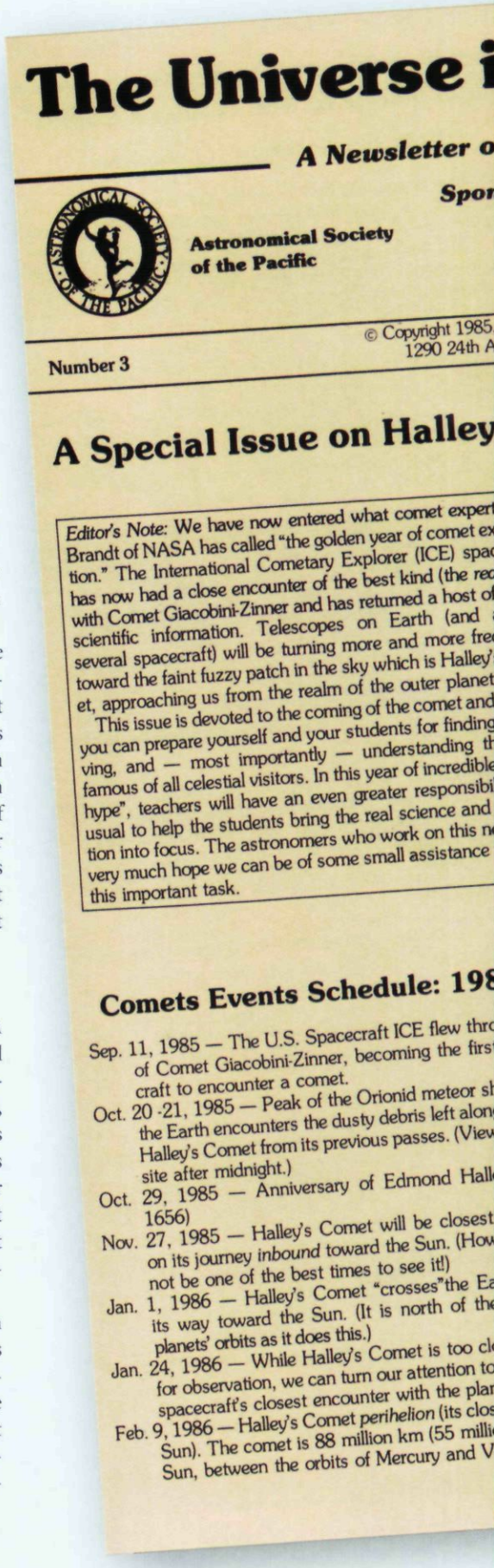
I quickly concluded that the author probably never made a comet using this material and really did not mean for anyone to make a comet using the recipe. If he did, the disposal of the oily goo would probably violate any local environmental standards. But I saw great potential in making a model comet that would bring "to life" the nature of the object that everyone was anticipating seeing when it returned after a 75-year absence in the night sky.

I saw no reason to make such a large comet—a gallon of motor oil is a considerable amount—and because many different organic compounds exist in comets, it was easy to identify a convenient alternative. In most presentations, I just find someone in the audience that will offer a splash of organics from their coffee, tea, soda pop, or juice. For adult audiences, I've always thought a dash of wine would be the most appropriate organic substance, especially at the end of a long day studying astronomy.

Comets for Everyone

The first published version of the *Make A Comet* activity debuted in the Astronomical Society of the Pacific's *Universe in the Classroom* newsletter, Number 3 (Fall 1985), when it went to more than 10,000 educators across the country. It became a mainstay as the finale for many ASP annual teacher workshops and Project ASTRO events. It is still found on the ASP's website at *www.astrosociety.org/education/publications/tn1/03/halley2.html.*

During the return of Halley's Comet in late 1985 and early 1986, *Make A Comet* was a regular feature of the Pacific Science Center's demonstration program. Comets were made on the hour, every hour. The largest number of comets I saw made one-after-another was in the Center's school pro-



The Universe i

A Newsletter o

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Astronomical Society of the Pacific

Number 3

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A Special Issue on Halley

Editor's Note: We have now entered what comet expert Brandt of NASA has called "the golden year of comet ex tion." The International Cometary Explorer (ICE) spac has now had a close encounter of the best kind (the rec with Comet Giacobini-Zinner and has returned a host of scientific information. Telescopes on Earth (and several spacecraft) will be turning more and more fre toward the faint fuzzy patch in the sky which is Halley' et, approaching us from the realm of the outer planet

This issue is devoted to the coming of the comet and you can prepare yourself and your students for finding ving, and — most importantly — understanding th famous of all celestial visitors. In this year of incredible hype", teachers will have an even greater responsibi usual to help the students bring the real science and tion into focus. The astronomers who work on this m very much hope we can be of some small assistance this important task.

Comets Events Schedule: 198

Sep. 11, 1985 — The U.S. Spacecraft ICE flew thro of Comet Giacobini-Zinner, becoming the firs craft to encounter a comet.

Oct. 20 -21, 1985 — Peak of the Orionid meteor sh the Earth encounters the dusty debris left alon Halley's Comet from its previous passes. (View site after midnight.)

Oct. 29, 1985 — Anniversary of Edmond Hall 1656)

Nov. 27, 1985 — Halley's Comet will be closest on its journey *inbound* toward the Sun. (How not be one of the best times to see it!)

Jan. 1, 1986 — Halley's Comet "crosses" the Ea its way toward the Sun. (It is north of the planets' orbits as it does this.)

Jan. 24, 1986 — While Halley's Comet is too cl for observation, we can turn our attention to spacecraft's closest encounter with the plan

Feb. 9, 1986 — Halley's Comet *perihelion* (its clos Sun). The comet is 88 million km (55 milli Sun, between the orbits of Mercury and V

Activity Corner

Making A C **t in the Classroom**

Schatz

Center, Seattle

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students make

1) Cut open one garbage bag and use it to line your mixing bowl.
2) Have all ingredients and utensils arranged in front of you.
3) Place water in mixing bowl.
4) Add sand or dirt, stirring well.
5) Add dash of ammonia.
6) Add dash of organic material (e.g. corn syrup), stirring until well mixed.
7) Place dry ice in 3 garbage bags that have been placed inside each other. (Be sure to wear gloves while handling dry ice to keep from being burned.)
8) Crush dry ice by pounding it with hammer.
9) Add the dry ice to the rest of the ingredients in the mixing bowl while stirring vigorously.
10) Continue stirring until mixture is almost totally frozen.
11) Lift the comet out of the bowl using the plastic liner and shape it as you would a snowball.
12) Unwrap the comet as soon as it is frozen sufficiently to hold its shape.

Now you can place the comet on display for the students to watch during the day as it begins to melt and *sublimate* (turn directly from a solid to gas — which is what carbon dioxide does at room temperature and comets do under the conditions of interplanetary space when they are heated by the Sun.)

The comet is reasonably safe to touch without getting burned by the dry ice, but it is still best to have a spoon or a stick for the students to use while examining it. As the comet begins to melt, the class may notice small jets of gas coming from it. These are locations where the gaseous carbon dioxide is escaping through small holes in the still-frozen water. This type of activity is also detected on real comets, where the jets can sometimes expel sufficient quantities of gas to make small changes in the orbit of the comet.

After several hours, the comet will become a crater-filled ice ball as the more volatile carbon dioxide sublimates before the water ice melts. Real comets are also depleted by sublimation each time they come near the Sun. Ultimately, old comets may break into several pieces or even completely disintegrate. In some cases, the comet may have a solid rocky core that is then left to travel around the comet's orbit as a dark barren asteroid.

Editor's note: *Dennis Schatz is the author of a marvelous new student (and teacher) activity book about Halley's Comet discussed elsewhere in this issue.*

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sletter for Teachers

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Fall 1985

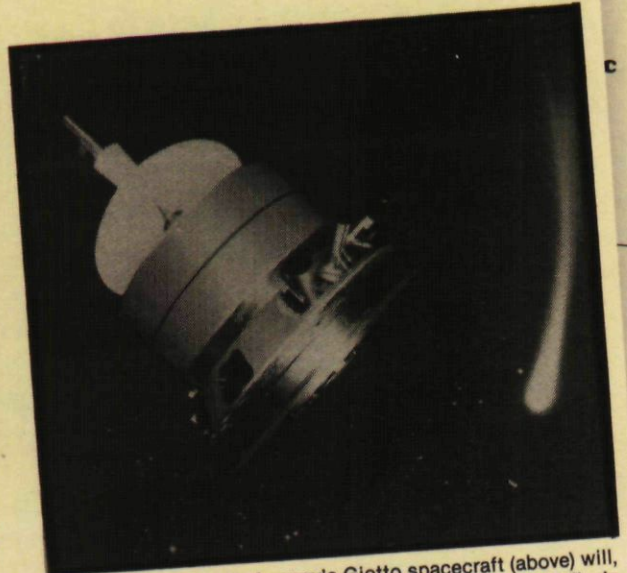
Comet

[During March of 1986, five spacecraft will fly by the comet and study the nucleus (the dirty snowball, just a few miles across, which is the main body of the comet), the coma (the much larger cloud of evaporated gas and dust, formed by the Sun's radiation), and the tail (the long streamers of comet material pushed away from the nucleus by the Sun's radiation and wind). Several of the spacecraft are equipped with excellent cameras that will send back historic first photographs of what a comet looks like close-up, as well as a steady stream of other scientific data.

Note: All the spacecraft encounter dates below are tentative and subject to minor revision.]

Mar. 6, 1986 — Expected date of closest flyby of VEGA 1 (U.S.S.R.), the first spacecraft to reach Halley's Comet. Flyby distance will be about 10,000 km (6,000 mi).

Mar. 8, 1986 — Planet A spacecraft (Japan) has its closest flyby of Halley's Comet; distance = 100,000 to 200,000 km (60,000 to 120,000 mi)



The European Space Agency's Giotto spacecraft (above) will, if all goes well, come within 500 km of Comet Halley's nucleus on March 14, 1986.

The ASP's newsletter for teachers, *Universe in the Classroom*, has existed for twenty years. In one of the earliest issues, the recipe for making a Schatz Comet first appeared.

grams: more than 100 students lined up wearing gloves and goggles, holding out sandwich-sized Ziplock bags. The line moved past Pacific Science Center staff members, who put in a scoop of water, a teaspoon of dirt, a few drops of ammonia and corn syrup, and finally a scoop of dry ice. The students massaged the mixture from the outside of the bag until they each had a miniature dirty snowball. They then Ziplocked the bag closed to take the comet home. There were always a few that closed the bag too early—before all the frozen carbon dioxide converted to a gas—providing an additional learning experience as the bags expanded until they exploded.

The largest number of comets I saw made at the same time was at a teacher workshop I did for 120 teachers in Florida. I usually make the comet as a demonstration for everyone to see. But the leader of the workshop wanted every teacher to have the opportunity to make his or her own. The logistics were formidable. The teachers worked in groups of four: this meant we had to locate thirty sets of bowls and spoons and hundreds of plastic trash bags, and distribute 120 pounds of dry ice among thirty Styrofoam ice chests. Each group's four teachers took a turn making a comet. It was quite a sight to see 120 comets lined up across the room. Fortunately I did not have to stay to clean up!

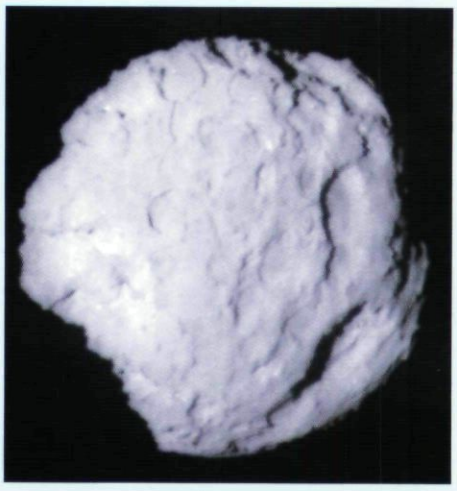
Comets by the 1000s

The most unusual use of the comet recipe was by Don Brownlee, Principal Investigator of NASA's Stardust Mission, which sent a spacecraft to Comet Wild 2. The spacecraft collected a sample of the comet in January 2004 and will return to Earth in 2006 with the sample. As part of Don's presentation to the NASA committee reviewing the mission proposal, he made a comet to emphasize the nature of the mission and illustrate one possibility for comet education and public outreach.

Many people have asked me how many comets have been made using the recipe. This is difficult to estimate because many educators have shared the recipe with their colleagues, published the recipe in countless educator guides, and put the recipe on the web. I can only count the ones I have personally done, which I estimate at more than 500 in the last twenty years—including demonstrations of the recipe to thousands of teachers.

Probably the best estimate of how widespread the recipe has become comes from searching the web for it. A quick search reveals the recipe at these sites or linked to from these sites:

Fifth-grade students at Washington Elementary School in Edison, New Jersey, unveil their own model comet. Taken by their teacher, Sharon Russell-Fowler, this photo won the 2003 ASTRO Photo Contest Grand Prize. Photo courtesy of S. Russell-Fowler.



NASA's Stardust spacecraft flew by Comet Wild 2 in early 2004 and will return a sample of cometary material to Earth in January 2006. This image is the closest short exposure of the comet. Image courtesy of NASA/JPL-Caltech.

- **www.noao.edu/education/crecipe.html** — *National Optical Astronomy Observatory*
- **whyfiles.org/011comets/index.php?g=6.txt** — *The Why Files*
- **astro.pas.rochester.edu/~jagoetz/comet/recipe.html** — *University of Rochester*
- **www.astro.washington.edu/labs/clearinghouse150/labs/Makecomet/comet.html** — *University of Washington*
- **bca.cryst.bbk.ac.uk/bca/ed/ice/Recip.html** — *British Crystallographic Association*
- **www.whiteoaks.com/mac-2002/index.html#photos** — *Whiteoaks.com*
- **analyzer.depaul.edu/paperplate/Comet%20Ikeya%20Zhang.htm** — *Depaul University*
- **stardust.jpl.nasa.gov/ed/sd-cometcnct.html** — *NASA Stardust Mission*
- **www.aas.org/~wgae/97mar17_files/countdown_to_comet_.html** — *American Astronomical Society*
- **www.star.net/people/~nsaac/newslet/oct97.htm** — *North Shore Amateur Astronomy Club*
- **www.solarviews.com/eng/edu/comets.htm** — *Views of the Solar System*
- **www.pha.jhu.edu/~weaver/nova.html** — *Johns Hopkins University*
- **www.lowell.edu/Public/LEARN/voli1.htm** — *Lowell Observatory*
- **www.moonchildren.com/space/** — *Children of the Moon in Space*
- **associate.com/ministry_files/Earth-Space-Safety/solar-system-teachers-guide/index-47.html** — *Associates.com*
- **cse.ssl.berkeley.edu/SegwayEd/lessons/cometstale/mmcom.html** — *Center for Science Education at Space Sciences Laboratory, University of California, Berkeley*

For those of you who have never made a comet, the original recipe is given in the accompanying box.

I do not have the patience to scan the skies for real comets, so I will never have a comet named after me like the first person to discover a comet in the night sky. But even after twenty years of unveiling "Schatz's Comet," I never tire of the fun and excitement when people see a model comet for the first time. m

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