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SPACE CENTER
Roundup

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STS-96 prepares ISS for 'Expedition One' crew

By Nicole Cloutier

The International Space Station hosted its first visitors with the successful docking of *Discovery* May 28. STS-96, the first space shuttle mission of the year, will go down in history as a benchmark for future ISS dockings and the mission of the second longest space walk in shuttle history.

After a flawless launch on May 27, the international crew, including Commander Kent Rominger, Pilot Rick Husband, Mission Specialists Ellen Ochoa, Tammy Jernigan, Dan Barry, Julie Payette of the Canadian Space Agency, and Valery Tokarev of the Russian Space Agency, caught up with ISS on flight day two and completed the first docking of a shuttle to the orbital facility.

Tasked with transferring a multitude of supplies and clothing to the space station, the crew spent more than 79 hours inside the ISS. Ochoa orchestrated the team as they maneuvered more than 4,500 pounds of equipment, clothing and supplies to the space station for use by its first crew in early 2000.

While most of the supplies and equipment, such as water, laptops and clothing, were destined for the inside of the space station, about 700 pounds of equipment were mounted externally on the orbiting facility. Jernigan and Barry executed 7 hours and 55 minutes of Extravehicular Activity, the second longest space walk in shuttle history, to attach two large cranes, one U.S.-built and one Russian-built, to the station. They will be used for future ISS assembly and, eventually, maintenance. The crew also transported handrails, foot restraints and additional EVA tools to various sites on the station.

JSC Photo S99-05757 by James Blair

STARSHINE Project Director and Physicist Gilbert Moore stands next to a model of STARSHINE, an STS-96 student satellite.

With those designated tasks completed, Barry and Jernigan continued their EVA to document painted surfaces on Zarya and Unity, install an insulating cover on a Unity trunnion pin and inspect an Early Communications System antenna on Unity. Later, the astronauts also replaced a power distribution unit and transceiver for the system which is now operational.

Jernigan and Barry were assisted on their monumental space walks by Ochoa, who operated the shuttle's robot arm to position Jernigan, and Payette, who directed the EVA activities from *Discovery*'s aft flight deck.

While docked, the crew also conducted some maintenance of the station components. Crewmembers replaced battery recharge controllers, which had been experiencing a slight loss in charging capacity during recharge; installed acoustic installation around Zarya fans to reduce noise levels; and installed shelving racks already present in Unity.

After almost six days of docked activity, the crew released from the station and deployed the Student-Tracked Atmospheric Research Satellite for Heuristic International Networking Equipment (STARSHINE) from the orbiter's payload bay. STARSHINE, now in a circular orbit 220 miles above the Earth, is part of an educational project and will be watched and tracked by more than 25,000 students worldwide. With more than 900 aluminum mirrors masquerading the beachball-sized satellite, the students will track the twinkling satellite for its six-month lifetime and enter their observations onto the project's Web site (http://www.azinet.com/starshine) to calculate its orbit. Their observations will be compared with solar activity to see how it affects the Earth's upper atmosphere.

STARSHINE is the brainchild of physicist Gilbert Moore. At 71, the retired Air Force Academy professor and now STARSHINE project director has invited youths throughout the world to share in the excitement of space exploration by joining this group of satellite watchers.

The 10-day mission concluded June 6 with a rare night landing as *Discovery* touched down at Kennedy's Shuttle Landing Facility. ■

Astronaut Tammy Jernigan, backdropped against terrain, totes part of a Russian-built crane, called Strela. Jernigan's feet are anchored on a mobile foot restraint connected to *Discovery*'s remote manipulator system. Astronauts Jernigan and Dan Barry spent more than seven hours on the space walk.

NASA Photo S96e5020

Historic Apollo era Pogo used for station tests.

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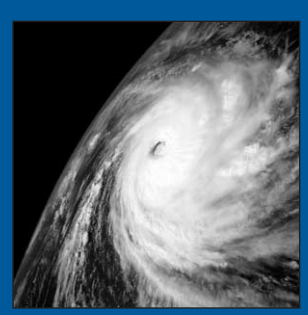

JSC prepares for the worst, hopes for the best.

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Team NASA celebrates diversity.

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Partial Gravity Simulator Facility used for first station tests

The Partial Gravity Simulator in JSC's Space Vehicle Mockup Facility in Bldg. 9 was recently used to support the International Space Station for the first time.

Commonly called the Pogo, the simulator consists of a pneumatic actuator suspended from an overhead air-bearing rail. It can provide both partial gravity and microgravity simulations in the vertical axis for a crewmember or a payload. The crewmember or payload is supported by a gimbal assembly that provides 3-degree of freedom movement.

John Sims, chief of the Mission Operations Directorate's Space Vehicle Mockup Facility, said, "We are excited that the Pogo is beginning to be used by the station program. It has a long history of being a useful training and engineering tool. It also has great potential to be useful for future lunar or Martian exploration programs."

David Ray, a member of the Space Vehicle Mockup Facility Office, is the lead NASA engineer for the Pogo. According to Ray, "The Pogo provides accurate partial gravity and microgravity simulations within two percent of the required lift load. It is used to support biomechanical research and engineering evaluations of human locomotion in partial gravity and microgravity environments. The Pogo also allows for safe operations of suited crewmembers, while manipulating various payloads required for specific missions."

Lockheed Martin EVA Engineer Stephen Smith translates along a wall using handholds.

JSC Photo S99-05364

Lockheed Martin Extravehicular Activity Engineers Stephen Smith and Bill Lynch recently used the Pogo to conduct evaluations of suited exercises. The test subjects were lifted to provide a microgravity simulation, while evaluations were performed on general suit mobility activities involving reach and access to suit controls, tether protocols with and without the Modular Mini-Workstation, Modular Mini-Workstation and tool operations and adjustable portable foot restraint ingress familiarization.

These evaluations were performed since a major component of the mission of the Crew and Thermal Systems Division is the research, design, development, certification, and sustaining engineering support of human life support systems. The objective of the exercises on the Pogo was to initiate CTSD engineers to the suited environment and the physical demands required to be a test subject for future engineering evaluations.

According to Smith and Lynch, the Pogo is a useful simulator that is definitely beneficial for CTSD personnel or anybody requesting spacesuit systems operations, EVA operations and procedures familiarization. They both believe that the Pogo will certainly be used in the future by CTSD engineers to design and develop new procedures and hardware for ISS assembly missions.

The original Pogo was designed and constructed in the 1960s. It was used for Apollo crew training to simulate the one-sixth gravity environment on the moon. "The current Pogo incorporates some of the hardware from the original Pogo. The vertical servo mechanism, piston/cylinder and overhead air-bearing rail were all used in the Apollo program. In fact, the vertical servo mechanism which controls the flow of pressurized air to maintain a constant upward lift force on the test subject or payload was patented by NASA engineers Harold Johnson and Arthur Trader in the 1960s," said Ray.

In 1993, Ray modified the Pogo to accommodate microgravity simulations so that it could support training for payload mass handling and crewmember locomotion studies for shuttle and ISS assembly. These modifications included a new control console, a new data acquisition system and hardware changes to increase Pogo sensitivity to provide for microgravity simulations.

The Pogo was used to support mass handling training for the STS-61 Hubble repair mission flown in December 1993 and EVA contingency training for deployment of the Cryogenic Infrared Spectrometers and Telescopes for the Atmosphere-Shuttle Pallet Satellite during the STS-66 mission in November 1994.

A spin-off of the Pogo technology could be used to build a training device for use in physical therapy for patients who have suffered injuries to the spine and legs. This simulator, or a scaled down version of it, could be used to off-load a patient's weight in varying degrees until the patient is able to walk. ■

For more information on the Pogo or to use the facility to support training or evaluations, contact Ray at (281) 483-5928 or e-mail at dray@ems.jsc.nasa.gov

For more information on Pogo see https://mod.jsc.nasa.gov/dx/dxhome/dxhome.htm

JSC contractor earns international registration

BRSP, the contractor for JSC that provides logistics, facility operations and maintenance services including prime and backup utilities to the Mission Control Center during space launch periods, has earned full certification to the ISO 9001 quality standard, the universal measurement for world-class companies.

ISO stands for the International Organization for Standardization, an independent worldwide federation with representatives from more than 100 countries. Approximately 70 percent of the companies seeking international registration fail, but BRSP achieved certification on the first review. BRSP is a subsidiary of Brown & Root Services, a business unit of Halliburton.

BRSP currently provides center operations support services to JSC including program management; operations and maintenance of critical facilities, utility plants, and life support systems; engineering, design and construction; logistics support services; environmental operations; security services; grounds maintenance; heavy hauling and lifting capabilities; and custodial services. There are currently more than 500 team members, including subcontractors, working together to provide these services.

> *'Achieving this certification demonstrates Brown & Root Services' commitment to meeting our customers' expectations and providing quality services and products.'*
>
> –Randy Harl, president, Brown & Root Services

BRSP is currently working toward achieving recognition from the Occupational Safety and Health Administration's Voluntary Protection Program for demonstrated safety excellence and ISO 14001, an international standard of environmental operations excellence. ■

Employees' children earn scholarships

This year's winners of the NASA College Scholarship Fund are Minghan Leo Tsay, son of Goddard Space Flight Center employee Dr. Si Chee Tsay; Sonali Mukherjee, daughter of Langley Research Center employee Dr. Vivek Mukhopadhyay; Jennifer Kiessling, daughter of Marshall Space Flight Center employee Edward H. Kiessling III; Megan Madaras, daughter Langley Research Center employee Eric I. Madaras; Michelle Precourt, daughter of Johnson Space Center employee Charles Precourt; and Yvonne Parisa, daughter of Marshall Space Flight Center employee Roger K. Parisa. This brings the total number of recipients to 84 and 52 of these have graduated.

Applications were restricted to dependents of NASA employees who are planning to major in science or engineering. All NASA centers were well represented among the candidates with 96 eligible applications received. All had exceedingly high grade point averages and all scored well on the SAT (several in the 1,500 and above range) and all were actively involved in their community.

The NASA College Scholarship Fund, Inc. Board of Directors has determined that six scholarships will be awarded next year. Each scholarship will be renewable annually for a maximum of $8,000 over 6 calendar years.

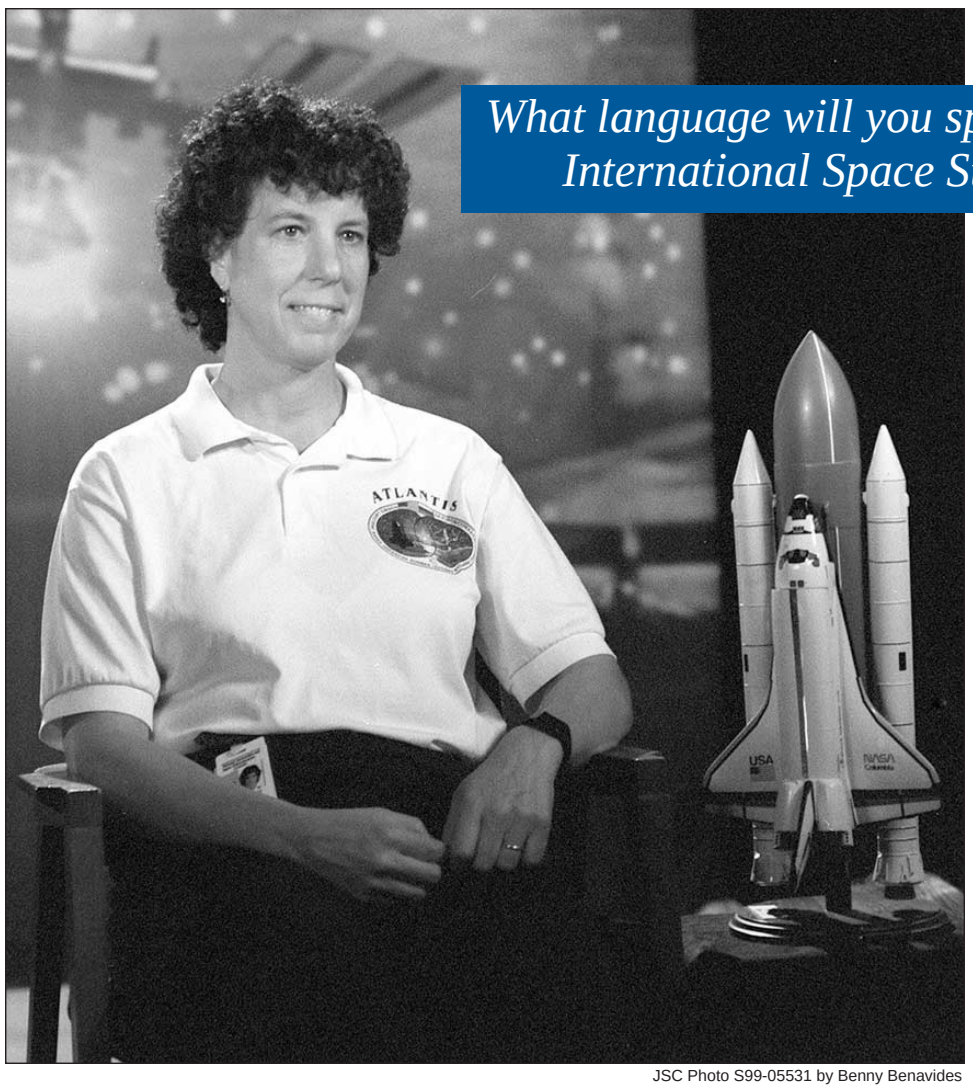
The scholarship fund was established to award scholarships agencywide to qualified dependents of NASA and former NASA employees. The fund was established as a direct result of a substantial unsolicited gift by the noted Pulitzer Prize-winning author James A. Michener. Many NASA employees have contributed to the fund directly or through the Combined Federal Campaign. Other major contributors include the Freedom Forum (to honor the Hubble crew members in 1994 and again in 1997 to honor Shannon Lucid) and the JSC chapter of the NASA Alumni League.

Information about the Scholarship Fund may be obtained from Teresa Sullivan at x31034. ■

COMMUNITY NEWS

NASA TV makes contact with Cosmosphere

By Nicole Cloutier



What language will you speak on the International Space Station?

JSC Photo S99-05531 by Benny Benavides

Astronaut Dr. Ellen Baker prepares for an interactive videoconferenece with students at the Kansas Cosmosphere and Space Center. Through NASA TV, Baker and Astronaut Bill Shepherd shared their space flight experiences with more than 230 students at the Cosmosphere.

That was one of many questions asked by Kansas students celebrating International Space Day May 6. More than 230 elementary and high school students gathered in the Kansas Cosmosphere and Space Center for the event, and through NASA TV, were able to direct questions to Astronauts Bill Shepherd and Dr. Ellen Baker via real-time satellite video.

"It's thrilling," said Helen Unruh, director of special projects for the Kansas Cosmosphere. "It's not what you'd expect to find here in the open prairies of Kansas and the kids love it."

The students, mostly first through fourth graders, are more educated about the space program than you might think. As neighbors to the Kansas Cosmosphere, which opened in 1981, they are close to a facility quickly becoming the most comprehensive space museum in the world. The Cosmosphere's extensive collection of U.S. and Russian space artifacts includes the Apollo 13 command module, German V-1 and V-2 rockets, a SR-71 Blackbird, and Mercury and Gemini spacecraft.

And while the Kansas center also boasts of possessing the planet's largest collection of space suits, it is short of live astronauts. That's where NASA TV steps in.

"Using facilities and technology already installed on site, we're able to bring human space flight virtually anywhere across the country," said Bob Fitzmaurice, JSC's senior education program specialist, who facilitates events such as this. "We are only limited by our imaginations."

Not Worlds Apart

The proliferation of audiovisual technology has made it possible to share the sites and sounds of our center with audiences everywhere. For this event, NASA TV staff used a fully equipped production studio located in Bldg. 2 to stage the interactive videoconference.

"This was an excellent example of how we can use our tools on site to partner with organizations like the Cosmosphere and really bring space to students," said Fitzmaurice. "We have so many resources here, the backdrops, the shuttle and station props, dedicated speakers, and they all bring space to life for the students."

And for students like those in rural Kansas, getting a glimpse of the space program, or talking to an astronaut, can inspire a lifetime of dreams.

"It's fabulous," said Jessica Schrock, 17, a sophomore who attends a Magnet school at the Cosmosphere and was present for the videoconference on Space Day. "We have only 23 students at my original high school, and one of the other schools is in the middle of a pasture, so it's pretty neat to be able to see and listen live to an active astronaut. It's very inspiring."

Inspiring the students is the goal of the outreach and education programs.

"That is what means so much to me about this job," added Fitzmaurice. "I feel good that we, as a center, can make students feel special and provide them with an opportunity to interact with our astronauts at JSC." ■

Preflight briefing: *JASON Project alumni reunite at JSC*

By Nicole Cloutier

More than 50 JASON Project argonauts toured JSC sites as part of their 10-year reunion May 14. Argonauts are a select group of students and teachers who accompany researchers on the various JASON Project adventures.

To gear them up for JASON XI, which focuses on sea and space exploration, Astronaut Bill Shepherd, crewmember for International Space Station flight 2R, spoke to the argonauts about ISS and space exploration during a reunion banquet. The argonauts also received a tour of the Neutral Buoyancy Lab, the Mission Control Center, and the space shuttle and space station mockups, followed by a conference call with JASON Project Founder Dr. Bob Ballard and a day-long conference of work sessions and student briefings.

"Seeing each other again and sharing our different experiences, that is the most exciting part," said Matthew Reamy, a JASON IX student argonaut from Oklahoma. His reunion companions, some from as far away as Canada and Scotland, shared his sentiment.

> *'It brings the sense of awe and discovery back into the classroom.'*
>
> – Cindy McGlynn

JASON XI is the next planned JASON Project adventure. Entitled "Going to Extremes," the project will highlight ISS flight 2R and the National Oceanic and Atmospheric Administration's Aquarius Underwater Lab activities. Approximately 25 JASON argonauts will return to JSC for flight 2R in February to participate in a joint live broadcast with argonauts at the Aquarius Lab in Florida. The JASON teams will be investigating how the two sites allow researchers to go beyond physical limitations to study the unknown.

"The best part of the JASON Project is that it breaks down the walls of the classroom," said Cindy McGlynn, a teacher and argonaut from New York. "It brings the sense of awe and discovery back into the classroom." ■

JSC Photo S99-05563 by Benny Benavides

JASON Project argonauts convene at JSC to celebrate their 10-year reunion.

Riding Out the Storm

JSC prepares for the worst, hopes for the best

It's not hard to realize that hurricane season is upon us again with the number and ferocity of storm activity seen recently on the Texas gulf coast. Hurricane season began June 1 and extends through Nov. 1. JSC has entered a state of continual preparedness in anticipation of the final storm season of this century. The JSC Hurricane Ride-out Team is preparing for the worst while hoping for the best. The Hurricane and Severe Weather Plan at JSC lists the guidelines that direct the preparations for a storm.

Action Level 4

Action Level 4 begins when a storm poses a threat to JSC within 72 hours. "This is typically when the storm enters the Gulf of Mexico," said Dennis Perrin, JSC's hurricane planning manager. Members of the hurricane team are required to review the plan to ensure that JSC will have a full stock of emergency supplies to ride out a storm if needed. JSC's Bill Roeh, chief of the Center Operations Directorate Project Management Office, is captain of the Hurricane Ride-out Team and has primary responsibility for preparing the center when severe storms threaten.

The Spaceflight Meteorology Group follows the storm using weather satellite imagery and other data and interprets the bulletins issued by the National Hurricane Center. The forecasters advise the JSC senior staff and the Hurricane Ride-out Team throughout the storm threat period. "At this point we ask supervisors to allow employees with special considerations such as small children to use the liberal leave policy in order to evacuate their families," Perrin said.

Supervisors and managers also should review project priorities and assignments during Level 4 to assure operations can be reduced or terminated before storm conditions pose a threat to the center.

Action Level 3

Action Level 3 goes into effect when a hurricane could threaten JSC/Ellington Field within 48 hours. At the direction of the Center Operations Director, Bill Parsons, the Hurricane Ride-out Team moves to the Emergency Operations Center in Bldg. 30L to set up a command center. Each organization has a designated emergency planning representative and an alternate who stay informed of the status of the action levels during a hurricane. "When a storm is 48 hours out from JSC, we encourage supervisors to allow all employees to use the liberal leave policy and we encourage employees to take it," Perrin noted.

Action Level 2

Level 2 is initiated by authorization of the center director when the threat to JSC is within 36 hours from landfall. "At Level 2, we look for JSC Director George Abbey to release employees and close the center," Perrin said. "The only people left on site are the Ride-out Team," he added. Prior to closing the center, employees will be asked to secure their offices. "An important part of preparing the center for closing because of a hurricane threat is securing offices, a responsibility that falls on every employee," JSC Emergency Preparedness Manager Bob Gaffney said.

These preparations include protecting computers, raising blinds, securing classified materials, and closing all doors. The emergency planning representatives in each organization are kept informed on the status of the action levels during the alert and will coordinate information concerning shutdown activities and work assignments for their area.

Fourteen Area Protection Teams from the Plant Engineering Division check buildings and roofs, picks up loose objects outside, secure possible hazards and make preparations to shut down site utilities. "The main thrust should be on preparation – those things that all employees can do to mitigate the effects of a storm or minimize the degree of damage they can do," Roeh said. "Preparation is the key to successful recovery; we'll recover regardless, but our recovery will be faster if we prepare adequately in advance." The Hurricane Ride-out Team completes all protective measures that will place the center in a final state of preparedness. The Ride-out Team continues to secure the center up to the point the weather becomes unsafe.

Action Level 1

Action Level 1 is initiated by the center director and goes into effect when gale-force winds arrive at the center, making it too dangerous to continue outside activities. The Ride-out Team gathers at its post and waits for the storm to subside. During the storm, activities are limited to only essential emergency repairs that can be performed without placing the health and safety of the assigned personnel at risk.

Immediately after the storm, the Ride-out Team moves back into action, assessing the damage and arranging for necessary repairs. "We have a Damage Assessment Plan and Damage Assessment Teams that survey the damage and evaluate the buildings for safety," Perrin said. "The Damage Assessment Teams report to the Hurricane Ride-out Team captain. Their evaluations help determine when it's safe for employees to return to work and what buildings are brought on line first," Perrin added.

In the event of an evacuation, employees can continue to stay in contact with the center through the use of the two emergency information phone numbers listed below. Public Affairs notifies employees when to return to work through the Employee Information Service, x36765, and broadcasts by local radio and television reports. ■

For hurricane information on the Internet, employees may access http://shuttle.nasa .gov/weather/.

Q&A Questions and answers about hurricanes from the JSC Spaceflight Meteorology Group

What is the difference between a tropical disturbance, a tropical depression, tropical storm and a hurricane?

A tropical disturbance is a discrete system of organized showers and thunderstorms that originates in the tropics and maintains its identify for 24 hours or more.

A tropical depression is an organized system of clouds and thunderstorms with a defined counter-clockwise circulation with maximum sustained winds of 38 mph or less.

A tropical storm is an organized system of strong thunderstorms with a defined circulation and maximum sustained winds of 39 to 73 mph.

A hurricane is an intense tropical weather system with a well-defined circulation and sustained winds of 74 mph or greater.

How is a hurricane formed?

Hurricanes start as a cluster of showers and thunderstorms over tropical waters. A hurricane's main sources of energy are heat and moisture. Developing hurricanes gather this energy through contact with warm ocean waters. Water temperatures of 80 degrees Fahrenheit or warmer are typically needed for storm development.

Wind patterns are critical for tropical storm formation. The pattern most conducive to tropical storm formation is when low-level winds, below 5,000 feet, are converging, and upper-level winds, above 25,000 feet, are light and diverging. Upper-level winds that are too strong will greatly inhibit tropical storm development, and often cause a hurricane or tropical storm to weaken.

What are the different parts of the hurricane?

The typical hurricane has two or three and sometimes more outer convective bands, also called feeder bands. These bands are comprised of cells resembling ordinary thunderstorms and can be up to 300 miles from the eye. The outer convective bands are generally 40 to 80 miles apart and come in advance of the main rain shield.

The rain shield is a solid area of rain that typically becomes heavier closer to the eye. The outer edge is well-defined and its distance from the eye varies greatly from storm to storm.

Spiral bands or convective rings are regions of active showers and thunderstorms that encircle the centers of hurricanes. They are prevalent in the more intense hurricanes and curve cyclonically inward toward the center of the storm where they appear to merge to form the eye wall.

The eye wall is an organized band of thunderstorms that immediately surrounds the center or eye of a hurricane. It typically contains the fiercest winds and most intense rainfall.

The eye is a relatively calm center of the hurricane. The winds are light, and skies may be partly cloudy or even clear. The average hurricane eye diameter is a little more than 20 miles. In general, when the eye is shrinking in size, the hurricane is intensifying. After the eye's passage, the violent wind blows in the opposite direction to what it was right before the eye moved over an area and the heavy rain returns.

What is a storm surge?

A storm surge is a large dome of water often 50 to 100 miles wide that sweeps across the coastline near where a hurricane makes landfall. Storm surge can range from four to six feet for a minimal hurricane to greater than 20 feet for the stronger ones. The stronger the hurricane and the shallower the offshore water, the higher the surge will be. This can cause severe flooding in coastal areas, especially when the storm surge coincides with normal high tides. Water weighs about 1,700 pounds per cubic yard; extended pounding by frequent waves can demolish any structures not specifically designed to withstand such forces. Along the immediate coast, storm surge is the greater threat to life and property, even more so than the high winds.

Hurricane Camille produced a 25-foot storm surge in Mississippi. Hurricane Hugo in 1989 generated a 20-foot storm tide in South Carolina. Hurricane Andrew in 1992 caused a 17-foot storm surge in southeast Florida.

Note, the elevation of JSC ranges from 15 to 23 feet, so a 20 foot storm surge could put the lowest elevations at JSC under five feet of water.

How much rainfall and flooding can a hurricane produce?

Hurricanes, tropical storms, and tropical depressions are capable of producing abundant amounts of flood-producing rainfall. During landfall, a hurricane rainfall of 6 to 12 inches is common. If the storm is large and moving slowly, greater amounts of rainfall can be expected. To estimate the potential rainfall amount (in inches), divide the storm's forward motion into 100. For example, a storm moving five miles per hour could produce 20 inches of rain.

What kind of damage can happen from the wind of a hurricane?

As winds increase, pressure against objects is added at a disproportionate rate. Pressure force against a wall increases with the square of wind speed; a threefold increase in windspeed gives a ninefold increase in pressure. A 25 mph wind causes about 1.6 pounds of pressure per square foot, and places 50 pounds of force on a four by eight sheet of plywood. In 75 mph winds, that force becomes 450 pounds, and in 125 mph, it becomes 1,250 pounds.

What about tornadoes?

Hurricanes also produce tornadoes, which add to the hurricane's destructive power. Typically, the more intense a hurricane is, the greater the tornado threat. When a hurricane brings its winds inland, the fast-moving air hits terrain and structures, causing increased low level wind convergence due to friction. This, in turn, enhances atmospheric lifting which increases the threat of tornadoes. The greatest concentration of tornadoes occurs in the right front quadrant of the hurricane.

Who issues hurricane watches and warnings?

Hurricane watches, warnings and advisories are officially issued by the National Weather Service's National Hurricane Center in Coral Gables, Fla. Meteorologists at NHC specialize in hurricane and tropical storm forecasting. They continually monitor atmospheric and ocean conditions, evaluate an array of atmospheric computer models and issue watches, warnings and advisories on tropical storms and hurricanes. The Houston/Galveston National Weather Service Office in League City customizes tropical storm and hurricane watches and warnings for southeast Texas. The Spaceflight Meteorology Group further customizes watches, warnings and advisories for JSC management and emergency planning managers.

How accurate are hurricane forecasts?

The National Weather Service's National Hurricane Center in Miami, Fla., prepares the official hurricane watches, warnings and advisories for the U. S. and adjacent ocean areas. Major advances have been made in hurricane forecast accuracy during the past 25 years due to improved satellite imagery and more sophisticated computer models. The average 72-hour forecast position error is about 300 miles, and the average 24-hour forecast position error is about 100 miles. This distance can mean the difference between destructive winds and storm surges and merely "tropical storm" conditions. Hurricane intensity changes are quite difficult to predict and the best plan is to expect the worst. A good rule of thumb is to plan for a storm arriving one category stronger and 12 hours sooner than predicted. ■

WEB SITES FOR TROPICAL WEATHER

NWS Spaceflight Meteorology Group Tropical Page
http://www.srh.noaa.gov/smg/tropic.html

NWS National Hurricane Center
http://www.nhc.noaa.gov

NWS Houston / Galveston National Weather Service
http://www.srh.noaa.gov/hgx

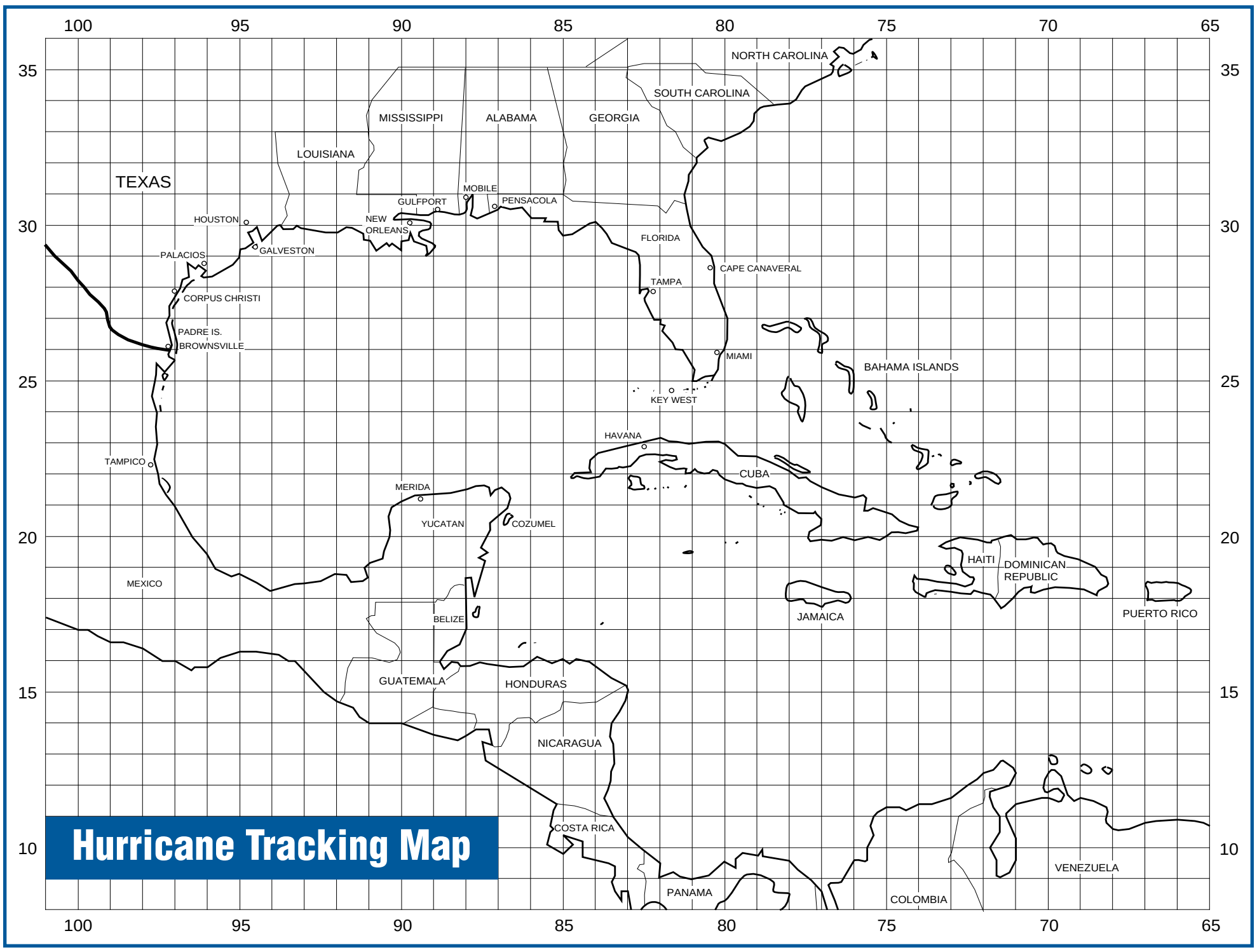
FEMA & Lowes-sponsored Hurricane Central page
http://www.storm99.com

NWS Tallahassee Tropical Page
http://www.nws.fsu.edu/tropical

Dr. William Gray's Seasonal Hurricane Forecasts
http://tropical.atmos.colostate.edu/forecasts/index.html

University of Hawaii - Worldwide Tropical Storm Tracks
http://www.solar.ifa.hawaii.edu/Tropical/

National Oceanic and Atmospheric Administration (NOAA)
http://hurricanes.noaa.gov/



Hurricane Tracking Map

Emergency Supply Kit

- Flashlight
- Tissues
- Radio
- Pocket knife
- Sanitary Supplies
  - Toothbrush
  - Soap
  - Shampoo
  - Sponge
  - Cleanser
  - Bleach
- Batteries
- Pencils
- Drinks/Juices
- Nuts
- Rice – Pasta
- Soups
- Canned Foods
- Water
  (1 gal per person per day)

30-gallon trash barrel

- First Aid Kit
- Medicines
- Rubbing Alcohol
- First Aid Handbook
- Towels
- Blankets
- Paper Towels
- Toilet Paper
- Candles
- Matches
- Can Opener
- Peanut Butter
- Crackers
- Dried Beans
- Change of Clothing
- Foul Weather Gear
- Sterno, Stove, Fuel
- Garbage Bags
- Cooking Utensils
  - Cooking Pot
  - Plastic Dishes
  - Silverware
  - Aluminum Foil

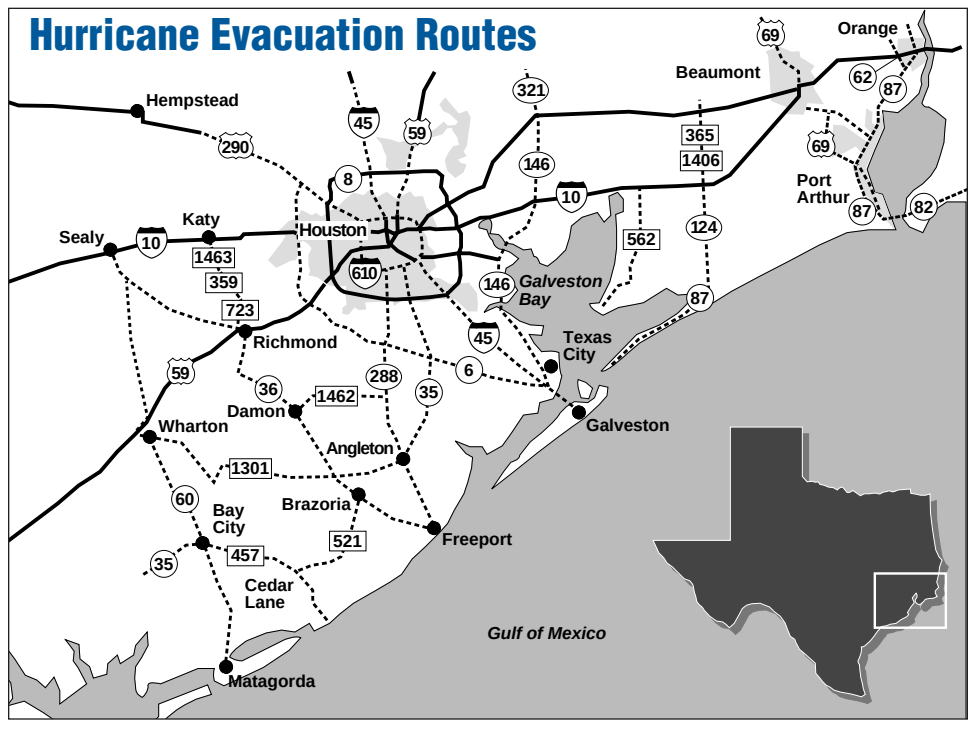
Emergency Numbers

JSC Emergency Information Line	x33351
JSC Employee Information Line	x36765
National Weather Service	281-337-7895
Texas Highway Department (road closures)	1-800-452-9292

Emergency Management Offices

American Red Cross	
Galveston County	409-945-7200
Harris County	713-526-0636
Clear Lake Office	281-282-6039
Bayou Vista	409-935-0449
Baytown	281-420-6556
Clear Lake Shores	281-334-1034
Deer Park	281-479-1511
Dickinson	281-337-2489 x240
El Lago	281-326-1951
Friendswood	281-996-3335
Galveston (city)	409-766-2102
Galveston County (north)	1-800-388-1428
Harris County	713-881-3100
Hitchcock	409-986-5991
Houston (city)	713-881-3045
Kemah	281-334-5414
LaMarque	409-938-9269
League City	281-332-0440
Nassau Bay	281-333-4200
Pasadena	281-475-5588
Santa Fe	409-925-8901
Seabrook	281-291-5610
Taylor Lake Village	281-326-2843
Texas City	409-948-2525
Webster	281-332-1826

Hurricane Evacuation Routes



CLIP AND SAVE—Keep this handy reference in daily planners by cutting the page on the dotted line, placing holes on the left side of the pages and folding once. By keeping these references close at hand, you should be able to minimize the effects of a storm to your office and personal property.

Hurricane Preparation To Do List

Before leaving the office:

- ✔ Unplug computers and wrap in plastic bags.
- ✔ Unplug all electrical equipment.
- ✔ Close all doors.
- ✔ Move unique or valuable papers to inside rooms.
- ✔ Secure all classified material, lock all security files, safes and cabinets.
- ✔ Remove bottom file drawers and place on a desk or table, if file cabinets are located on the first floor.
- ✔ Raise venetian blinds to near the top of the window.

Things to do at home:

- ✔ Check your portable radio and battery-operated lights and flashlights.
- ✔ Monitor weather broadcasts for current conditions and advisories from local emergency management officials.
- ✔ Restock food supplies every six months.
- ✔ If evacuating, be sure to post a prominent note with evacuation details.
- ✔ Provide for pets, especially if evacuating.

NOTE: This list is not intended to be all-inclusive. Employees must decide what supplies are best suited for their family's survival. This list contains only suggestions for consideration.

Ripped from the ROUNDUP

Ripped straight from the pages of old Space News Roundups, here's what happened at JSC on this date:

1974

Speaking at a press conference held recently at JSC, John Young, acting chief of the Astronaut Office, said he believes the space shuttle orbiter will "revolutionize the United States and the world."

"The shuttle will open new avenues to science and will stimulate the development of advanced technology in the 1980-1990 time-frame," he said.

According to Robert F. Thompson, shuttle program manager, the first manned orbital flight is scheduled to take place by the second quarter of 1979. The system is expected to be completely operational in 1980.

1979

Derelict space station Skylab continues to drop lower in its orbit despite force fields sent out by psychokinesis buffs, and suggestions by callers to capture Skylab with "huge magnets" or to shoot it down with a surface-to-air missile. This week's prediction for 50% probability of Skylab entry from NORAD (North American Air Defense Command) is for July 16, with a 95% probability of entry between July 4 and July 28. NORAD updates its predictions weekly based upon skin tracking of Skylab.

Abnormal solar flare activity during the six years since the Skylab Workshop was launched has caused "bulges" in the Earth's atmosphere to reach out to the space station's altitude, forcing Skylab's orbit to wear out faster. When launched in May 1973, Skylab was predicted to have an orbital lifetime of 10 years.

1994

NASA Contracting Officer Lee Evey, at JSC from NASA Headquarters, and Russian Space Agency representative Nikolai Zhulin sign an agreement for the two countries to work together on Phase I Russian Program science and research aboard Mir and some Phase II International Space Station development activities. The contract was delivered to Washington, D.C. for final signatures by NASA Administrator Daniel Goldin and RSA Director Yuri Koptev.

Employees empowered for safety

S-s-s-s-summer is here… *and so are the snakes!*

By Mary Alice Pruessner

In the last few weeks, several close call reports of snake "sightings" on site have been reported. The sightings have occurred close to various buildings and outlying parking lots. This has triggered some concern and questions about how to identify whether a snake is venomous or non-venomous.

Below is a quick reference for snakes most common to the local area. For more detailed information and pictures, visit the Houston Zoo Web site at: http://www.houstonzoo.org/reptiles/snakeset.htm.

If you encounter a snake, make no sudden moves and avoid the area. If the snake is in a high traffic area and could cause a threat call JSC Security at x34658.

Western Cottonmouth (Water Moccasin)

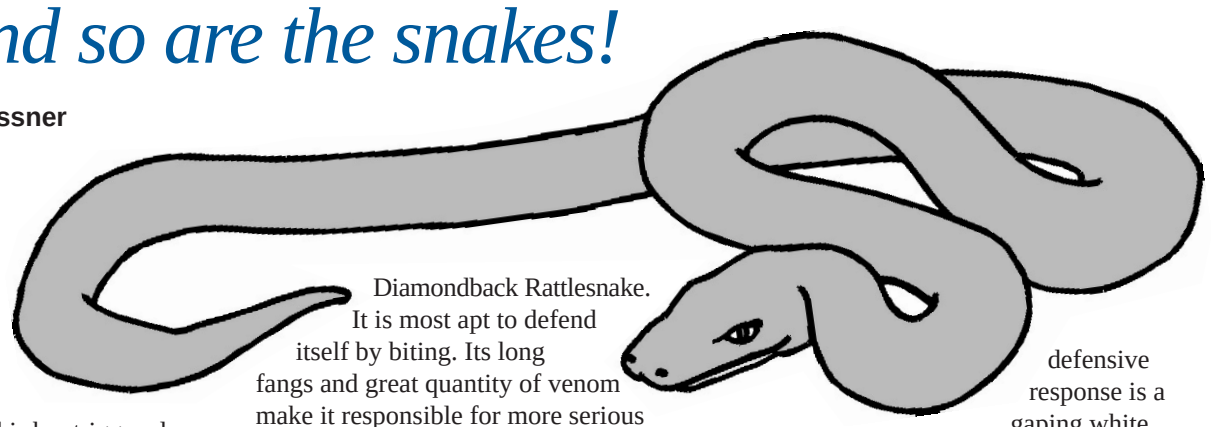
General: It tends to hold its ground even when escape might be easy, rapidly vibrating its tail and gaping at the intruder to expose the white "cotton" lining of its mouth from which it gets the name "cottonmouth." It can bite under water. Its venom is more toxic than that of its close relative, the copperhead.

Habitat: Almost any aquatic area from swamps, bayous, lakes, rivers, sloughs, irrigation ditches, and stagnant backwaters They are frequently found lying underneath objects on the ground.

Description: This is a pit viper, variable in color and markings and difficult to recognize. It has a dark, chunky, heavy body, brown or black above, patternless or with dark, indistinct crossbands. The head is shaped somewhat like a diamond. White face stripes are present on many, although obscure or absent on others. They are usually 2 to 3 feet long; the record is 4.5 feet. The young have a light brown body with dark brown bands and bright yellow or chartreuse tail tips which are used as a lure for potential prey. The distinct bands fade to a dark brownish-black as it ages. They closely resemble a variety of beneficial harmless watersnakes.

Western Diamondback Rattlesnake

General: One of the largest, most common, and dangerous venomous snakes in the U.S., second only to the Eastern Diamondback Rattlesnake. It is most apt to defend itself by biting. Its long fangs and great quantity of venom make it responsible for more serious bites and fatalities than any other snake in the U.S.



Habitat: Heavily wooded areas.

Description: This is a large, heavy-bodied pit viper ranging from 3 to 7 feet that can be identified immediately by the alternating black and white rings of about equal width on the tail. These rings resemble the ones on a raccoon's tail, so it is sometimes called the "coontail rattlesnake." The back is patterned with light-bordered dark diamonds, and there are two light diagonal lines on the side of the face.

Southern Copperhead

General: It is the most abundant of the U.S. venomous snakes and is often confused with the harmless hognose snake. It usually remains coiled and quiet unless approached or touched, and will vibrate its tail when angry. It often seems reluctant to strike. Its soft colors blend well with leaves on the forest floor, making it easy to step on and increasing the chance of contact with children and pets; however, its bites are usually not serious and fatalities from its bite are almost unknown.

Habitat: Wooded, watery areas; wooded, hilly areas broken by expanses of rocky ledges; abandoned buildings, vacant lots, old plank roads, woodpiles, and grassy areas with scattered logs and debris for cover.

Description: This pit viper has a thick, stout body, usually brown, pinkish tan or chestnut colored with darker hourglass-shaped crossbands. Some may be solid color with no dark bands. Adults average 2 to 3 feet; the record 4.5 feet.

Texas Rat Snake

General: It can frequently be found in open places during the day in cool spring and fall weather. Because it has a tough, slightly laterally flattened body and sharp-edged belly scales that can dig like spikes into tree bark, it is an especially agile climber. It is a very muscular snake and can stiffen its body to span branch-to-branch distances more than a third of its length. When it is surprised, its dramatic defensive response is a gaping white mouth. A desperate snake may rear its forebody into an elevated, S-shaped curve, hiss vigorously, vibrate its tail, and eventually fling itself toward its assailant. Much of the posture is a bluff to allow the snake to escape; unfortunately the display often causes the snake to be misidentified as a venomous species and killed.

Habitat: Habitats range from bayous, swamps and wooded areas.

Description: The average length of this slim, wiry-trunked snake is 3.5 to 6 feet; the record length is more than 7 feet. It may exhibit a strongly blotched pattern, or be almost solid dark grey to black. Blotches are brown to blue-black and the background color is gray to yellowish-orange. Rat snakes have a distinctive body shape; a cross section resembles a loaf of bread. The belly is pale and generally blotched with dark squares and a gray overwash. The underside of the tail tip is usually solid gray.

Texas Coral Snake

General: Its venom is primarily neurotoxic, depressing the central nervous system. Death occurs by respiratory or heart failure. The venom is very potent (lethal dose 5 to 10 mg). Because of their secretive and nonaggressive nature (except in feeding), few human fatalities are recorded. Most bites occur when victims handle the snakes or step on them. The Texas coral snake resembles several other harmless snakes and it is important to recognize the differences. Remember the saying, "red on yellow, kill a fellow; red on black, venom lack." If these two warning colors touch on the snake's body, it is venomous.

Habitat: Broad range of habitats including pine and hardwood forests, coastal and inland prairies, cedar brakes, rock canyons and hillsides. It is usually secretive, nocturnal or crepuscular.

Description: This is a slender, shiny, medium-sized snake with broad, alternating bands of red and black separated by narrow yellow or white rings. The head is black with a yellow ring behind the eyes. Adults average 2 feet long, but specimens of 4 feet have been reported. ■

TICKET WINDOW

Exchange Store hours

Monday-Friday

Bldg. 3 7 a.m.-4 p.m.

Bldg. 11 9 a.m.-3 p.m.

All tickets are non-refundable.

Metro tokens and value cards are available.

For more information, please call x35350.

The following discount tickets are available at the Exchange Stores

General Cinema Theaters				$5.50
Sony Loew's Theaters				$5.00
AMC Theaters				$4.75
Fiesta Texas	adult	$18.25	(child under 48")	$15.50
Astroworld One-day Admission				$21.00
Astroworld Season Pass (valid at all Texas Six Flags Theme Parks and Water World)				$54.75
Water World				$10.75
Moody Gardens (2 of 6 events)				$10.75
Sea World	adult	$27.25	child (age 3-11)	$18.25
Schlitterbahn Water Park	adult	$20.75	child (age 3-11)	$17.50
Space Center Houston (JSC civil service employees free.)	adult	$10.25	child (age 4-11)	$6.50
Space Center Houston Annual Pass				$18.75
Splash Town Water Park	adult	$14.50	(child 48" and under)	$11.50

Houston Comets tickets are now available for July 1, Aug. 6 and 18. Quantities are limited.

American Heritage Week

'Team NASA: Facing the New Millennium-Together!'

The sixth annual American Heritage Week celebration is set to begin June 28. JSC's American Heritage Committee and Team NASA will sponsor the week-long event scheduled to run from June 28 through July 2. Team NASA is an ongoing partnership among JSC civil service employees, contractor employees, and the Clear Lake community.

"American Heritage Week celebrates the diverse heritage of the entire Team NASA," said Equal Opportunity Programs Director Estella Hernandez Gillette. "Employees, families and friends of JSC and our aerospace partners to celebrate the similarities that bring us together as well as the differences that allow us to learn and grow."

Special activities will be held from 11:30 a.m. to 12:30 p.m. daily during American Heritage Week in the Bldg. 3 cafeteria. Entertainers, including the JSC Town Criers and the Mixteco Ballet Folklorico Dancers, will provide a variety of musical performances. Exhibits ranging from Apollo memorabilia to wearable art will be on display. The cafeteria will offer a variety of special menus during the week.

The Children's Art Committee encourages children ages 2 - 15 to submit entries depicting the theme "Team NASA: Facing the New Millennium – Together!" The entries will be displayed June 28 - 30 in the lobby of Bldg. 1 and July 1 at the Gilruth Center. Entry forms may be picked up from Paula Scheffman, Mail Code AJ, Bldg. 1, Room 172. All entries must be submitted with an official entry form and must be returned to Scheffman by June 21. Entries will be divided into three age categories (2 - 6, 7 - 10, and 11 - 15). A panel of judges will select the winners. Contact Scheffman at x30601 for additional information.

JSC Photo S99-05513 by James Blair

ASIAN PACIFIC AMERICAN OBSERVANCE—The Polynesian Cultural Association provided a view of the culture of the South Pacific during JSC's recent observance of Asian Pacific American Month.

The American Heritage Week parade will begin at 1 p.m. July 1 in front of Bldg. 1, travel throughout JSC, and end at 4 p.m. at the Gilruth Center.

The week-long celebration will conclude with the grand finale set for 4 p.m. to 7:30 p.m. July 1 at the Gilruth Center. An American Heritage Week mini-parade, featuring the award-winning Houston Showstoppers Marching Band, will kick off the event.

The grand finale will feature exhibits and simultaneous cultural performances in both the ballroom and the old gym. Employees and their families will enjoy a host of cultural performances including praise dancing, American Indian dancing, and Polynesian dancing. The Arts Alliance Center at Clear Lake will display late 18th- and 19th-century original and replica pieces including painting, quilting, and wood working. Some artists will provide live demonstrations. Free hot dogs, popcorn, and beverages will be available. The event is free.

Throughout the week, and especially during the parade and grand finale on July 1, employees are encouraged to wear clothing depicting their heritage.

Volunteers are still needed to help with exhibits, entertainment, and decorating. To assist with exhibits, contact Georgia Way at x30595; to assist with entertainment, contact Patricia Burke at x30606; and to assist with decorating, contact Scheffman at x30601. ■

Week-long Activities

11:30 a.m. -12:30 p.m in Bldg. 3

Monday, June 28

Entertainment: FMD Singers
Menu: chicken fried steak, two vegetables, roll, butter, drink
Exhibit: Multicultural

Tuesday, June 29

Entertainment: Abraham's Tree
Menu: Mexican dinner, roll, butter, drink
Exhibit: Needlecrafts/wearable art

Wednesday, June 30

Entertainment: Leapers for Joy
Menu: fried chicken, two vegetables, roll, butter, drink
Exhibit: Art

Thursday, July 1

Entertainment: JSC Town Criers
Menu: Smoked Sausage, German potato salad, sauerkraut, roll, butter, drink
Exhibit: None

Friday, July 2

Entertainment: Mixteco Ballet Folklorico Dancers
Menu: stir fry chicken, salad, roll, butter, drink
Exhibit: Apollo memorabilia

Grand Finale

July 1: 4 - 7:30 p.m. in the Gilruth Center Ballroom and Old Gym

Parade: 1 p.m. – Houston Showstoppers Marching Band

Opening Ceremonies

Native American Invocation	Ms. Powtawche Neengay Williams
Presentation of Colors	Clear Lake High School
National Anthem	Ms. Ashley Dunbar
Welcome	Mr. George W. S. Abbey, Center Director
Mistress of Ceremonies	Dr. June Bennett Larsen

Entertainment

Praise Dancer – Ms. Jennifer Ghee
Polynesian Dancing – Hula Ulu Pua
Jhankar School of Dancing
Singer – Reverend Samuel Antley
American Indian Resource Center Dancers
Houston Highlander Bagpipe Band
Contemporary Gospel Music – Triumph
Silent Ones Singers
O'Maioledigh Irish Dancers
Aldersgate Praise Singers
Ball High Folklorico Dancers
Jr./Sr. Jam Squad Dancers
Lost Souls
Astronaut autographs

Refreshments: Hot dogs, popcorn, beverages

Exhibit (Old Gym): The Arts Alliance Center at Clear Lake

For additional information, contact the Equal Opportunity Programs Office at x30601.

DATES & DATA

June 23

Astronomy seminar: The JSC Astronomy Seminar Club will meet at noon June 23 and 30 in Bldg. 31, Rm. 248A. For additional information, call Al Jackson at x35037.

Spaceland Toastmasters meet: The Spaceland Toastmasters will meet at 7 a.m. June 23 and 30 at the House of Prayer Lutheran Church. For details, call George Salazar at x30162.

Communicators meet: The Clear Lake Communicators, a Toastmasters club, will meet at 11:30 a.m. June 23 and 30 at Freeman Library, 16602 Diana Lane. For additional information, call Allen Prescott at (281) 282-3281 or Mark Caronna at (281) 282-4306.

Spaceteam Toastmasters meet: The Spaceteam Toastmasters will meet at 11:30 a.m. June 23 and 30 at United Space Alliance, 600 Gemini. For additional information, call Patricia Blackwell at (281) 280-6863.

June 24

Radio Club meets: The JSC Amateur Radio Club will meet at 6:30 p.m. June 24 at Piccadilly, 2465 Bay Area Blvd. For more information, call Larry Dietrich at x39198.

June 28

Alzheimer's support group meets: The Clear Lake Alzheimer's Caregiver Support Group will meet from 7:30 p.m. to 9 p.m. June 28 in the first floor conference room in St. John Hospital, West Building, in Nassau Bay. For details, call Nancy Malley (281) 480-8917 or John Gouveia (281) 280-8517.

September 8 - 10

Announcement/Call for Presentations: Presentations are now being accepted for the Third Annual All Texas Pro/ENGINEER User's Conference, which will be held September 8 -10 at the San Luis in Galveston. Those interested in presenting may send an abstract by June 30 to Kelly McDonald at kmcdona2@ems.jsc.nasa.gov or call (281) 228-7696. Conference registration information can be found at www.prouser.org/rugs/ghpug.

New Dial-In Service for JSC

Beginning July 1, 1999, JSC will have new dial-in service replacing Shiva and Cubix. This new service provides standard modem dial-in supporting transfer rates up to 56K with 60 ports available, as opposed to 33.6K and 24 ports with Shiva. Users will see a significant improvement over the current dial-in capabilities. Current Shiva users will use their JSC NT domain ID and password for authentication, and there will be new local and 1-800 phone numbers. Cubix capabilities will no longer be supported. See http://www4.jsc.nasa.gov/ for more detailed information in the coming weeks, including instructions on configuration set-up as well as a time table of when these changes will occur.

GILRUTH CENTER NEWS

Hours: The Gilruth Center is open from 6:30 a.m.-10 p.m. Monday-Thursday, 6:30 a.m.-9 p.m. Friday, and 9 a.m.-2 p.m. Saturday. Contact the Gilruth Center at (281) 483-3345.

Sign up policy: All classes and athletic activities are on a first-come, first-served basis. Sign up in person at the Gilruth Center and show a yellow Gilruth or weight room badge. Classes tend to fill up two weeks in advance. Payment must be made in full, in exact change or by check, at the time of registration. No registration will be taken by telephone. For more information, call x33345.

Gilruth badges: Required for use of the Gilruth Center. Employees, spouses, eligible dependents, NASA retirees and spouses may apply for photo identification badges from 7:30 a.m.-9 p.m. Monday-Friday and 9 a.m.-2 p.m. Saturdays. Cost is $10. Dependents must be between 16 and 23 years old.

Nutrition intervention program: Six-week program includes lectures, a private consultation with the dietitian and blood analysis to chart your progress. Program is open to all employees, contractors and spouses. For details call Tammie Shaw at x32980.

Defensive driving: One-day course is offered once a month at the Gilruth Center. Pre-registration required. Cost is $25. Call for next available class.

Stamp club: Meets every second and fourth Monday at 7 p.m. in Rm. 216.

Weight safety: Required course for employees wishing to use the Gilruth weight room. Pre-registration is required. Cost is $5. Annual weight room use fee is $90. The cost for additional family members is $50.

Exercise: Low-impact class meets from 5:15-6:15 p.m. Mondays and Wednesdays. Cost is $24 for eight weeks.

Step/bench aerobics: Low-impact cardiovascular workout. Classes meet from 5:15-6:15 p.m. Tuesdays and Thursdays. Cost is $32 for eight weeks. Call Kristen Taragzewski, instructor, at x36891 for more information.

Yoga: Stretching class of low-impact exercises designed for people of all ages and abilities in a Westernized format. Meets Thursdays 5-6 p.m. Cost is $32 for eight weeks. Call Darrell Matula, instructor, at x38520 for more information.

Ballroom dancing: Classes meet from 7-8:15 p.m. Thursdays for beginner advanced classes and from 8:15-9:30 p.m. for beginner-intermediate and intermediate students. Cost is $60 per couple.

Country and western dancing: Beginner class meets 7-8:30 p.m. Monday. Advanced class (must know basic steps to all dances) meets 8:30-10 p.m. Monday. Cost is $20 per couple.

Fitness program: Health-related fitness program includes a medical screening examination and a 12-week individually prescribed exercise program. For more information call Larry Wier at x30301.

http://www4.jsc.nasa.gov/ah/exceaa/Gilruth/Gilruth.htm

Office of Criminal Investigations Hotline

The Office of Criminal Investigations is the investigative arm of the NASA Inspector General. The primary mission of this component is to conduct criminal and civil investigations of reported or suspected fraudulent acts by employees, contractors, and others relating to the administration of NASA contracts and programs. Although much emphasis is placed on major procurement fraud (particularly allegations of product substitution, cost mischarging, kickbacks, anti-trust violations, and research misconduct), investigations are also conducted of theft, conflict of interest, environmental and hazardous waste violations, health care fraud, and computer-related crimes. The OCI also provides fraud briefings for government and contractor employees that are designated to highlight potential risks concerning safety, fraud, waste or mismanagement. To schedule a briefing, call 281-483-8427. To report suspected violations, call 281-483-8427 locally or the toll free Hotline at 1-800-424-9183, or write: NASA Inspector General, P.O. Box 23089, L'Enfant Plaza Station, Washington, DC 20024. The OIG Cyber-Hotline can be accessed at www.hq.nasa.gov/office/oig/hq.

NASA BRIEFS

FIRST GLOBAL 3-D VIEW OF MARS REVEALS DEEP BASIN, PATHWAYS FOR WATER FLOW

An impact basin deep enough to swallow Mount Everest and surprising slopes in Valles Marineris highlight a global map of Mars that will influence scientific understanding of the red planet for years.

Generated by the Mars Orbiter Laser Altimeter, an instrument aboard NASA's Mars Global Surveyor, the high-resolution map represents 27 million elevation measurements gathered in 1998 and 1999. The data were assembled into a global grid with each point spaced 37 miles apart at the equator, and less elsewhere. Each elevation point is known with an accuracy of 42 feet in general, with large areas of the flat northern hemisphere known to better than six feet.

"This incredible database means that we now know the topography of Mars better than many continental regions on Earth," said Dr. Carl Pilcher, science director for Solar System Exploration at NASA Headquarters. "The data will serve as a basic reference book for Mars scientists for many years, and should inspire a variety of new insights about the planet's geologic history and the ways that water has flowed across its surface during the past four billion years."

The amount of water on Mars can be estimated using the new data about the south polar cap and information about the North Pole released last year. While the poles appear very different from each other visually, they show a striking similarity in elevation profiles. Based on recent understanding of the North Pole, this suggests that the South Pole has a significant water ice component, in addition to carbon dioxide ice.

NASA HQ RECOMMENDED FOR ISO 9001 CERTIFICATION

An audit conducted by an internationally recognized registrar reports that NASA Headquarters will be recommended for ISO 9001 certification, becoming the seventh NASA facility to gain ISO certification.

ISO 9001 is the internationally accepted technical standard for managing all processes that affect an organization's ability to meet customer requirements for a quality service or product. The audit was conducted by Det Norske Veritas.

HUBBLE COMPLETES EIGHT-YEAR EFFORT TO MEASURE EXPANDING UNIVERSE

The Hubble Space Telescope Key Project Team last month announced that it had completed efforts to measure precise distances to far-flung galaxies, an essential ingredient needed to determine the age, size and fate of the universe.

"Before Hubble, astronomers could not decide if the universe was 10 billion or 20 billion years old," said team leader Wendy Freedman of the Observatories of the Carnegie Institution of Washington. "The size scale of the universe had a range so vast that it didn't allow astronomers to confront with any certainty many of the most basic questions about the origin and eventual fate of the cosmos. After all these years, we are finally entering an era of precision cosmology. Now we can more reliably address the broader picture of the universe's origin, evolution and destiny."

The team's precise measurements are the key to learning about the universe's rate of expansion, called Hubble's constant. Measuring Hubble's constant was one of the three major goals for NASA's Hubble Space Telescope when it was launched in 1990.

SPACE CENTER Roundup

The Roundup is an official publication of the National Aeronautics and Space Administration, Johnson Space Center, Houston, Texas, and is published by the Public Affairs Office for all space center employees. The Roundup office is in Bldg. 2, Rm. 181. The mail code is AP3. The main telephone number is x38648, and the fax is x32000. Electronic mail messages may be directed to:

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