The Orion Nebula: gas, dust

http://apod.nasa.gov/apod/ap120715.html
material - enriched with heavy elements - returned by stars to the Galaxy (to the “interstellar medium”)

- stellar winds
- planetary nebulae
- supernovae
Radio image of the Milky Way - cold atomic gas in a thin layer: revealed by the 21 cm emission line of atomic hydrogen
Radio image of the Milky Way - cold molecular gas in a thin layer; but also supernova remnants with bubbles above and below the disk plane.

http://apod.nasa.gov/apod/ap050205.html
Horsehead Nebula in Orion

http://apod.nasa.gov/apod/ap051130.html
FIGURE 19.16  Interactive Photo  This photo from the Hubble Space Telescope shows Galaxy M51’s two magnificent spiral arms, along with a smaller galaxy that is currently interacting with one of those arms. Notice that the spiral arms are much bluer in color than the central bulge. Because massive, blue stars live only for a few million years, the relative blueness of the spiral arms tells us that stars must be forming more actively within them than elsewhere in the galaxy. (The large image shows a region roughly 90,000 light-years across.)
Dark patches on inner edge of spiral arm show where gas clouds are packing together . . .

. . . and compression of these clouds triggers star formation in the arm.

Blue specks are young stars that formed in the spiral arm.

Red patches are ionization nebulae around the hottest, youngest stars.

Flow of gas and stars through spiral arm.
Spiral structure: very luminous stars and gas clouds tend to occur in spiral arms.
Galactic Center (optical)

http://apod.nasa.gov/apod/ap090925.html
Galactic Center (infrared)
Black Hole at the center of the Milky Way: X-ray flares

Infrared View of Milky Way

X-ray Image of Galactic Center

Pre-Flare

Flare

Post-Flare

http://apod.nasa.gov/apod/ap121102.html
Journey to the Center of the Galaxy

http://apod.nasa.gov/apod/ap120702.html
stars orbiting the Galactic center

http://www.astro.ucla.edu/~ghezgroup/gc/
8-year time-lapse

http://apod.nasa.gov/apod/ap001220.html
Wide-Field Radio Image of the Galactic Center
\( \lambda = 90 \text{ cm} \)
(Kassim, LaRosa, Lazio, & Hyman 1999)

Galactic Center (long-wavelength radio)
Formation of the Milky Way: spherical cloud of gas starts to collapse, forms stars destined to become halo stars, gas settles into orbiting disk, ongoing star formation there out of gas that’s increasingly metal-enriched
the “Magellanic Stream” - gas being pulled out of the Magellanic Clouds (our nearby neighbor galaxies) by the gravity of the Milky Way
The variety of galaxy types
Andromeda
Andromeda Galaxy

http://apod.nasa.gov/apod/ap130927.html
UV light: hot stars

http://apod.nasa.gov/apod/ap120518.html
Infrared: warm dust (orange)

X-ray: massive binaries (blue)

http://apod.nasa.gov/apod/ap110120.html
The variety of galaxy types

- E0
- E3
- E7
- S0
- Sa
- Sb
- Sc
- SBa
- SBb
- SBC
The Spitzer Infrared Nearby Galaxies Survey (SINGS) Hubble Tuning-Fork

The Spitzer Space Telescope observed 75 galaxies as part of its SINGS (Spitzer Infrared Nearby Galaxies Survey) Legacy Program. The galaxies are presented here in a Hubble Tuning-Fork diagram, which groups galaxies according to the morphology of their nuclei and spiral arms. The designation of these galaxies and their placement in the diagram is based on their visible-light appearance. The main goal of the SINGS program is to characterize the infrared properties of a wide range of galaxy types. The images of the galaxies are composites created from data taken by IRAC (the Infrared Array Camera) at 3.6 and 8.0 μm, and MIPS (the Multiband Imaging Photometer for Spitzer) at 24 μm.

The infrared range probed by these and other observations taken for the SINGS project allows for the detailed study of star formation, dust emission, and the distribution of stars in each galaxy. Light from old stars appears as blue in the images, while the lumpy knots of green and red light are produced by dust clouds surrounding newly born stars. The elliptical galaxies on the left are almost entirely made of old stars, while spiral galaxies like our own Milky Way are rich in young stars and the raw materials for future star formation.

More information can be found at:
http://sings.stsci.edu/