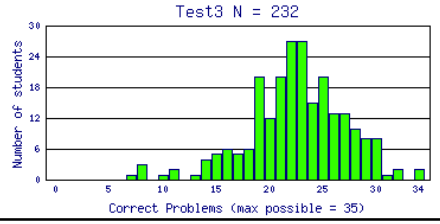
Winners of the OBAFGKM Mnemonic

On **B**reak **A** **F**riendly **G**uy **K**issed **M**om~~?~~ –Aarika Gerstler
Oscar Bought A Fried Guppy Kiddie Meal — Corinne Copeland
Obese Benny Asked For Glazed Kellogg's Maltomeal — Jonathan Vanderlee
Old Bakers Are Fairly Good Kneader-Men — Matthew Milia
Only Bad Astronomers Feel Good Knowing Mnemonics — Dash Dudley
Oh Be A Friend! Give Kevin Money — Andrew Mouranie
Oh Boy, An F Grade Kills Me. — David Moll
October Brings A Football Game; Kill Michigan — Emy Ibrahim
Only Bears Are Found Grazing Kalamazoo's Meijer — Stephanie Cady
Our Blessings Are From God's Kingdom Majestic — Latoya Baker
One Boy Ate Five Green Killer Mosquitoes — Kyle Bridges
Obese Badgers Attack Furiously, Gnawing/Killing Many — John Mallory
On Bob's Animal Farm, George Kept Mice — Whitney Jackson
Only Boring Astronomers Find Glee Knowing Mnemonics — Korina Raiford
Only Boys Accepting Feminism Get Kissed Meaningfully — David Silverman
Onion Breath Amidst Flaming Gingivitis Kills Molars —. James Falkowski

1 April

- Broken clickers: What H-ITT says.
  - New (2 columns of buttons) clickers are under warranty. Bookstore will replace these.
  - Old (1 column of buttons). Trade them in to me.
- Test3
  - www.loncapa.msu.edu
  - Average 23/35. Max 34/35
  - #13 has not been fixed yet
  - 4.0:≥28; 3.0: ≥ 25; 2.0:≥21; 1.0:≥ 17
  - Clickers & homework raise your grade: Average is 4.0.



Other Galaxies— 1 April

- Our Milky Way
  - Young stars, dust, & gas in disk. Circular orbits.
  - Old stars in halo. Elongated orbits
- How are other galaxies different from the Wilky Way?
  - Type of star? Gas? Dust?
  - Orbits
  - Dark matter
- How did M87, the central galaxy in the Virgo Cluster come to its present form?
  - History of galaxies

Elliptical
Spiral
Barred Spiral
Irregular

Other Galaxies— 1 April

M87

Elliptical
Spiral
Barred Spiral
Irregular

1. Which type of galaxies have no young stars?
   a. Elliptical
   b. Spiral
   c. Barred spiral
   d. Irregular
2. Which type of galaxy has the most gas?

- Stars form out of gas.
- For there to be O stars, there must have been gas 20 Myrs ago. (Compare to age of the sun, 4.5Byrs.)

Elliptical Galaxy: M87

- M87 in center of Virgo Cluster
- Virgo Cluster has hundreds of galaxies
- No gas
- No young stars
- No dust
- Halo
- Globular clusters
- Dark matter

NGC 4414: Spiral Galaxy

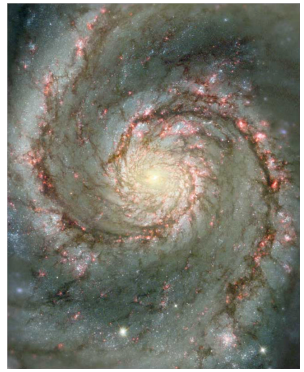
- Gas
- Young stars
- Dust
- Halo
- Globular clusters
- Dark matter

2. In this picture, what is evidence that this galaxy has young stars?
   a. Blue color
   b. Bright center
   c. Spiral structure
   d. Dark regions

M51: Spiral Galaxy

- Gas
- Young stars
- Dust
- Halo
- Globular clusters
- Dark matter

3. In this picture, what is evidence that this galaxy has young stars?
   a. Blue color
   b. Bright center
   c. Spiral structure
   d. Dark regions
   e. Red clouds



Large Magellanic Cloud: Irregular Galaxy

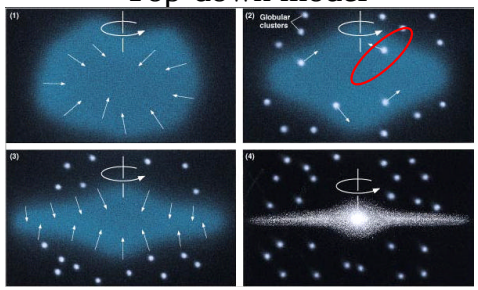
- Gas
- Young stars
- Dust
- Globular clusters
- Dark matter

4. In this picture, what is evidence that this galaxy has dark matter?
   a. Blue color
   b. Bright center
   c. Red clouds
   d. Dark regions
   e. None

Galaxy Formation

- After the Big Bang, the universe was filled very uniformly with hydrogen & helium
- Gravity pulled matter together to form galaxies & stars
- Clouds with spin formed spiral galaxies.
- Clouds with little spin formed elliptical galaxies.
- Galaxies cluster together by gravity
- Galaxies collide
  - Some collisions causes bursts of star formation.
  - Some collisions remove gas.

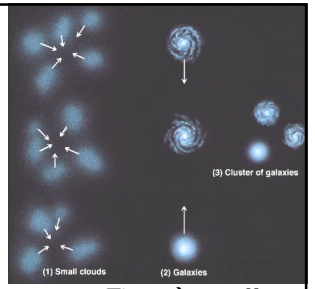
Formation of the Galaxy: Top-down model



- Collapse ➔ rotating disk
- Halo (Globular clusters & halo stars) formed during collapse.
  - Once formed, stars don't collide.

Competing theory:

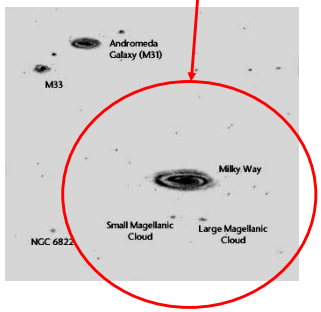
"Bottom Up" Galaxy Formation



Time → Now

- Small structures form first
  - Dwarf galaxies
  - Globular Clusters
- Galaxies grow by cannibalism
- Ellipticals formed by mergers of spirals (?)

Satellite galaxies around the Milky Way

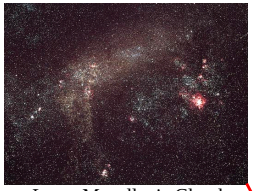


- In close orbits about our own Galaxy
- Irregulars and dwarf ellipticals

Galaxy	D (1000LY)	Lum. ($L_\odot$)
Milky Way	0	10^{11}
Large Magellanic Cloud	160	10^{10}
Small Magellanic Cloud	192	10^{10}
Fornax	450	10^{8}
Sagittarius Dwarf	80	10^{8}
Sculptor	285	10^{7}
+ 7 more known ones		

New one discovered 2 years ago

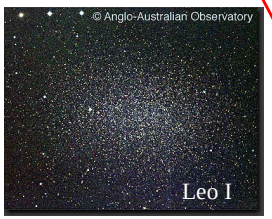
Satellite Galaxies



Large Magellanic Cloud

Small Magellanic Cloud

Milky Way



M31, M32, NGC 205

Life in the fastlane…

Colliding galaxies

Meanwhile, in a galaxy close, close to home…

The Milky Way Meets Andromeda

2.5 million ly away

Approaching at 500,000 km/hr

➔ Collision in 3 billion yrs

Movie lasts 1.3 billion yrs.

play