Solar System
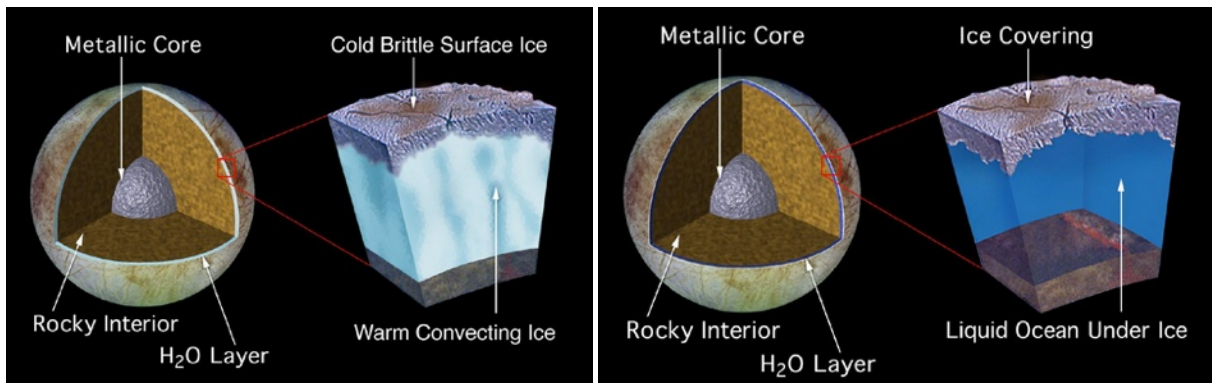## B Division
Sample Test (Modified Test Originally distributed at Mesa Robles Invitational, February 1st, 2014)

SCIENCE OLYMPIAD
™
Exploring the World of Science

Team Name:_____

Team #:_____

Student Names: _____

_____

IMAGE SHEET A
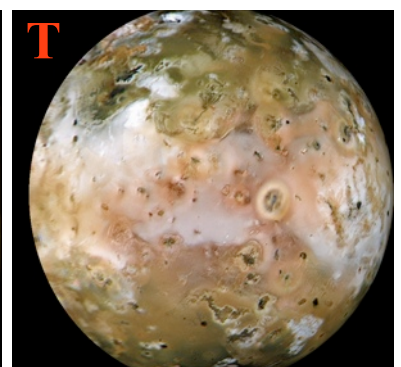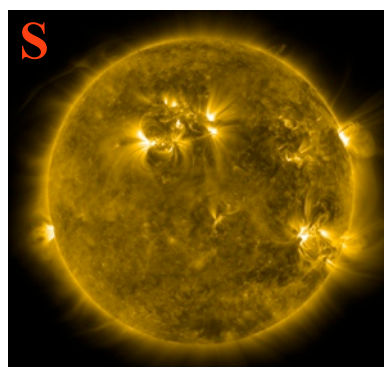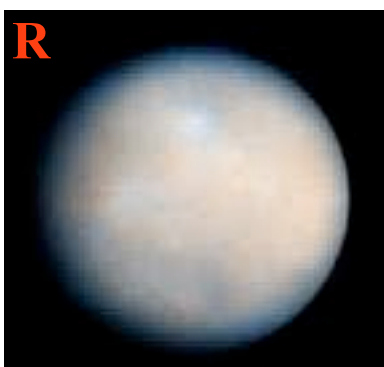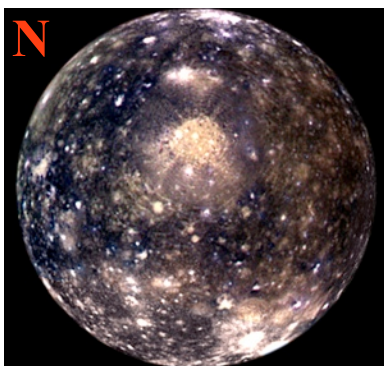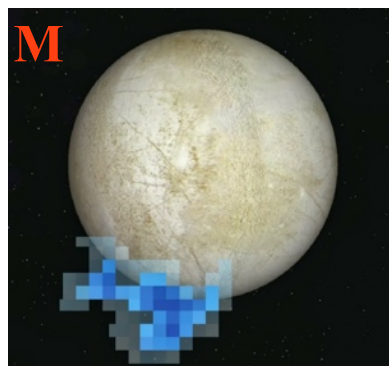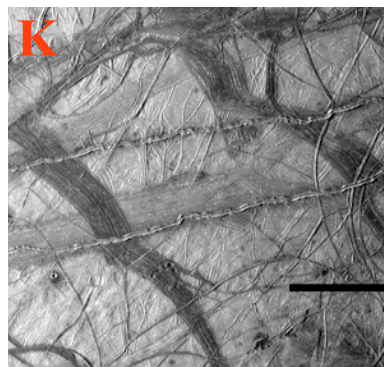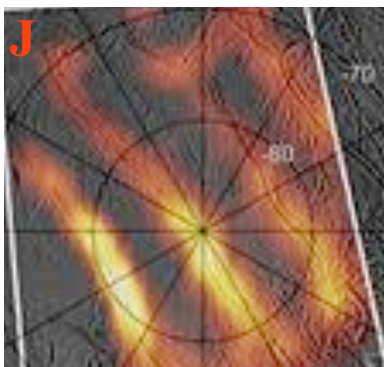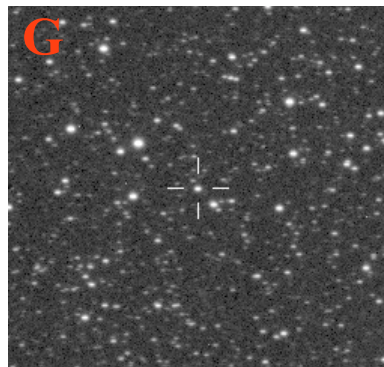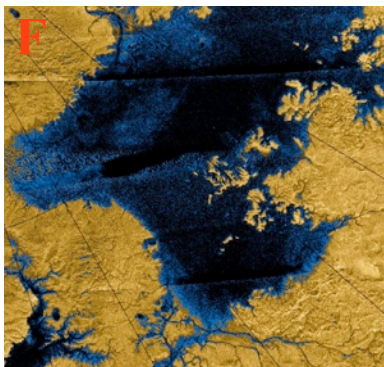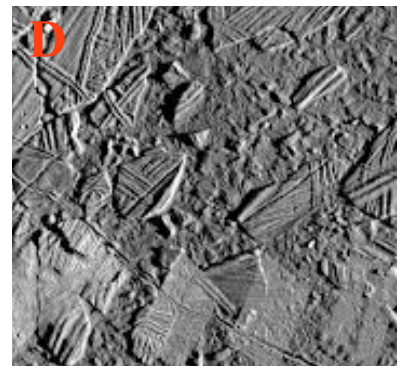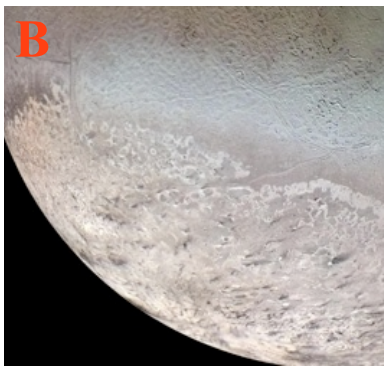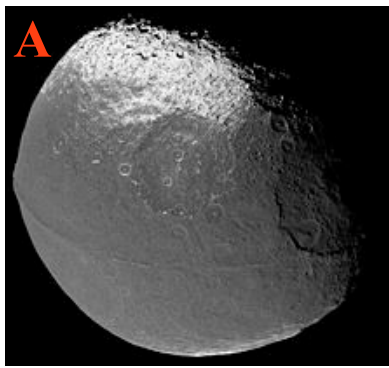
IMAGE SHEET B
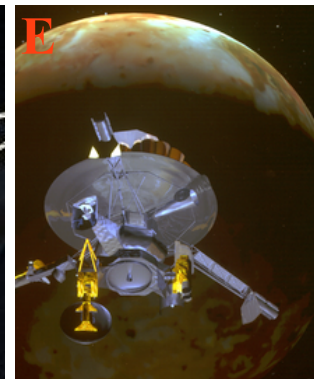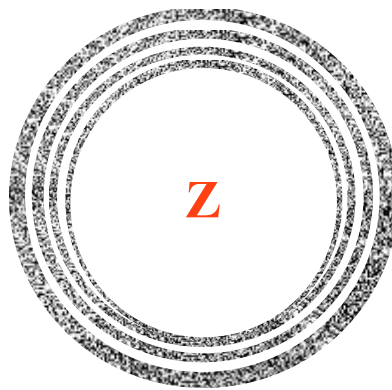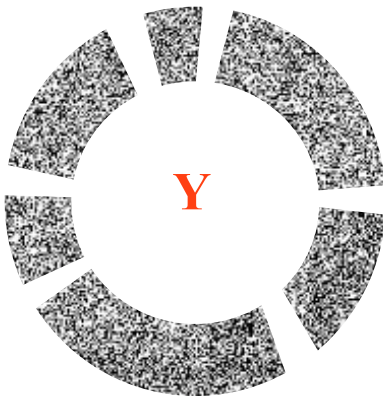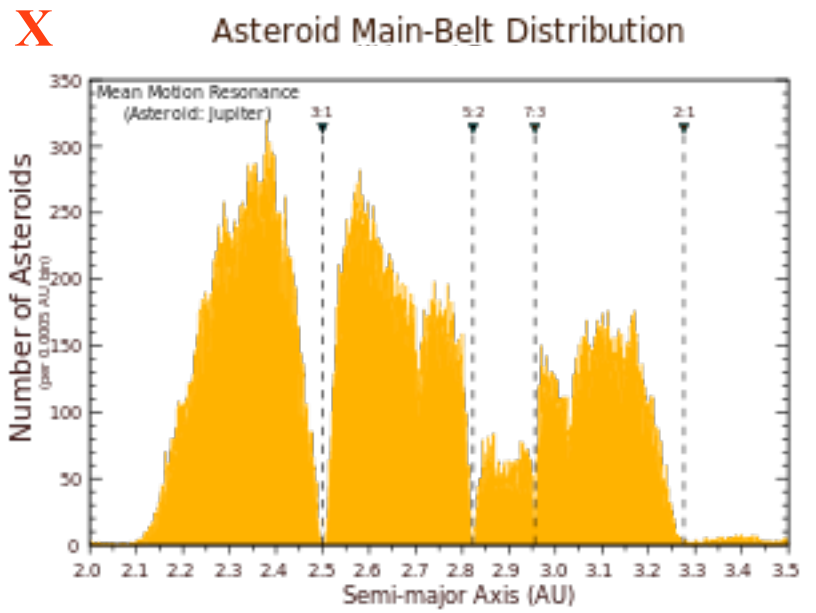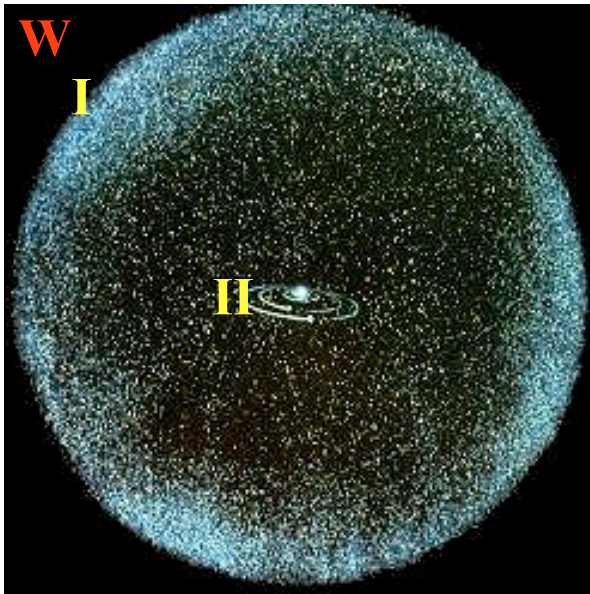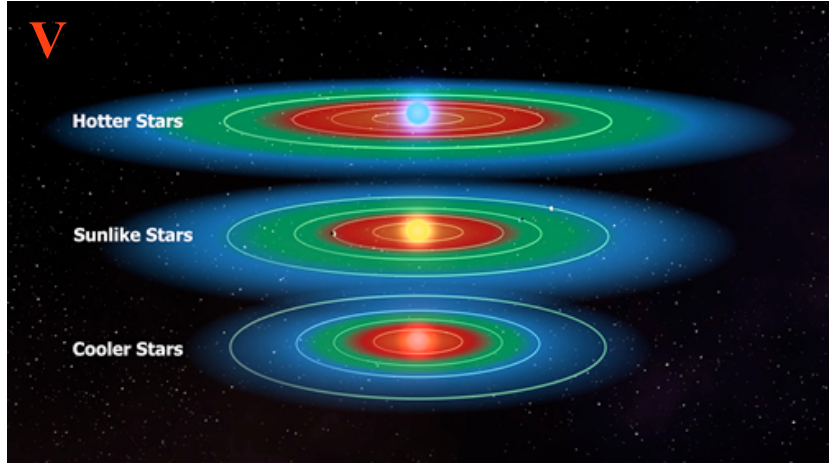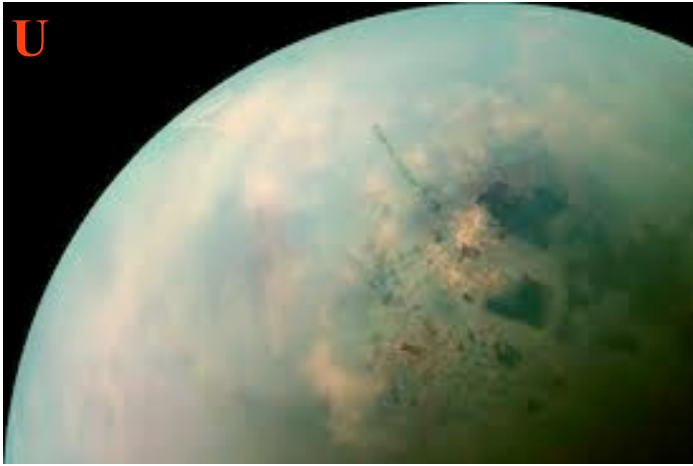
U

V

Hotter Stars

Sunlike Stars

Cooler Stars

W

I

II

X

Asteroid Main-Belt Distribution

Mean Motion Resonance
(Asteroid: Jupiter)

3:1   5:2   7:3   2:1

Number of Asteroids (per 0.0005 AU bin)

Semi-major Axis (AU)

Y

Z

A   **B**   **C**   **D**   **E**

1. Refer to the images on the cover sheet of the test. These images depict a simplified model of which object's surface?

2. Explain the differences between the theories depicted in the two images. What mission, proposed to launch in 2022, might conclusively settle this dispute?

3. Match each of following objects (1-14) with the feature, discovery, or mission (A-O) it is associated with. For option 15, please fill in the blank on your answer sheet with the missing matching object (to match the remaining feature, discovery or mission not already matched).

A. Damascus, Baghdad, Cairo, Alexandria	1. Mars
B. Maunder minimum	2. Ceres
C. First satellite to leave Solar System	3. Hyperbolic Comets
D. Interacts with Saturn's E Ring	4. Titan
E. Kuiper Cliff	5. Iapetus
F. Gale Crater	6. Kuiper Belt
G. First imaged Titan's surface in infrared	7. Enceladus
H. Huygens Probe	8. Tiger Stripes
I. Discovered 1846 by William Lassell	9. Sun
J. Tamu Massif	10. Pluto
K. Largest Asteroid	11. Oort Cloud
L. Icy bodies from outside the Solar System	12. Triton
M. Extends 1 LY from the Sun	13. Earth
N. Lowest albedo in the Solar System	14. Hubble Space Telescope
O. Recent Dwarf Planet status	15. _____

4. Due to proper atmospheric pressure and low gravity, on which object from Solar System rules could humans fly by simply flapping their arms?

5. What are the temperature (K) and pressure(atm) at the surface of this object?

6. On the surface of which object from the rules might you find water at the "Triple Point" on a phase diagram?

7. Which crystalline form of ice is the most common in space? Which is the least common?

8. Scientists are able to study water ice abundances and crystalline structures using what electromagnetic wavelength of spectroscopy?

9. Is this kind of electromagnetic spectroscopy of a shorter or longer wavelength than that which is used to study topographic features in the solar system?

10. What is the name of the band of the electromagnetic spectrum between 1420 and 1666 MHz, corresponding to 18-21 cm wavelengths that signals the presence of water in a spectroscopic target?

11. Which image shows a comet?

12. Which comet is shown in this image?

13. What comet-chasing satellite, currently 250 km away from Earth, was recently awakened from a state of hibernation in anticipation of its August 2014 contact with 67P/Churyumov–Gerasimenko?

14. What instrument was used to take the orange-yellow superimposed image on Image J?

15. What do these areas of brighter color indicate?

16. Which other image shows the same object as is pictured in Image J?

17. Image L shows the surface of which object?

18. What instrument was this image taken with?

19. What phase are most of the water and volatiles on this object in?

20. Which image shows the same object as Image L?

21. When was this object discovered, and by who?

22. Which two images show the object which features the "Piazzi Bright Spot"?

23. Which two satellites took these two images?

24. Which object are images O and P features of?

25. Are these features found near the North Pole, South Pole, or equator of this object?

26. What is the difference between images O and P?

27. Which other image shows the same object as Images O and P?

28. Which image shows an object that rotates its planet with retrograde motion?

29. What is the common name for the surface terrain on this object?

30. Which image shows Iapetus?

31. What is the name of the large impact crater visible on Iapetus's dark side?

32. Which object is shown in image M?

33. Imagery from which two satellites were used to create this image?

34. What does the blue in Image M show? When was this discovery announced?

35. Which other two images also show this object?

36. What are the names of the surface features in these images?

USE IMAGE SHEET B FOR QUESTIONS 37-47

37. What are the names of the distribution gaps in the Asteroid Belt Shown in image X?

38. Viewed above the plane of the solar system, do these gaps resemble a structure more like Image Y or Image Z?

39. The North Pole of which object is shown in Image U?

40. What is the name of the largest lake near the North Pole of this object?

41. In Image W, what are the regions labelled I and II?

42. In Image V, what does the bright green **line** represent?

43. In Image V, what do the green **regions** around each star represent?

44. In Image V, why might habitable planets not be found in the blue region?

45. In Image V, why might habitable planets not be found in the red region?

46. In Image V, what is the name of the distance from the star where the green region becomes the blue region?

47. Order the missions A-E in order of earliest launch date to to most recent.

48. Give the names of as many of these missions as you can.

49. Label the parts of a comet as shown
in the diagram to the right.

A

B

E

10^8 km

10^6 km

C

D

To Sun

Comet's motion

10^7 km
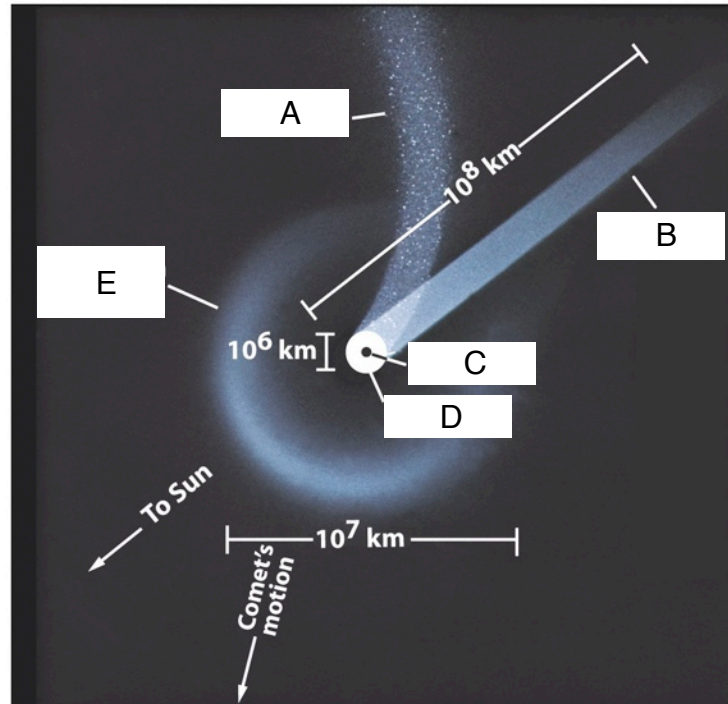
50. Why do scientists suspect that there may have been life on Mars at one point, despite currently uninhabitable conditions for life as we know it? Which conditions for habitability does Mars meet and which does it not?

51. Explain the water cycle and hydrodynamics on Europa. What is the leading hypothesis behind this dynamic system? How were surface features such as cycloids and ridges formed?

Score:	
Total Points Possible:	106
% Correct:	
RANK:	

TEAM NAME_____**TEAM NUMBER**_____

STUDENT NAMES: _____

_____

1. _____ (1)

2. _____

_____

_____

_____ (4)

MISSION:_____ (1)

3. A. _____ (1)   E. _____ (1)   I. _____ (1)   M. _____ (1)
    B. _____ (1)   F. _____ (1)   J. _____ (1)   N. _____ (1)
    C. _____ (1)   G. _____ (1)   K. _____ (1)   O. _____ (1)
    D. _____ (1)   H. _____ (1)   L. _____ (1)

The matching object that should be option 15 is: _____ (1)

4. _____ (1)
5. Temperature_____ (1)
   Pressure_____ (1)
6. _____ (1)
7. Most Common:_____ (1)
   Least Common:_____ (1)
8. _____ (1)
9. _____ (1)
10. _____ (1)
11. _____ (1)
12. _____ (1)
13. _____ (1)
14. _____ (1)
15. _____ (1)
16. _____ (1)
17. _____ (1)
18. _____ (1)
19. _____ (1)
20. _____ (1)
21. When:_____ (1)
    Who:_____ (1)
22. _____ (1) &_____ (1)
23. _____ (1)
   &_____ (1)

24. _____ (1)
25. _____ (1)
26. _____

_____

_____ (2)
27. _____ (1)
28. _____ (1)
29. _____ (1)
30. _____ (1)
31. _____ (1)
32. _____ (1)
33. _____ (1)
   &_____ (1)
34. _____

_____ (2)
   When:_____ (1)
35. _____ (1) &_____ (1)
36. _____ (1)
   & _____ (1)
37. _____ (1)
38. _____ (1)
39. _____ (1)
40. _____ (1)

ANSWER SHEET PAGE 2

TEAM NAME_____**TEAM NUMBER**_____

STUDENT NAMES: _____

_____

41. I:_____ (1)   II:_____ (1)

42._____ (1)

43._____ (1)

44._____

_____ (2)

45._____

_____ (2)

46._____ (1)

47. _____ (1) _____ (1) _____ (1) _____ (1) _____ (1)

48. A._____(1)

    B._____ (1)

    C._____ (1)

    D._____(1)

    E._____ (1)

49. A._____ (1)

    B._____ (1)

    C._____ (1)

    D._____ (1)

    E._____ (1)

50._____

_____

_____

_____

_____ (6)

51._____

_____

_____

_____

_____ (6)

Score:	
Total Points Possible:	106
% Correct:	
RANK:	

TEAM NAME: KEY   **TEAM NUMBER KEY**

STUDENT NAMES: KEY

1. Europa (1)

2. Thin vs. Thick Shell Hypothesis (1) *Points awarded based for specific points addressed in response*
   Depth and nature of internal heat sources (1)
   Ice vs Water as convective medium (1)
   Thickness of Europa's shell and depth of subsurface oceans, if they exist (1)
   MISSION: JUICE (1)

3.   A. 8 (1)   E. 6 (1)   I. 12 (1)   M. 11 (1)
      B. 9 (1)   F. 1 (1)   J. 13 (1)   N. 5 (1)
      C.15 (1)   G. 14 (1)   K. 2 (1)   O. 10 (1)
      D. 7 (1)   H. 4 (1)   L. 3 (1)

   The matching object that should be option 15 is: Voyager I (1)

4. Titan (1)
5. Temperature 85-95 K (1)
   Pressure 140-150 atm (1)
6. Mars (1)
7. Most Common: Amorphous (1)
   Least Common: Hexagonal (1)
8. Infrared (700 nm-1mm) (1)
9. Shorter (1)
10. Waterhole (1)
11. C (1)
12. Hale-Bopp(1)
13. Rosetta (1)
14. CIRS (1)
15. Higher temperatures (1)
16. H (1)
17. Titan (1)
18. Huygens Probe (1)
19. liquid (1)
20. F (1)
21.When: 1789 (1)
   Who: William Herschel (1)
22. R (1) & G (1)
23. Dawn Mission (1)
   & HST (1)

24. Mars (1)
25. North Pole(1)
26. Ice cap sizes change with the seasonal sunlight and temperature chances (2)
27. I (1)
28. B (1)
29. Cantaloupe Terrain (1)
30. A (1)
31. Falsaron OR Turgis (1)
32. Europa (1)
33. HST (1)
   & Cassini Orbiter (1)
34. Jets of water (and other particulate organic material (1)
   When: Dec. 12, 2013 (1)
35. D (1) & K (1)
36. Conamara Chaos (1)
   & Cycloids (1)
37. Kirkwood Gaps (1)
38. Z (1)
39. Titan (1)
40. Kraken Mare (1)

ANSWER SHEET PAGE 2

TEAM NAME KEY   **TEAM NUMBER KEY**

STUDENT NAMES: KEY

41. I: Oort Cloud (1)   II: Kuiper Belt (1)
42. Earth's Orbital Conditions (1)
43. Habitable Zone (1)
44. Too Cold, not enough non-ice solid formation to sustain most life (2)
45. Too Hot, planets may be ripped apart by gravity in unstable orbits (2)
46. frost line OR snow line (1)
47. B (1)   E (1)   A (1) C (1) D (1)

48. A. Cassini Huygens Mission (1)
     B. Voyager II (1)
     C. Mars Reconnaissance Orbiter (1)
     D. JUNO (1)
     E. Galileo (1)

49. A. Dust Tail (Type II Tail) (1)
     B. Ion Tail (Type I Tail) (1)
     C. Nucleus (1)
     D. Coma (1)
     E. Hydrogen Envelope(1)

50. No Methane detected (1)
    Water, Carbon Dioxide, Ammonia detected (1)
    Within Habitable Zone (1)
     Organic Material in Soil, evidence of past running water(2)
    Seasonal changes, evidence of active water(1)

51. Tidal Heating/flexing of icy shell from Jupiter's influence and LaPlace resonance with Ganymede
    and Io (2)
    Jets on South Pole (1)
    New Ice diapirs melting through icy crust(1)
    Subsurface oceans (1)
    Cycloids and Ridges formed from emergence of subsurface ice and changes in pressure(1)