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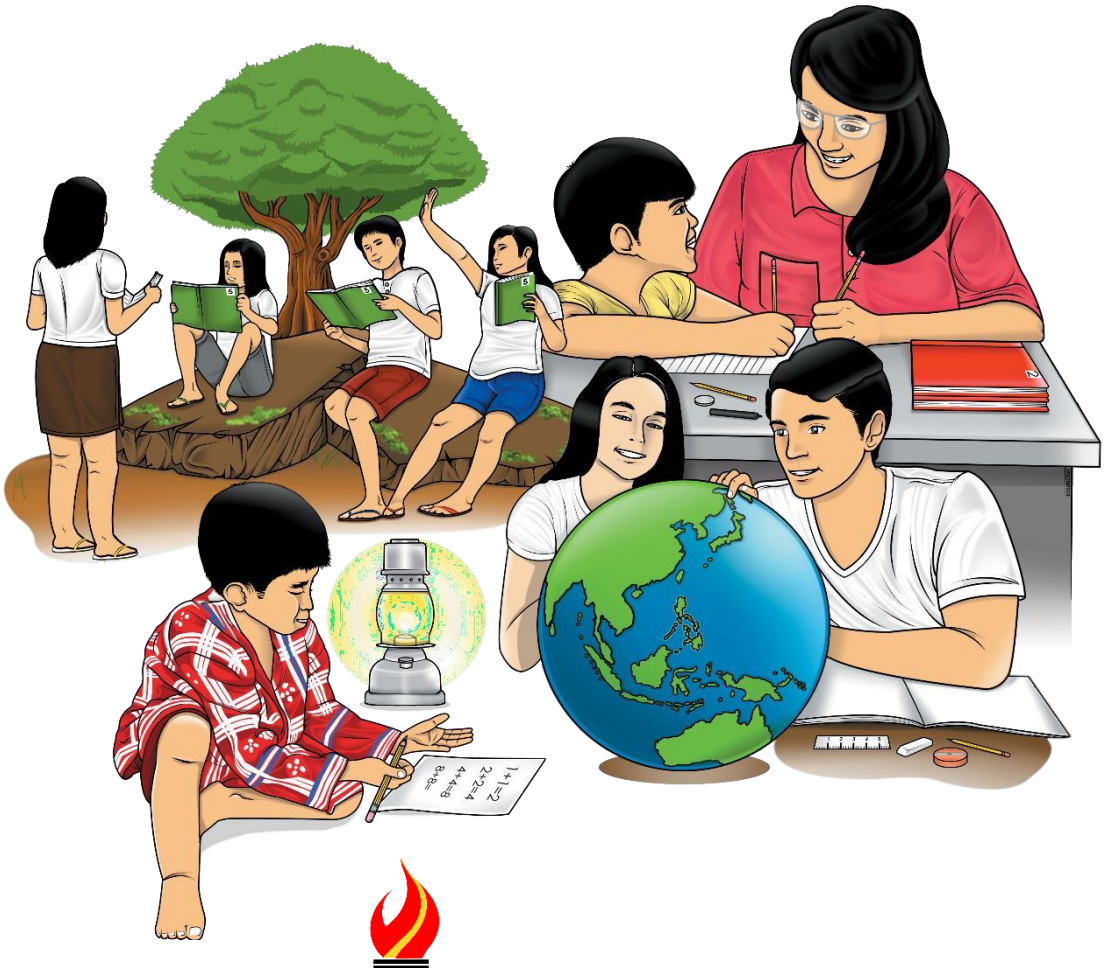
Science
Quarter 2 – Module 6: Comets, Meteors, and Asteroids



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ADM

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Quarter 2 – Module 6: Comets, Meteors, and Asteroids
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Science
Quarter 2 – Module 6: Comets, Meteors, and Asteroids

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using them.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

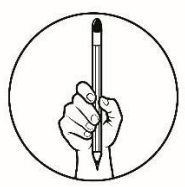
If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.
Thank you.

What I Need to Know

This module was designed and written with you in mind. It is here to help you master **comets, meteors, and asteroids**. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

After going through this module, you are expected to:

1. Compare and contrast comets, meteors, and asteroids *(MELC Week S8ES-IIg-22)*



What I Know

Directions: Choose the letter of the correct answer. Write your answers on a separate sheet of paper.

1. What are commonly called as “shooting stars”?
   A. asteroids
   B. comets
   C. meteors
   D. meteorites

2. What are found in the circular or somewhat like “doughnut-shaped” region between Mars and Jupiter?
   A. asteroids
   B. comets
   C. meteors
   D. meteorites

3. Which Near-Earth Objects (NEO) are found on the Kuiper Belt and Oort Cloud?
   A. asteroids
   B. comets
   C. meteors
   D. meteorites

4. What are comets made of?
   A. dust only
   B. metal only
   C. dust and metal
   D. dust, metal, and ice

5. What do you call the shining “head” around a comet?
   A. coma
   B. crown
   C. halo
   D. ring

6. What do you call the depression caused by the objects that fell on a planet or moon?
   A. canyon
   B. crater
   C. plateau
   D. pothole

7. Which could have probably caused the extinction of dinosaurs?
   A. They caught the flu.
   B. An asteroid hit the Earth.
   C. They ate each other until they went extinct.
   D. A meteorite came and hit the Earth causing their extinction.

8. What causes the bright sparks of light brought by meteors?
   A. humidity
   B. air friction
   C. condensation
   D. atmospheric pressure

9. What is the major difference among comet, meteor, and asteroid in terms ofstructure?
   A. Comet contains icy shell while asteroid and comet do not have.
   B. Meteor contains icy shell while asteroid and comet do not have.
   C. Asteroid and comet contain icy shell while meteor does not have.
   D. Asteroid contains icy shell while asteroid and meteor do not have.

10. Which of the following is the correct location of comets?
   A. Kuiper Belt
   B. Asteroid Belt
   C. Neptune's orbit
   D. Earth's atmosphere

11. What do you call a celestial body that reaches the Earth's crust?
   A. comet
   B. meteor
   C. meteorite
   D. meteoroid

12. What will happen if a comet gets closer to the sun? A comet will___.
   A. expire
   B. explode
   C. melt and disappear
   D. form a long tail made of gas and dust

13. Why do scientists study comets? It is because they_____.
   A. like studying it
   B. need to survey the space
   C. want to examine the mineral contents
   D. want to study the origin of the Earth and other planets

14.What celestial body is shown in the picture?

A. asteroid
B. comet
C. meteorite
D. meteoroid

Source: https://pixabay.com/illutrations/space-stars-comet-astronomy-*1486556/*.

15.What Near-Earth Object (NEO) is shown in the picture?

A. asteroid
B. comet
C. meteor
D. meteorite

Source: https://pixabay.com/vectors/dark-darkness meteor-night-2024127/)

Lesson 1 Comets, Meteors, and Asteroids

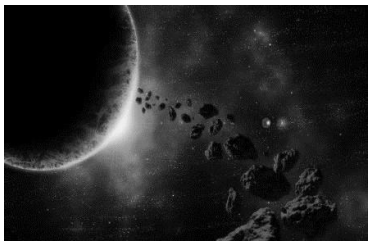
Have you already watched a movie showing rocks from outer space crashing violently on Earth? Do you know that there are many rocks in outer space? Those are what we call comets and asteroids. Are you aware that "falling stars" are not stars but meteors? Read the module and answer the activities to find out.

What's In

Activity 1. Match It

Directions: Match Column A with Column B. Write your answers on a separate sheet of paper.

A B

1. 
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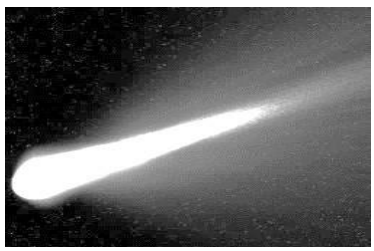
3. 

Picture Sources:
1.https://pixabay.com/illustrations/space- asteroids-planets-cosmos-1422642/

2.https://pixabay.com/illustrations/space- stars-comet-astronomy-1486556/)

3. https://pixabay.com/photos/asteroid-comet- meteorite-3628185/)

What's New

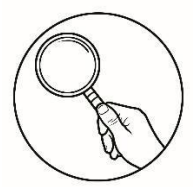
Characteristics of Comets, Meteors, and Asteroids

Did you know that recent discoveries like the Comet 'Neowise' that dazzled on Hungary's sky on July 23, 2020 have made the experts know more about the Near-Earth Objects (NEO) like comets, asteroids, and meteors? With the advent of telescopes and space probes, these instruments provided more knowledge on the origin and nature of the universe. Recently, astronomers have discovered asteroid 2012 DA14 that came close to Earth. It made a very close approach to the Earth as it orbited the Sun on February 16, 2012. It exploded over the Lake Cherbakul in Russia causing damages to properties and according to the press release of National Aeronautics and Space Administration (NASA), the material exploded are composed of different objects.

Table 1. Characteristics of Comets, Meteors, and Asteroids

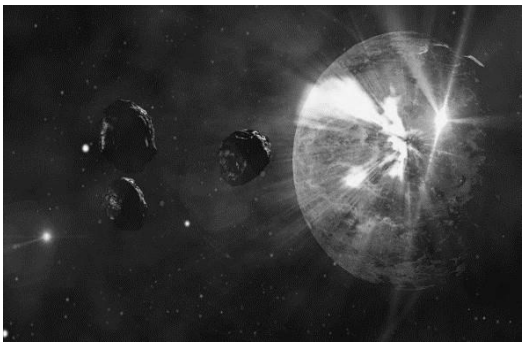
Characteristics	Comets	Meteors	Asteroids
Origin	Kuiper Belt and Oort Cloud	most are from the Asteroid Belt	Asteroid Belt
Shape	varied/irregular	varied/irregular	varied/irregular
Size	1 to 10 nuclei	about 1 inch (2.5 cm long)	1 to 100 ++
Chemical Composition	dust, rock, metals, ice, frozen gases, ammonia, methane, carbon dioxide, and other organic compounds	fragments of asteroids and comets iron, stone, stony-iron, and chondrites	dust, rock, and metals like silicate, iron, and nickel including olive and pyroxene
Orbit	highly elliptical	no orbit as it is inside the Earth's atmosphere	more rounded
Orbital Period (in years)	75 to 100,000++		1 to 100
Importance to Research	provides clues on how liquid water was formed on Earth	provides information on star formation and evolution	provides information on the composition of the Earth's interior

Source: Pia C. Campo, et.al, Science *8 Learner's Module.* Pasig City: Department of Education, 2013, 156

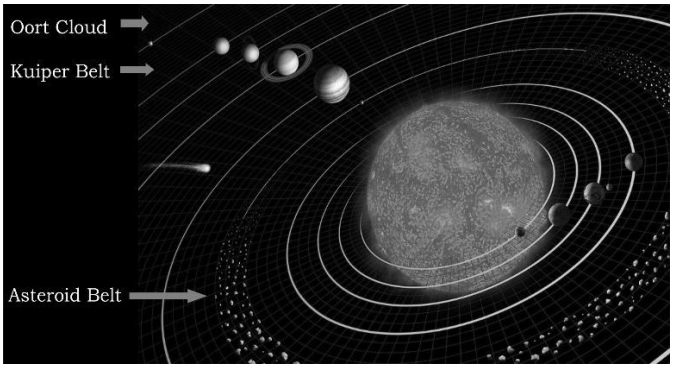


What is It

Comets, meteors, and asteroids come in different sizes and compositions. A relatively higher amount of silicate content caused these celestial bodies to reflect light. Silicates are types of metal that contain silicon, oxygen, and at least one metal. If an asteroid has fewer silicate content, then it would be hard to see it even with the aid of a telescope because only a small part of the asteroid can reflect light and it might seem smaller than its actual size.



(Source: https://pixabay.com/photos/asteroids-planet- space-meteor-1017666/)



(Source: https://pixabay.com/illustrations/solar-system-planet- planetary-system-11111/)

Both the comet and asteroid orbit the Earth and move relatively slow when viewed from the Earth. This means that you can view a comet for up to a year in the night sky. The main difference between the comet and asteroid is the origin. Comets typically come from the Oort Cloud which is beyond the solar system and some from the Kuiper Belt which is beyond the Neptune's orbit. Long-period comets originate from the Oort Cloud while a short-period comes from the Kuiper Belt.

Comet Halley is the most well-known short-period comet of the 20th century since it takes 75 to 76 years for this comet to orbit the Sun. We can view it in the sky every time it comes closer to the Sun. All other comets have been identified as long-period comets since it takes 200 to several thousand years to complete their orbit around the Sun. On the other hand, asteroids originate from the Asteroid Belt. These are found between Mars and Jupiter.

The recent theory states that the Asteroid Belt was heavily populated with asteroids, but the gravitational pull of Jupiter has made these asteroids thrown. It was also theorized that Jupiter's gravitational pull prevented these asteroids from forming into a new planet. Another group of astronomical researchers theorized that the Asteroid Belt was an empty space and the debris of other planets have filled this area with the objects which are then called asteroids.

The orbit of an asteroid is more rounded and less elliptical than the orbit of a comet. On February 2013, Asteroid 2012 DA14 made a closer approach to Earth as it orbited around the Sun. Distance in space was measured by lightyears and this asteroid was just 0.4 lightyears away from the Earth, the closest that an asteroid has ever been on Earth. On December 2012, during the issue of the doomsday prophecies, Asteroid Toutatis has made a near approach to Earth but not as close as Asteroid 2012 DA14.

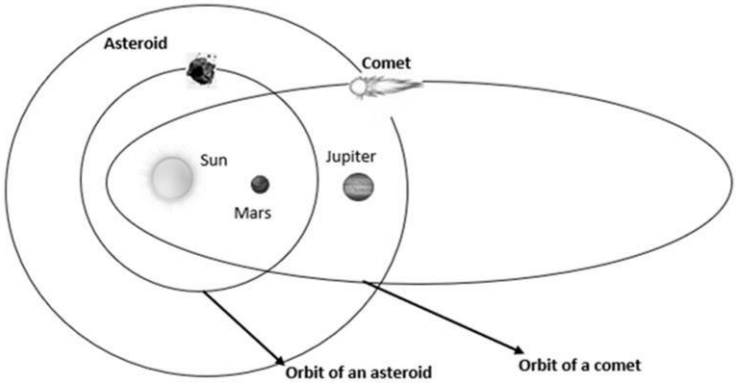


Figure 1: The Asteroid and Comet's Orbit

Illustrated by: Shawn Dwight A. Ga

Figure 1 shows the orbits of asteroid and comet. The orbit of an asteroid is more circular compared to that of the comet. An asteroid's orbit lies between Mars and Jupiter. The region between these two planets is called Asteroid Belt. On the other hand, the orbit of a comet is more elongated or elliptical in shape since it extends from the far region of the solar system. Oort Cloud is found beyond the solar system while Kuiper Belt is located beyond Neptune.

Another difference between asteroids and comets is their chemical compositions. Asteroids contain rocks and metals while comets contain ice or icy objects including dusts, metals, and elements like Sodium and Argon. Unlike a comet, an asteroid is composed of rocky metals that are mostly Iron and Nickel. Scientists discovered that Comet-Hale Bopp contains Argon which made the comet appear brightly.

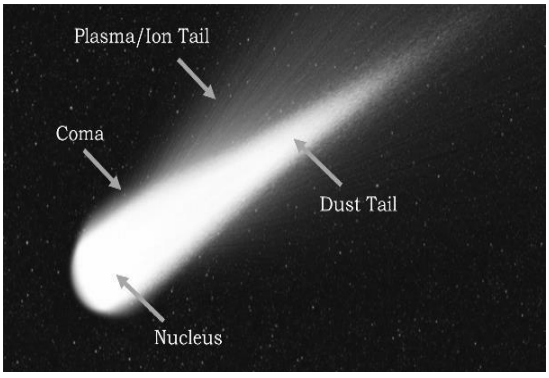


Figure 2: Parts of the comet
Illustrated by: Shawn Dwight A. Ga

The "dirty snowball" made of ice is the nucleus of a comet. As the comet gets closer to the Sun, the ice melts and evaporates together with dust particles. These particles of gases make a shining "head" around the comet called a coma.

Scientists theorized that Earth has been too hot to have water on the surface. A closer study reveals that the collected samples of ice from drilling down the Earth's crust and marine layers have brought water to the planet. The comet's composition provides clues for them to understand how Earth obtained liquid water which makes it habitable.

The composition of an asteroid provides information to the chemical compositions of planets in the solar system. Iron and Nickel are the asteroid's components which are the same metals that make up the Earth's core. An element called Iridium was discovered on oceanic sedimentary layers of Denmark, Italy, and New Zealand, by Alvarez Brothers namely Luis and Walter Alvarez. They have discovered the rocks that contains higher level of Iridium compared to the Earth's crust which is with the same level of Iridium of the asteroid. Because of this, they have presumed that asteroids landed on Earth that caused the death of the dinosaurs. They came up to their hypothesis which was later called as Alvarez Hypothesis.

Based on Alvarez hypothesis, an asteroid with about ten kilometers in diameter made an impact on Earth. This phenomenon caused the blocking of sunlight in the air, bringing a period of long winter that caused the mass extinction of plants and animals including the dinosaurs.

Scientists theorized that Earth has been too hot to have water on the surface. A closer study reveals that the collected samples of ice from drilling down the Earth's crust and marine layers has brought water to the planet. The comet's composition provides clues for them to understand how Earth obtained liquid water which makes it habitable.

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Based on Alvarez hypothesis, an asteroid with about ten kilometers in diameter made an impact on Earth. This phenomenon caused the blocking of sunlight in the air, bringing a period of long winter that caused the mass extinction of plants and animals including the dinosaurs.

Figure 2: Meteor
Illustrated by Mary Grace M. Lad

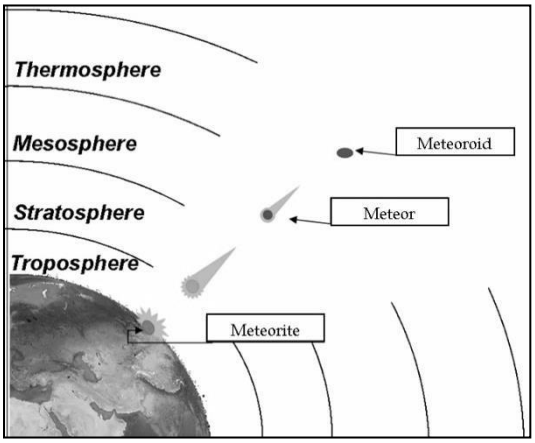
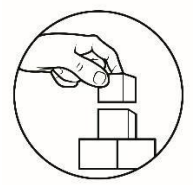


Figure 3: Meteoroid, Meteor, and Meteorite
Illustrated by: Mary Grace M. Lad

Meteoroids are remnants or fragments of asteroids and comets located outside the Earth's atmosphere. Meteoroids originated from the collision of asteroids. They were also known to be the debris of comets that travel around the sun or debris from the impact of collision of Mars or the moon with asteroids. When these meteoroids enter the Earth's atmosphere, it will then be called **meteors** as shown in Figure 2. When these landed on the Earth's ground, it is then called **meteorites** as shown in Figure 3.

A little body begins as a meteoroid skimming through space between the planets until it enters the Earth's atmosphere creating a streak of light as a meteor or commonly known as "shooting star". Afterwards, if it was not vaporized completely by frictional heat and landed on the Earth's ground, it is called meteorite. There are times in the year where we observe meteor showers occurring when the Earth passes through debris left by comets or asteroids.

The orbit of an asteroid is more rounded and less elliptical than the orbit of a comet. On February 2013, Asteroid 2012 DA14 made a closer approach to Earth as it orbited around the Sun. Distance in space was measured by lightyears and this asteroid was just 0.4 lightyears away from the Earth, the closest that an asteroid has ever been on Earth. On December 2012, during the issue of the doomsday prophecies, Asteroid Toutatis has made a near approach to Earth but not as close as Asteroid 2012 DA14.



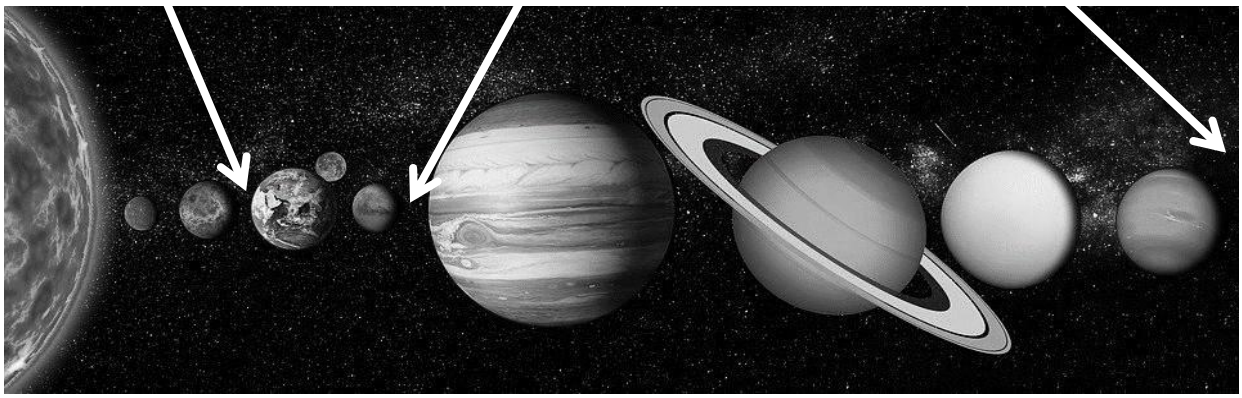
What's More

Activity 2. Spot Some NEOs

Directions: Identify what Near-Earth Objects are seen in each item. Choose your answer from the box. Write your answers on a separate sheet of paper.

Asteroid	Comet	Meteors	Meteorite

1._____ 2. _____ 3. _____



(Source: https://pixabay.com/illustrations/sky-stars-planets-space-moon-star-3880590/)

Activity 3. Identify It

Directions: Identify what is being referred to in each item. Choose your answers from the box. Write your answers on a separate sheet of paper.

Earth's Atmosphere	Kuiper Belt	Mars and Jupiter	
Oort Cloud	Asteroid Belt	Uranus	Earth and Mars

_____1. It is the origin of the comets that is beyond the solar system.

_____2. It is where the asteroids originated.

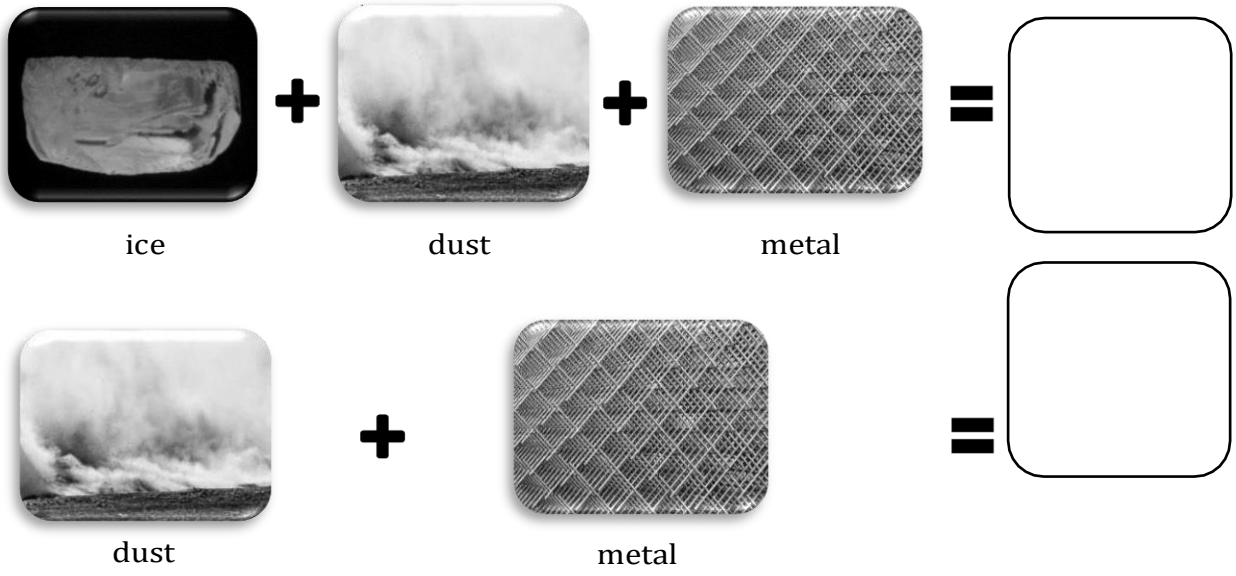
_____3. It is the origin of the comets located within the orbit of Neptune.

_____4. It is where meteors can be found.

_____5. Most asteroids can be found between these two planets.

Activity 4. Take It from Mixing and Colliding

Directions: Determine the Near-Earth Objects after mixing or colliding the different celestial components. Write your answers on a separate sheet of paper.



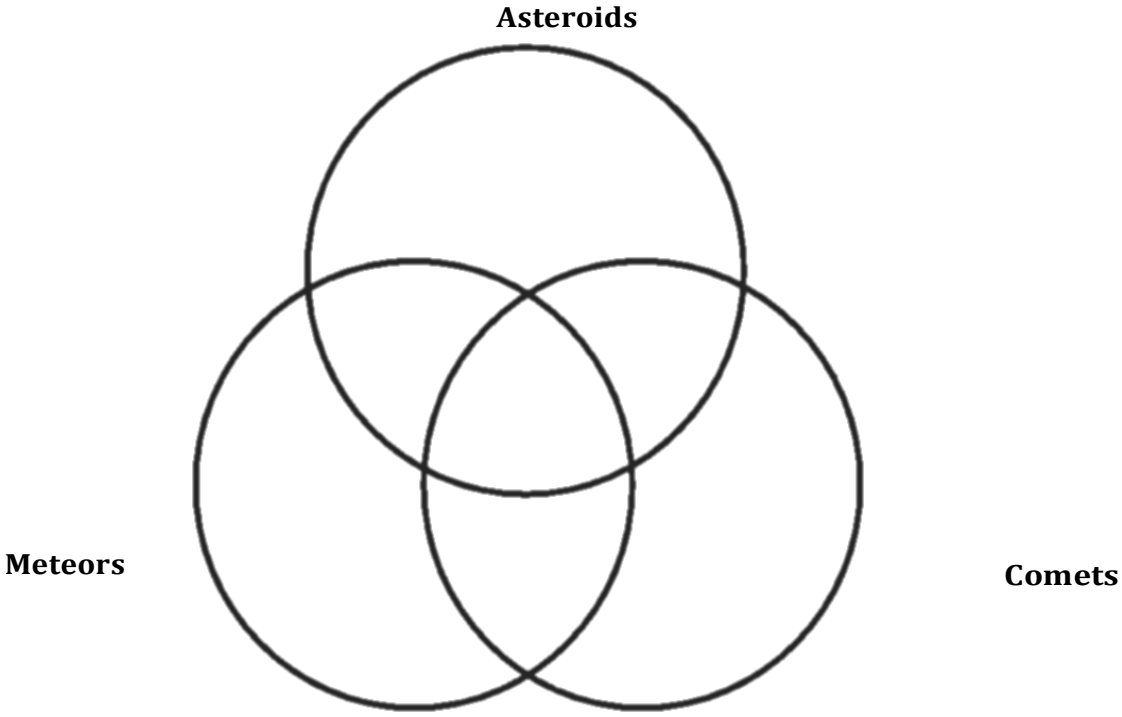
asteroid asteroid

Picture Sources:

Ice- https://pixabay.com/photos/st one-glass-colorful-gem-color-6580/
Dust- https://pixabay.com/photos/race- car-race-track-dirt-road-car-1031767/
Metal- https://pixabay.com/photos/gri d-wire-mesh-stainless-rods-826831//
Asteroid: https://pixabay.com/photos/ast eroid-meteorite-comet-63125/)

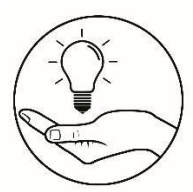
Activity 5. Let Us Know Them More

Directions: Fill in the Venn diagram by identifying the different components present in comets, meteors, and asteroids from the box below. Writeyour answers on a separate sheet of paper.



metals	silicates	dusts	rocks
ice	Iron	Nickel	Ammonia
flame	Carbon dioxide	Sodium	Argon

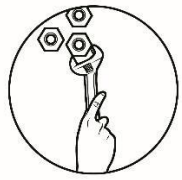
Clues: At the intersection of the circles, write the components that are both present in the two circles from the two Near-Earth Objects mentioned. At the center, write the components that are common from comets, meteors, and asteroids.



What I Have Learned

Directions: Fill in the blanks with the correct answer. Write your answers on a separate sheet of paper.

1. _____ typically come from the Oort Cloud and some from the Kuiper Belt.
2. Asteroids originated from the _____ which is in between Mars and Jupiter.
3. _____ is a streak of light that happens when a meteoroid enters the Earth's atmosphere.
4. The _____, _____, and _____ differ in orbits, orbital periods, origins, chemical compositions and their importance to research.
5. The "dirty snowball" made of ice is the _____ of a comet.
6. The orbit of an asteroid is _____ while the orbit of a comet is elongated.
7. _____ are remnants or fragments of asteroids and comets located outside the Earth's atmosphere.
8. _____ is the most well-known short-period comet of the 20th century since it takes 75 to 76 years to orbit the Sun.
9. On February 2013, _____ made a closer approach to Earth as it orbited around the Sun.
10. Kuiper Belt is located beyond _____.



What I Can Do

Directions: Read the news article and answer the questions that follow. Write youranswer on a separate sheet of paper.

source of picture**:** https://pixabay.com/illustrations/armageddon-apocalypse-earth-2104385/

Risks of Asteroid Strike to Earth from Elon Musk's Starlink Project Feared

By: Nirmal Narayanan

December 10, 2019- In an attempt to provide internet to all corners of the globe, Elon Musk's Starlink project will gradually send tens of thousands of satellites into the earth's orbit. But some astronomers believe the project could increase the chances of asteroid hits to earth.

Space agencies like NASA (National Aeronautics and Space Administration) and astronomers make use of telescopes to track near-earth objects that could pose a threat to earth in the future. However, the task will become extremely difficult when telescopes have to filter out tens of thousands of Starlink satellites that are already in the earth's orbit.

A few months back, while interacting with followers on Twitter, the Tesla founder revealed that humans do not have a proper shield to protect the planet from doomsday asteroids. He made the comments when one of his followers asked whether asteroid Apophis will hit earth in 2029.

"Great name! Wouldn't worry about this particular one, but a big rock will hit Earth eventually & we currently have no defense," wrote Musk on Twitter. However, later Musk called NASA's planetary defense mission 'Armageddon', prompting fears that something sinister from deep space was on its way to earth.

Source: "Risks of Asteroid Strike to Earth from Elon Musk's Starlink Project Feared", IB Times Corporation, last modified December 10, 2019, https://www.ibtimes.sg/risks-asteroid-strike-

Questions:

1. What is the news article all about?

   _____

2. What could possibly happen if the asteroid would hit the Earth?

   _____

3. What are the disadvantages of having too many satellites in the Earth's orbit?

   _____

4. Based on the news you have read, could the impact of the asteroid cause extinction to some organisms including animals? Support your answer.

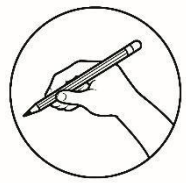
   _____

5. What could be the possible measures humans can do to avoid or block the asteroid from hitting the Earth?

   _____

Rubric

5 points	4 points	3 points	2 points	1 point
The answer is complete. All information provided is accurate.	The answer is missing 1 detail. All information provided is accurate.	The answer is missing 2 details. Almost all information provided is accurate.	The answer to the question is lacking any detail. Some information provided is accurate.	Question is not answered. A small amount to none of the information provided is accurate.



Assessment

Directions: Choose the letter of the correct answer. Write your answers on a separate sheet of paper.

1. Which statement is true?
   A. Only asteroids collide with Earth.
   B. Comets are ball of ice, dust, and metal.
   C. All comets in our solar system have tails.
   D. Only asteroids can be found in the solar system.

2. What do you call the fragments or debris that resulted from the collision of asteroids or comets?
   A. Meteors
   B. Meteoroids
   C. Oort Cloud
   D. Kuiper Belt

3. What is the bright glow around the "head" of a comet?
   A. Coma
   B. Crown
   C. Halo
   D. Ring

4. What is the name of the famous comet that can be seen from Earth every 75 to 76 years?
   A. Hale Boop
   B. Comet Halley
   C. Comet Tempel 1
   D. Shoemaker Levy-9

5. What is the correct term for a "shooting star"?
   A. Asteroid
   B. Comet
   C. Falling star
   D. Meteor

6. What is an Asteroid Belt?
   A. It has rocks crossing the Sun, Mars, and Jupiter.
   B. It has rocks crossing the Sun, Jupiter, and Uranus.
   C. It is an area between Mars and Jupiter where most asteroids are found.
   D. It has rocks between the Earth and Jupiter where most asteroids are found.

7. What is a meteorite? It is a_____.
   A. dim meteor
   B. bright meteor
   C. meteoroid that lights up
   D. remains of meteoroids that hit the Earth

8. What is a comet? It is a/an_____.
   A. rock from Mars
   B. class of smaller inner solar system bodies that orbit around the sun
   C. icy ball of rock that displays a coma, a fuzzy temporary atmosphere, or a tail when it travels close to the sun
   D. natural object from small to huge that originates in space and survives the impact on the Earth's surface

9. What composes silicate?
   A. silicon, oxygen, and at least one metal
   B. silicon, carbon, and at least one metal
   C. silicon, methane and a rock
   D. iron, nickel, and argon

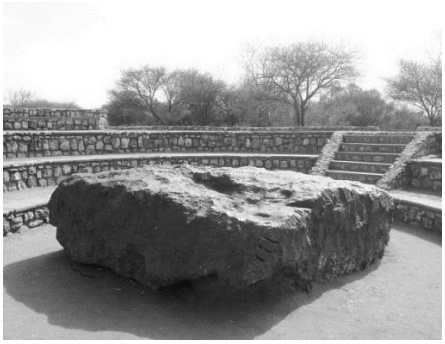
10. Why do scientists study comets?
   A. They are valuable minerals.
   B. They could provide Earth with rocks.
   C. They can help make the Earth a habitable planet.
   D. They provide information how the Earth obtained liquid water.

11. Why would global temperature of the Earth drop when struck by a massive asteroid?
   A. The resulting cloud would block out sunlight.
   B. The low temperature of asteroid would chill the oceans.
   C. The impact would move the Earth farther from the Sun.
   D. The ice in the asteroid would increase the Earth's reflective power.

12. When objects strike on the surface of a planet, they leave a deep impression on the surface called_____.
   A. canyon
   B. crater
   C. plateau
   D. pothole

13. Meteoroids are formed when asteroids collided and crushed into pieces. Based on this statement, where did the meteoroids originate?
   A. Asteroid Belt
   B. Mars
   C. Moon
   D. Sun

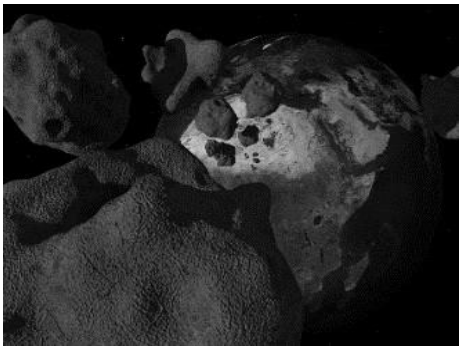
14. Which best describes the picture below?



(Source: https://pixabay.com/photos/meteorite-stone- hoba-namibia-700836/)

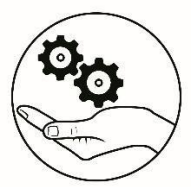
A. meteorite
B. meteoroid with dust
C. comet with coma and ion tail
D. asteroid that falls to the Earth

15. What celestial body is shown below?



(Source: https://pixabay.com/photos/asteroid- meteorite-impact-meteor-179319/)

A. Meteors
B. Meteorites
C. Meteoroids
D. Meteor shower



Additional Activities

Directions: In a long bond paper, draw the solar system highlighting the location of the comets, meteors, and asteroids.

Rubric

Criteria	4	3	2	1
Complete and in correct order	Complete and all are ordered correctly	Most parts are present and are ordered correctly	Some parts are present and are ordered correctly	Incomplete and ordered incorrectly
Label	All are labeled correctly	Most are labeled correctly	Some are labeled correctly	All are labeled incorrectly
Artistic quality	The drawing is highly colorful and artistic.	The drawing is somewhat colorful and artistic.	The drawing has few artistic qualities.	The drawing has no artistic qualities.

Answer Key

Assessment

1. B
2. B
3. A
4. B
5. D
6. C
7. D
8. C
9. A
10. D
11. A
12. B
13. A
14. A
15.C

Additional Activity

What I have learned? (page 16)

1. Comets
2. Asteroid Belt
3. Meteors
4. Comets, Meteors, and Asteroids (can be interchanged)
5. nucleus
6. rounded
7. meteoroids
8. comet Halley
9. Asteroid 2012 DA14
10. Neptune

What I can do? *(page 17-18)*

Answers may vary

Suggested Answers:

1. It is all about the thousands of satellites sent in Earth's orbit increasing chances of asteroids to hit the Earth.
2. It will leave destruction to the part of the Earth that will be hit by the asteroid. Worst, if the asteroid is massive or big enough then it might be the end of Earth. If it happened years ago, then many animals or other organisms might not be seen today because it might have been extinct
3. The task of tracking the NEOs that could pose a threat to Earth in the future will become extra difficult because they have to filter out thousands of satellites that are already in Earth's orbit.
4. Yes, if the asteroid is much bigger than the earth, the extinction could be possible.
5. Reduce satellite launch to the space. Also, we can create satellites or machines that can break down big asteroids to smaller chunks before it can enter Earth's atmosphere.

What I Know?

1. C
2. A
3. B
4. D
5. A
6. B
7. B
8. B
9. A
10. A
11. C
12. D
13. D
14. B
15. C

What's In? Activity 1

1. C 2. B 3.A

What's More?

Activity 2

1. Meteor
2. Asteroid
3. Comet

Activity 3

1. Oort Cloud
2. Asteroid Belt
3. Kuiper Belt
4. Earth's Atmosphere
5. Mars and Jupiter

Activity 4

1. Comet
2. Asteroid
3. Meteoroid

Activity 5

Asteroids- metals, iron, dusts, nickel, rock, silicate, argon

Comets- metals, ice, dusts, rocks, carbon dioxide, ammonia, argon, sodium

Meteors- rock, dust, flame

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