

Analysis of implemented lesson-Kostka (Expanded Ticket in the Door)

1. Review:

Setting: I implemented my NAL lesson on January 27th, 2020. It was an Earth Science Astronomy lesson that was implemented in a series of six grade Middle School inclusion classrooms with 24 gifted students. The students included 14 females and 10 males and of these gifted students 1 is twice exceptional. The lesson has students independently learn about **asteroids** as planetary bodies found within our solar system and to compare/contrast them to common objects and discuss their importance to humans. To achieve this, the lesson is broken into Parts. Part 1: Engage, Part 2: Explore, and Part 3: Explain. (Essential Question: “How can rocks help us understand our place in the Universe?”)

Modifications from Lesson Plan: When implementing this lesson, I changed nothing from the original lesson plans in parts 1-3. I did however add an additional formative assessment after the next lesson to have students create a thinking map comparing asteroids and comets. This modification was made to check memory after new and different content. In addition, I added a draw an asteroid question to engage more of my student across their preferred learning strategies.

Technology: A smart board with google slides were used to facilitate the lesson with a slide show. Youtube time videos were used for part 3 and news articles were accessed and read using the internet.

Assessment

Students were formatively assessed based on teacher observations and question responses during nearpod discussions and work submissions. Their understanding of the learning target was assessed based on answers to 5 min. pause questions. I used equity sticks (popsicle sticks with students' names on it) and questioning slides with questions across the Mastery (M), Understanding (U), Interpersonal (IP) and Self Expressive (SE) areas .

2. Reflect:

In reflecting on my implementation of this lesson, I noticed that the hook really, really worked for most students. There was palpable excitement during the class discussion and it was hard to keep attention because students kept talking to their elbow partner. In fifth period, I gave extra time to talk to their elbow partner about their thoughts prior to a whole class discussion. What also worked well was using a graphic organizer to catch notes. In first period I did not use one and the notetaking in their notebooks was abysmal. Thus, for 2nd-5th period I had them glue in a graphic organizer to help take notes. In reviewing students notebooks, 80% of students completed it. Next time I would add space to the notetaker for the assessment questions. When implementing I had students discuss the questions with their partner and then we discussed them as a whole class. This worked well in the moment, but it would also be nice for students to go back to see their answers when studying later.

I do think it was helpful to plan and ask questions across the learning strategies and incorporate these into the notes lesson. I noticed some students participating that don't normally (one student who is normally very quiet responded to the question “since Earth's moon has asteroid craters, does the Earth have them too? with “Definitely. The moon isn't an asteroid magnet”. A second gifted student who responded to the question what does an asteroid look like said “Well it can look like anything. The long cigar from that slide earlier or it can look like Mickey Mouse. Just like clouds they have all shapes”) as a result. In addition, I find that students

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struggle to take notes normally, however with this lesson it is not as much of a problem when those same students are engaged in the thought provoking questioning strategies to engage their memory. From the responses to a simple check in with students using thumbs up, thumbs down, thumbs sideways and discussion, I found students really liked using the NAL format. One student said “Awesome another [Graphic Organizer].”, another said “I want to mine an asteroid”.

The assessment questions worked well, especially using equity sticks to randomly choose students to answer. Because of my learning style I prefer the understanding based questions (seeking why and deeper thought), so I especially liked the question “Where are asteroids found in the Universe and what is your evidence for that?”. I also really liked the interpersonal question “How big can an asteroid get relative to yourself” and the incorporation of a kinesthetic performance task to answer the question. According to the thumbs up/thumbs down assessment after it, the students enjoyed visualizing and answering the question in this way. One student said “I see it...I see it!”

On the final formative Ticket out the door, most students chose the question about mining an asteroid to answer. I had no student choose my preferred question (To answer the question “Would you want to sit on an asteroid? Why or Why not?” after reading a passage from Lucy and Stephen Hawking’s book “George’s Secret Key to the Universe). This was surprising. I am wondering if it was because in all classes we were short on time. Next year I might add this as an extension. The addition of the thinking map question was a strong assessment of understanding since it was a conceptual question and required students to consider what they have learned on two different topics and compare them (see student samples)

Overall this whole lesson was a GREAT success. My twice exceptional student much preferred the drawing section and struggled to complete her drawing and participate in discussion. My two ADD Gifted students struggled to focus to write notes, yet both participated in class discussions.

3. Refine:

After implementing the lesson, analyzing student products, and reflecting on the whole process, I would definitely do this again-- however, I would do so with modifications. First, I would require written answers to formative questions and check for completion of the graphic organizer. I would do this to allow for easier formative assessment of understanding for those students who choose not to participate in class discussion despite the equity sticks. (For example one gifted student who I warned ahead of time that she would be called on, sat silent while I counted to 40 seconds of wait time.) Alos, I could then better remember students individual responses when planning for future lessons.

Finally, I would create a google form to get feedback to formatively assess students’ reaction to the lesson and to gather data for future NAL lesson implementation.

END OF WRITTEN REFLECTION

Assessment Data

Photo 1: Student's answering the questions "How big can an asteroid get relative to yourself" and "What is the size of asteroid"? (not the best picture, but it is what I remembered to take) The students were very thoughtful DURING the imagery/mindfulness part of the lesson and enjoyed the interpersonal question that referenced the asteroid to themselves. I took this photo afterward to show their response that asteroids could come in different sizes and that some were larger than a person.



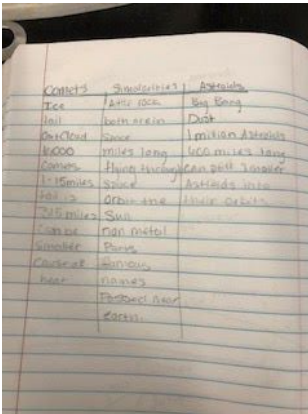
How big do you think an asteroid can get relative to yourself (IP)?

Everyone stand up
Close your eyes

Visualize a huge rock in your hand...now visualize it as so big you can't hold it in your hand, but have to use your arms, now imagine that you set this huge rock down on the floor in front of you. Now imagine it as big as you are. Now imagine it as bigger than an Adult.

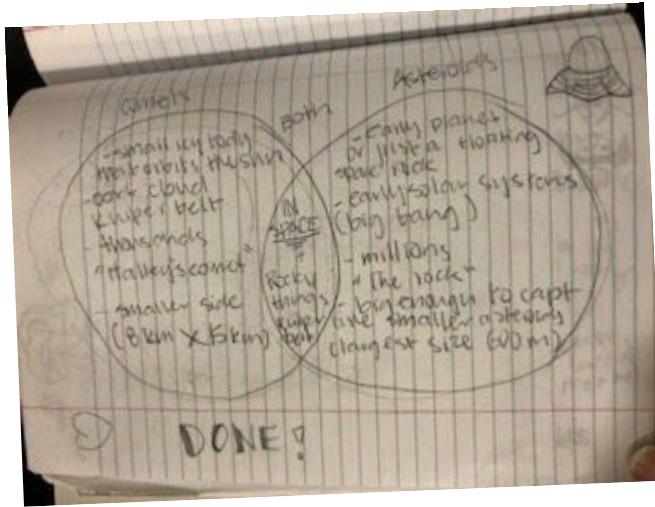
EXAMPLES OF Student Work plus reflection

Comparison Response Assessment



Student 1 (left): Strong, thoughtful response with +5 details per column. Excellent inclusion of quantitative and qualitative details

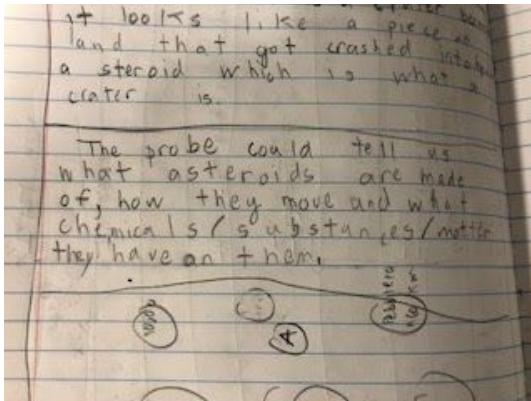
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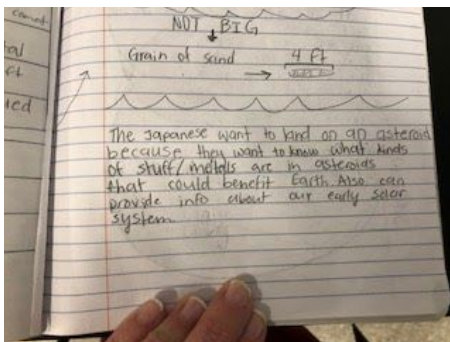
Student 2: Nice comparison, for stronger response consider additional ways they are similar.

to see what else is inside it and we might be able to find out what asteroids were created and if we could live on them because they have gravity

Final Assessment Mining an asteroid question: Student 2 Feedback: Provided 3 things we could learn about by mining. For a stronger answer include additional details/explanation. What do you mean about living on the asteroid? Size?



Final Assessment Mining an asteroid question: Student 3: Provided 2 things we could learn about asteroids by mining. For a stronger answer include additional details/explanation. Size?



Final Assessment Mining an asteroid question: Student 4: Provided details and connection to real world current event article. Also discussed 2 things we could learn about asteroids including our solar systems history and materials that make up an asteroid. For a stronger answer include additional details/explanation. Size?

The following 5 pictures (on next page) show completion of student graphic organizers in the NAL lesson, as well as the students engage response. Only one gifted students (identified with ADD) did not finish the task. Including drawing was beneficial across all students and can be seen in the additional drawings shown in picture 6 (student 5).

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COMPARING COMETS/Asteroids/Meteoroids

COMETS	ASTEROIDS	Meteoroid (Meteor/Meteorite)
Definition A small body of ice and dust that orbits the sun and has a long tail of gas and dust.	A small rocky or metallic body that orbits the sun.	A small rocky or metallic body that orbits the sun.
COMPOSITION (What is it made of?)	Rock and metal.	Rock and metal.
SIZE	Several meters to several kilometers.	Several meters to several kilometers.
LOCATION (Where do you find them in the solar system?)	Between Mars and Jupiter.	Anywhere in the solar system.
NUMBER (How many are there?)	Over 1 million.	Over 1 million.
OTHER FACTS		
NAMES OF FAMOUS ONES		
Draw and label		

Monday 27th 2020
Lesson 10

I think it is more kind of meteorite because of the shape and the surrounding background.

COMETS	ASTEROIDS	Meteoroid (Meteor/Meteorite)

I think it's An Asteroid because it's not a planet or sun or moon so it has to be a comet or asteroid.

COMETS	ASTEROIDS	Meteoroid (Meteor/Meteorite)
100's of billions Ice, rocks, organic material 394 million miles	Rock & Metal Asteroid Belt	bits of bits Tiny
Millions in the Oort cloud	over 1000	250000 per
used to be seen as good of bad omens	may have killed dinosaurs	but one the teacher has
-Hyakutake		metres

Take up to 1000 miles

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Asteroid

COMPARING COMETS/Asteroids/Meteoroids

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Draw and label		



COPY OF LESSON [link slides](#);

Lesson Plan Template

Candidate: Beth Kostka

Strategy (circle one): *NAL*

Unit Name

Astronomy

Lesson Name

Time Needed (Hours/Days)

Meteorites, Comets & Asteroids

2 class periods

Grade

Subject

Course

6

Earth Space

6th grade Earth Space Science

Essential Question(s)

What should students know when lesson is completed?

How can rocks help us understand our place in the Universe?

Standard

S6E1. Obtain, evaluate, and communicate information about current scientific views of the universe and how those views evolved.

e. Ask questions to compare and contrast the characteristics, composition, and location of comets, [asteroids](#), and meteoroids. **THIS LESSON WILL ONLY ADDRESS ASTEROIDS**

Learning Targets:

- I can explain the characteristics, composition, and location of asteroids (**S6E1c.**)
- I can compare and contrast size/scale of an asteroid to common objects
- I can discuss the effect of asteroid impacts on Earth and the Moon in the past and today

Teacher Lesson Preparation

Connect to prior Knowledge:

Prior Knowledge/Skills: Prior the lesson, students will explore the concept of scale with stations (text, videos, websites), as well as the origin of our Universe, the Big Bang Theory, and our solar system including the orbits, location and the characteristics of it's planets (through various labs and personal project). This background information will aid them in this NAL lesson by providing context and content.

Memory & Learning Connections:

This lesson is designed to address the three types of memory necessary to learn: Sensory, Permanent, and working memory. Specifically this lesson does this by 1) facilitating connection to past knowledge and building connection to content to come, 2) organizing and teaching students how to collect comparison information (through a graphic organizer that chunks material and incorporates review questions regularly, 3) using memory devices for dual coding (such as visualizations, map analysis, touch, image comparison and analysis, etc.), and 4) incorporating regular review (every 5 minutes) across four questioning types of mastery, understanding, interpersonal, and imagination.

Three types of memory were considered and planned for in this NAL lesson

1. Hook activates sensory memory, providing a visual focus and encouraging access of prior memory. Additional sensory memory activities incorporated into the lesson include a visualization (eyes-closed) of the size of an asteroid and a reading of a first-hand account of a comet crossing the night sky.
2. Permanent memory is invoked through delivery, repetition, and connection. The organizer and slides/notes facilitates chunking content into memorable pieces
3. Working memory is incorporated by application and use of questioning strategies across the 4 learning styles (Mastery, Interpersonal, Understanding, and Synthesis or Self-Expressive. The lesson is planned such that the teacher stops every 5 minutes to poses review questions, rotating through the 4 styles: mastery, understanding, interpersonal, and self-expressive.

List of Review questions for facilitating working memory:

Review (Mastery)-

- Based on your observations, what does an asteroid look like?
- Define Asteroid in your own words
- What are asteroids made of?
- Where are asteroids found in the solar system?
- How big are asteroids?
- Summarize in your own words where do asteroids come from?
- What were the two most important points to know about Asteroids?
- Turn your paper over and see how much you can remember about asteroids

- **Interpersonal (feelings)**
 - Discuss how big asteroids are relative to YOU
 - How would you react if you saw an asteroid crater up close?
 - On a map (Moon or Earth) where would you find asteroid craters?
 - How cool would it be to see (to find) an asteroid in the night sky?
 - Which of the three (asteroids, comets and meteoroids) do you feel strongest about and why? (after all three have been discussed)

- **Understanding (Analysis):**
 - Compare and contrast the size of an asteroid to known items on Earth
 - Are all asteroids the same? Why or why not? Support your answer with evidence
 - Compare and contrast Asteroids to Meteoroids (after discussed meteoroids in next lesson)
 - What effect would an asteroid impact have on Earth versus the Moon? How do you know?
 - How do asteroids move? What evidence do you have for your answer?
 - How are asteroids ancient clues to our solar system?
 - What can scientists learn from asteroids?

- **Self Expressive (Synthesis):**
 - Imagine you are a scientist on a star ship....
 - Imagine you were tasked to mine an asteroid for metals, how would you do it? What problems do you need to overcome? (Show news article of first landing on asteroid)
 - Read YA Fiction book by Stephen Hawkins...ask students if they would want to switch places with the main character, why or why not?

Gifted Identification: Students are identified as gifted through CSD testing and qualification. I have 24 students identified as gifted in science plus 16 Gifted in Math and/or Gifted in Reading and 1 twice exceptional (for a total of 41 gifted students in my class). I have asked our CSD gifted coordinator which students are gifted creatively and have not had confirmation yet (I hypothesize 3).

Goals: The goals of the lesson are for students to be able to do the following.

- (Mastery) I can **define and identify** an asteroid.
- (Mastery) I can **locate** where most asteroids are found in our Solar system
- (Understanding) I can **explain** the characteristics and composition of asteroids in relation to their origin

- (Understanding) I can **compare and contrast** size/scale of an asteroid to common objects
- (Interpersonal) I can **discuss** past and/or future ways asteroids affect humans

Pre-assessment:

To pre-assess whether students have met the learning goals prior to this lesson, they were given a google form at the beginning of the Astronomy unit with questions relating to these learning targets. Attached below is the pre-test section assessing CAM (Comets, Asteroids, and Meteoroids).

Misconceptions:

Based on assessment from prior years and from

<https://history.amazingspace.org/resources/explorations/cometmyth/teacher/lessonplan.html> website, I know that students have the following misconceptions about CAM

- **Misconception:** Comets are not a part of the solar system.
Reality: Comets are part of the solar system. They are believed to originate from one of two locations within the solar system: the Kuiper belt and the Oort Cloud (places researched prior to this lesson)
- **Misconception:** Comets are similar to asteroids.
Reality: Comets and asteroids have a very different make-up. Asteroids are composed of rocky and metallic material while comets are composed of water ice, dust, and carbon- and silicon-based compounds. There is also a size difference.
- **Misconception:** All comets look the same and don't change their appearance.
Reality: Comets have a coma and one, two, or three tails when near the Sun, and no coma or tail when far way from the Sun.
- **Misconception:** Pluto is the most-distant and last object in the solar system.
Reality: Beyond Pluto's orbit is a group of icy objects (comets) located in area known as the Kuiper belt. This is where many short-range comets come from. Further still is a sphere of icy bodies, called the Oort Cloud, from which long-range comets emerge. Short-period comets visit the inner solar system frequently while the long-period comets visit infrequently.
- **Misconception:** There is empty space between the planets.
Reality: There is gas and dust, also known as the interplanetary medium, between the planets. Comets are responsible for depositing some of the gas and dust found in the inner solar system.

Special Population Consideration: Consider this

A diversity of images are provided in the slides for special populations including female astrophysicist (Lindy Elkins-Tanton) and Minority Students (Japanese and Middle Eastern). To connect to our technologically savvy gifted students, included is a news article showing a "selfie" taken from a Japanese probe landing on an asteroid (Feb. 25, 2019- <https://www.space.com/hayabusa2-asteroid-landing-photo.html>). Graphic organizers and today's agenda provide structure for twice gifted students and a reflection question (Imagine you were tasked to mine an asteroid for metals, how would you do it? What problems do you need to overcome?) is provided for creatively identified gifted students. As we

progress into the lessons on comets and meteoroids, there will be modeling/drawing opportunities for creative students to show their understanding in a different way.

Activating Strategy (for example: Hook/Mini-Lesson/Warm-Up/Connection to Prior Learning)

Engage: What is it and how do you know? Picture of long narrow asteroid (interstellar from outside our solar system). Have a student record on the board their answers and their evidence in a two column chart. Use this hook to assess what they already know about Comets, Asteroids, Meteors.

(<https://www.news.com.au/technology/science/space/scientists-weigh-in-on-cigarshaped-ufo-believed-to-carry-alien-life/news-story/26ab15fa4da1860da65f08f2b5723d46>). (Aside: In future this could be made into a FQL lesson.)



“Great. You really know a lot about space. Now let’s add-on and build new information onto what you already know.”

Instructional Sequence and Activities including use of Technology by teacher and by students

Day 1

Engage:

- Present the engage image and ask “What is this a picture of? How do you know?” (See above Hook)
- Write down ideas and connections to prior learning as students identify them (see above)
- Encourage use of past unit vocab and content (Solar System, Kuiper Belt, Oort Cloud, Scale, gravity, mineral/rock, Big Bang Theory)
- Say “Great communication of your knowledge from last unit and its connection to this image. “Today we will use that knowledge to learn about asteroids.”

Explore:

- Pose the essential question “How can rocks help us understand our place in the Universe?”
- Hand out graphic organizer and ask students why we will use this instead of their notebooks? Discuss how it is important to organize our learning for memory recall and use.
- Students will complete the graphic organizer as you move through the content slides/lecture.

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COMPARING COMETS AND ASTEROIDS			
	COMETS	ASTERIODS	Meteoride <small>Meteorite</small> /meteor/meteorite
DEFINITION			
COMPOSITION (What it is made of)			
SIZE			
LOCATION (where do you find them in the solar system?)			
NUMBER (how many are there?)			
OTHER FACTS:			
NAMES OF FAMOUS ONES			

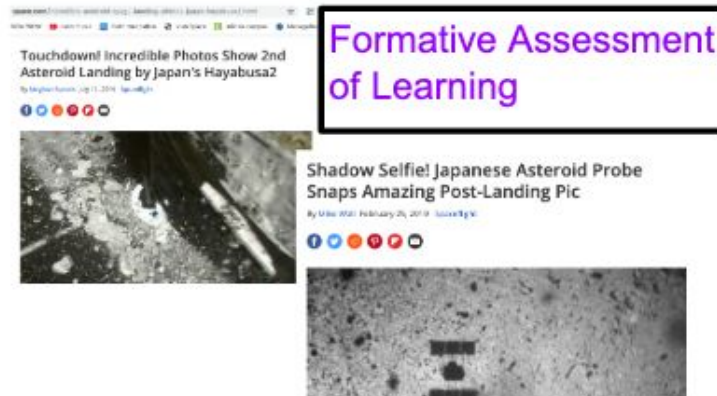
Explain:

- Show slides and videos about Asteroids. What is an asteroid? video; slides; As continue through slides ask the formative questions (M,U, IP, Self-E)
 - **see questions listed above and in slides**
- Ponder: Are all asteroids the same? Lead students to discussion of size (scale)
- Visualization (closed eyes) of the size of an asteroid. Compare asteroid to a human
- Ponder: Why do asteroids matter to humans
 - Show craters on moon and consider where they come from and why they are so distinct (no moon atmosphere so no friction and slowing of impact. also no weathering and erosion of impact craters)
 - Show Chicxulub crater and ask what is this (first picture from close up and slowly zoom out) use [Google Earth Technology](#)
 - video and slides of Chicxulub crater and theory of dinosaur extinction
- Reflect on Learning choice (answer one of the following)
 - “Do asteroids matter to humans? Why or Why not?”
 - “Imagine you were tasked to mine an asteroid for metals, how would you do it? What problems do you need to overcome?”
 - “After reading a passage from Lucy and Stephen Hawking’s book “George’s Secret Key to the Universe YA book (p. 208 & 211). “Would you want to sit on an asteroid?”

DAY 2

Elaborate/Apply/Evaluate

- What did we learn about asteroids yesterday? Let's fill in Graphic Organizer (GO) -Review
- **Today we will be applying our learning by answering the following question:**



July 2019 Japanese scientists landed a probe on an asteroid. What kind of things could the probe tell us? Answer this question in full sentences using your knowledge from yesterday

See below for Rubric

Assessment Strategies

Evidence of Learning

- Students will be able to **define and identify** an asteroid (as compared to a comet and meteor)
- Students will be able to **locate** where most asteroids are found in our Solar system (Asteroid belt between Mars and Jupiter)
- Students will be able to **explain** the characteristics and composition of asteroids in relation to their origin
- Students will be able to **compare and contrast** size/scale of an asteroid to common objects
- Students will be able to **discuss** past and/or future ways asteroids affect humans

Assessment: Students will be formatively assessed based on answers to 5 min. pause questions. Specifically, assessment by the teacher occurs with informal questioning using equity sticks (popsicle sticks with students names on it) and questioning slides across the Mastery (M), Understanding (U), Interpersonal (IP) and Self Expressive (SE) areas . If students struggle to answer, I will stop and use a Think/Pair/Share activity with students silently thinking/writing answers for 60 seconds on their

own, then sharing answers with a partner for one minute and then discussing as a class. I will do this to determine if students have understood content on the previous slides. The last activity before I move on to Comets and Meteors will be a formative writing assessment where students look at a news headline from this year showing that in July 2019 Japanese scientists landed a probe on an asteroid. They will then answer the question **“What kind of things could the probe tell us and why is it important?”**

RUBRIC

Considering the learning target is for students to identify the 1) composition, 2) size, 3) shape, 4) Origin, and 5) location of asteroids learning will assessed with these five items in mind.

Mastery (Can teach on own)	Understands	Progressing	Needs Support
Discusses all 5 learning targets	Discusses 4 out of 5 learning targets with some detail	Mentions 2-3 of the learning targets	Mentions 1 of the learning targets

Summative assessment will occur after students receive instruction for asteroids, meteors and comets. The assessment will include multiple choice (Factual) questions and an applied/conceptual task that requires students to write a Claim, Evidence, Reasoning (CER) statement to answer the following question and support it with evidence and reasoning **“Which celestial body is more dangerous to humans Asteroids, Comets, or Meteorites?”**

Differentiation

Scaffolds/ Interventions/Extensions/Enrichment/Adaptations for Special Pops students (acceleration, extension, enrichment, tiered)

This lesson differentiates by process types of scaffolding (graphic organizer) and product (choice for formative assessment question). In addition, it differentiates by learning profile (across the 6 different ways of thinking) and content through supplemental texts/sources.

Specifically, scaffolds (graphic organizers) are provided to gifted students needing help with organizational skills. Gifted students who are quick to grasp content and motivated to complete assignments have acceleration options of additional/expanded text sources (see materials section). Gifted students who are struggling writers will be provided with sentence starters to aid them in articulating their understanding. Finally, creatively gifted students are planned for by including modeling/drawing options for comparing and contrasting the celestial bodies.

Special populations are planned for through slides including Women and minority astronomers and accomplishments (see slides).

Possible acceleration to comets (modified from

<https://history.amazingspace.org/resources/explorations/cometmyth/teacher/lessonplan.html>)

1) Acceleration option #1- Comets

Students follow a webquest to complete the following:

1. Identify a fact associated with comets.
2. Identify a legend associated with comets.
3. Identify a myth associated with comets.
4. Comets are small solar system objects, yet ancient cultures knew about comets. Identify one property of comets that explains why humanity has known of comets for so long.
5. Describe the path of a comet and explain how this affects its reappearance.
6. Short-period comets tend to originate from the Kuiper belt — a region beyond the orbit of Neptune and similar in shape to the Asteroid belt. Long-period comets tend to originate from the Oort Cloud — a spherical region well beyond the orbits of Neptune and Pluto. Based on the reading, explain where each of the following comets is likely to have originated: Hale-Bopp, Swift-Tuttle, Hyakutake, and Halley's comet. Explain your choices.

2) Acceleration option #2- Meteorites

- Students read news articles to answer the question “How are meteorites ancient clues to our solar system?”

<https://www.forbes.com/sites/quora/2016/02/19/why-meteorites-are-an-incredible-window-to-our-universe/#4e2df89c6817>

https://solarsystem.nasa.gov/asteroids-comets-and-meteors/meteors-and-meteorites/overview/?page=0&per_page=40&order=id+asc&search=&condition_1=meteor_shower%3Abody_type

Extension option #1- Asteroids (Extension for more depth)

- Students research the Oumuamua Interstellar asteroid and share their understanding of this surprising asteroid in a poster. Poster to include: Discovery, Who found it and how, what it is made of (composition), size, location, and origin (with map).

<https://solarsystem.nasa.gov/asteroids-comets-and-meteors/comets/oumuamua/in-depth/>

Extension option #2- Planetary Defense (Extension for more depth and interest)

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Research and create a poster or 5 slide presentation on NASA's Planetary Defense Coordination Office using the website <https://www.nasa.gov/planetarydefense> and https://www.youtube.com/watch?v=VYO-mpoC8_s

Keeping in mind that the learning targets for the end of this unit:

After lessons on Asteroids (This lesson), continue to lessons on comets and meteoroids (Future lessons)

- *(Understanding) I can explain the difference and similarities between meteors, meteoroids, and meteorites*
- *(Understanding) I can identify a property of comets and explain how that property makes comets visible.*
- *(Understanding) I can compare and contrast the characteristics, composition and location of comets, asteroids, and meteoroids.*
- *(Synthesis) I can create a model of interplanetary objects that expresses either scale, location, or characteristics of the objects.*
- *(Interpersonal) I can discuss past and/or future ways interplanetary object impact humans*

Technology

Technology is incorporated in this lesson in the following ways:

- google classroom and google forms for pre-assessment
- Google Earth- used to zoom in on geologic features of craters making them mystery objects that students need to look at and make scientific observations and inferences
- Virtual Reality Moon simulation (NASA VR- <https://www.youtube.com/watch?v=6OTI86BkPTs> to see moon craters formed by asteroid impacts) Extension
- Videos
- Graphic Organizer available in google classroom and as a hard copy to differentiate for various learning styles

Materials/Links/Text References/Resources

Gifted Course Material: Course 2 (Teaching Style 4R's)

Slides: https://drive.google.com/open?id=1YfgVwf0V5cEn_fyjFCgbvaDVO_fqR6VA

Books

Lucy and Stephen Hawking (2007) "George's Secret Key to the Universe" Simon & Schuster Publishers (p. 208 & 211).

Videos (Asteroids)

- <https://www.youtube.com/watch?v=LopiH8cXtkI>
- <https://www.youtube.com/watch?v=iy19nHTVLEY>
- <https://www.youtube.com/watch?v=CGkjTYqtpco>

Simulations:

- Comets:** <http://history.amazingspace.org/resources/explorations/cometmyth/home.html>
 see also <http://deepimpact.umd.edu/gallery/index.html>
 Moon NASA VR- <https://www.youtube.com/watch?v=6OTI86BkPTs>

Struggling/on level material for review (asteroids)

- <https://spaceplace.nasa.gov/asteroid/en/>
- <https://spaceplace.nasa.gov/asteroid-or-meteor/en/>

APPENDIX (Attachments)

A quick way recall technique for each style is using the 4 R's (remember, relate, reason, reorganize)

<p>Mastery Questions (REMEMBER)</p> <ul style="list-style-type: none"> • Observing • Recalling • Following Directions • Categorizing • Sequencing • Listing • Naming • Summarizing • Prioritizing 	<p>Involvement /InterpersonalQuestions (RELATE)</p> <ul style="list-style-type: none"> • Preferring on the basis of personal values • Engaging • Empathizing • Harmonizing • Relating interpersonally • Achieving Self Awareness • Sharing • Feelings
<p>Understanding Questions (REASON)</p> <ul style="list-style-type: none"> • Analyzing • Evaluating • Comparing and Contrasting • Deducing • Inducing • Inferring • Hypothesizing • Explaining and Extrapolating 	<p>Synthesis / Self-Expressive Questions (REORGANIZE)</p> <ul style="list-style-type: none"> • Creating • Innovating • Imagining • Synthesizing • Thinking metaphorically • Imaging • Symbolizing

Analysis of implemented lesson-Kostka (Expanded Ticket in the Door)

CAM- PreAssessment

Show what you know before we get started on our astronomy unit!

Your email address (bkostka@csdecaur.net) will be recorded when you submit this form. Not bkostka?

[Sign out](#)
* Required

1. First Name *

2. Last Name *

3. Period *

Mark only one oval.

- Period 1
- Period 2
- Period 3
- Period 4
- Period 5

Pre-test CAM

4. Our universe is mostly *

Mark only one oval.

- rocks
- empty space
- gases
- stars

5. Everything everywhere. All the matter and all the light in space and time is called a(n) _____.

Mark only one oval.

- galaxy
- universe
- planet
- Earth

6. An enormous rock or boulder that revolves around the Sun, usually between the orbits of Mars and Jupiter is a(n) _____.

Mark only one oval.

- comet
- asteroid
- planet
- star

Analysis of implemented lesson-Kostka (Expanded Ticket in the Door)

7. A small, frozen mass of ice, dust and gas that travels through the solar system is a(n) _____ . Some call them "dirty snowballs". *

Mark only one oval.

- comet
- asteroid
- planet
- star

8. A star with a group of objects that orbit around it is called a(n) _____ . *

Mark only one oval.

- galaxy
- planet
- universe
- solar system

9. A lump of rock or metal that reaches the surface of Earth after moving through Earth's atmosphere is called a(n) _____ . *

Mark only one oval.

- asteroid
- meteoroid
- meteor
- meteorite

10. A lump of rock or metal that enters the Earth's atmosphere and burns is a(n) _____ . *

Mark only one oval.

- asteroid
- meteoroid
- meteor
- meteorite

11. The asteroid belt is found between which of the following planets in our solar system? *

Mark only one oval.

- Jupiter and Saturn
- Mars and Jupiter
- Earth and Mars
- Venus and Earth

12. What is the difference between a meteor, meteorite, and meteoride? *

Mark only one oval.

- the composition of the rock
- the size of the rock
- where it comes from
- the location it is found

Assessment Questions (Formative) for Lesson

Review (Mastery)-

- Based on your observations, what does an asteroid look like?
- Define Asteroid in your own words
- What are asteroids made of?
- Where are asteroids found in the solar system?
- How big are asteroids?
- Summarize in your own words where do asteroids come from?
- What were the two most important points to know about Asteroids?
- Turn your paper over and see how much you can remember about asteroids
- **Interpersonal (feelings)**
 - Discuss how big asteroids are relative to YOU
 - How would you react if you saw an asteroid crater up close?
 - On a map (Moon or Earth) where would you find asteroid craters?
 - How cool would it be to see (to find) an asteroid in the night sky?
 - Which of the three (asteroids, comets and meteoroids) do you feel strongest about and why? (after all three have been discussed)
- **Understanding (Analysis):**
 - Compare and contrast the size of an asteroid to known items on Earth
 - Are all asteroids the same? Why or why not? Support your answer with evidence
 - Compare and contrast Asteroids to Meteoroids (after discussed meteoroids in next lesson)
 - What effect would an asteroid impact have on Earth versus the Moon? How do you know?
 - How do asteroids move? What evidence do you have for your answer?
 - How are asteroids ancient clues to our solar system?
 - What can scientists learn from asteroids?
- **Self Expressive (Synthesis):**
 - Imagine you are a scientist on a star ship....
 - Imagine you were tasked to mine an asteroid for metals, how would you do it? What problems do you need to overcome? (Show news article of first landing on asteroid)
 - Read YA Fiction book by Stephen Hawkins...ask students if they would want to switch places with the main character, why or why not?

Analysis of implemented lesson-Kostka (Expanded Ticket in the Door)

COMPARING COMETS AND ASTEROIDS

	COMETS	ASTEROIDS	Meteoride /meteor/meteorite
DEFINITION	Object that orbits the sun made up of ICE, dust, and rock.	Object that orbits the sun made up chunks of rock and metal	Smallest. Object made of hunk of rock or grain of sand moving in space (<u>meteoride</u>), through atmosphere (meteor) or landing on Earth (meteorite)
COMPOSITION (What it is made of)	left overs of early solar system ICE, ROCK, DUST, CARBON	ROCK & METAL 3 types (silica, metals, and carbon-based)	broken bits of asteroids or comets
SIZE	Depends on how close to sun <1mi-15mi Tail= 354 million mi	600 miles (largest=Ceres) to couple meters	dust speck to 1 meter

Graphic Organizer Answer Key (Page 2)

LOCATION (where do you find them in the solar system?)	orbits the sun anywhere. begins in Oort cloud	orbits the sun. found mostly between mars and jupiter & beyond Neptune. Near Earth < 200	in space, in atmosphere and on Earth
NUMBER (how many are there?)	6339 (2018)	over 1 million	Average 50,000 per year hit Earth (>10g)
OTHER FACTS:	tail created when gets closer to sun and "warms" orbit: <100-100,000 yr	largest asteroids can have its own gravity impact may have caused dinosaur extinction	
NAMES OF FAMOUS ONES	HALLEY Shoemaker Hyakutake Kohoutek	Ceres Vesta Hygiea Eros The Dinosaur Killer	Willamette Hoba

New Vocabulary (taken from <https://history.amazingspace.org/resources/explorations/cometmyth/teacher/lessonplan.html>)

Asteroid —

A small solar system object composed mostly of rock. Many of these objects orbit the Sun between Mars and Jupiter. Their size can range anywhere from 10 meters in diameter to less than 1,000 kilometers.

Comet —

A small solar system object consisting of ice and rock. A comet will form a coma and sometimes a visible tail whenever it orbits close to the Sun.

Coma —

The cloud that forms around a comet's center core

Meteor —

The flash of light that we see in the night sky caused by the friction of a meteoroid passing through Earth's atmosphere.

Meteor Shower —

Many and sustained flashes of light that are seen in the night sky as a result of the Earth passing through the former path of a comet.

The debris released by the comet causes the meteor shower.

Meteorite —

Any part of a meteoroid that survives its fall through the atmosphere and lands on the Earth.

Meteoroid —

An interplanetary chunk of rock and/or metal that is smaller than a kilometer in diameter and most frequently measured in millimeters.

Comet Nucleus —

The solid rocky part of a comet.

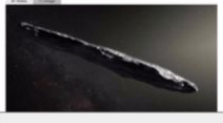
Comet Tail —

The visible dust and/or gas that flows off of a comet as a result of solar wind. The comet tail has two parts 1) dust tail and 2) gas tail


Warm UP

- Sit with your sticky (regular seats)
- Put everything under your desk
- Get out notebook and pencil
- Answer this question in your notebook

What is this and why do you think that?



What is it? What evidence tells you that?



Scientists have cracked the mystery behind the strange, cigar-shaped object known as 'Oumuamua'. Picture: European Southern Observatory Science APP



news.404TUTOR.com

Airports make 9 a.m. beer ok. pwnkey. (Lock Here)

technology science space


Scientists weigh in on cigar-shaped UFO, believed to carry alien life

A GROUP of scientists claim to have identified a mysterious object zipping through space and thought to have been an alien spaceship.



Connection to prior learning

Where might this asteroid have come from?



Next: learn more about celestial bodies found in our solar system that are not planets

Statement of Inquiry

Innovation helps us explore our Universe



I can **explain** the characteristics, composition, and location of **asteroids**

I can **compare and contrast** size/scale of an **asteroid** to common objects



I can **discuss** the effect of asteroid impacts on Earth and the Moon

Graphic Organizer

COMPARING COMETS AND ASTEROIDS

	COMETS	ASTEROIDS	Meteoroid /meteor/meteorite
DEFINITION			WAIT to Fill This Column Out
COMPOSITION (What it is made of)			
SIZE			
LOCATION (where do you find them in the solar system?)			
NUMBER (how many are there?)			
OTHER FACTS:			
NAMES OF FAMOUS ONES			

What is an Asteroid?



Asteroids-Memory Trigger

What does an asteroid look like (M)?

What is an asteroid-Definition (M)?

What are Asteroids made of (M)?

Asteroids review

Definition: Smaller object that orbits the sun and is made of **Rock and metal**

Composition:

Comes from: Early solar system (big bang)



Asteroids and Comets



VIDEO

Where are Asteroids found in the Universe (M)?

Why? What might be the reason they are found there (U)?




Analysis of implemented lesson-Kostka (Expanded Ticket in the Door)

Asteroids review

Definition: Smaller object that orbits the sun and is made of Rock and metal

Location found: Belt between Mars and Jupiter (some out in Keiper Belt) or beyond

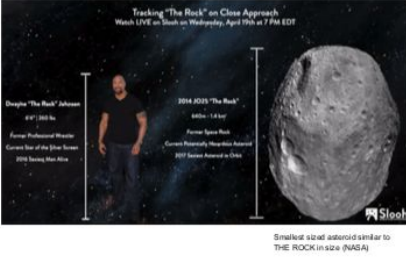
How big are they? Are asteroids bigger than...?



How big do you think an asteroid can get relative to yourself (IP)?

Everyone stand up
Close your eyes

Visualize a huge rock in your hand...now visualize it as so big you can't hold it in your hand, but have to use your arms, now imagine that you set this huge rock down on the floor in front of you. Now imagine it as big as you are. Now imagine it as bigger than an Adult.



Asteroids

How big are they? Are asteroids bigger than...(U)?



Asteroids range in size

- largest = 329 miles (Vesta) in diameter
- smallest = meters across (~8 feet+)

With your partner compare and Contrast Asteroids to known items on Earth.

Are all asteroids the same?

No way! Because asteroids formed in different locations at different distances from the sun, no two asteroids are alike. Here are a few ways that they differ:

- Asteroids aren't all round like planets. They have jagged and irregular shapes. **Different Shapes**
- Some asteroids are hundreds of miles in diameter, but many more are as small as pebbles. **Different Sizes**
- Most asteroids are made of different kinds of rocks, but some have clays or metals, such as nickel and iron. **Different Kinds of rocks and/or metals**


Are all Asteroids the same (U)? Why or Why not?



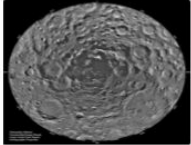
May be shattered rocks left over from formation of planets or Big Bang

How do we know?


One of NASA's newest missions to asteroids is being led by a female astrophysicist



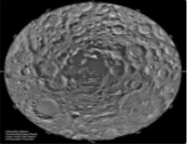
1. What are the key features of the moon (M)?
2. What specifically caused these features (M)?



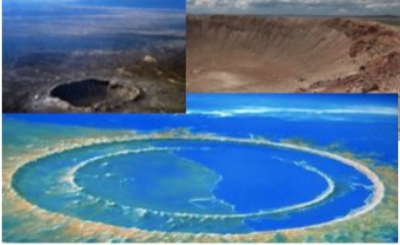
What is this?



1. Since the moon revolves around the Earth, does the Earth have these craters too (IP)?




How Cool would it be to see one of these craters up close? To stand on the edge of one?




NATURAL HISTORY MUSEUM

How on an asteroid ended the age of the dinosaurs



Large Asteroid hits Earth 65 Million Years Ago

- Collision produced an explosion = 100 trillion tons of dynamite
- Gouged out a crater about 60 miles in diameter
- How would an event like this affect Earth?



What Were the Biggest Asteroids to Hit Earth?

American Museum of Natural History ©

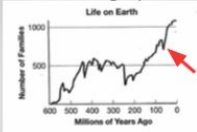
Analysis of implemented lesson-Kostka (Expanded Ticket in the Door)

What do Scientists Think Happened?

- Forests were wiped clean for a distance of 300 to 600 miles in all directions
- 300 foot wave struck the coast of Texas
- Powerful Earthquakes
- Landslides destroyed long stretches of coastline
- Explosion debris and poison gas into air over N.America
- blocked sunlight for months
-



What does this graph tell us?



Graphic Organizer

	COMPARING COMETS AND ASTEROIDS		Meteorite /meteor/meteorite
	COMETS	ASTEROIDS	
DEFINITION			WAIT to Fill This Column Out
COMPOSITION (What it is made of)			
SIZE			
LOCATION (where do you find them in the solar system?)			
NUMBER (how many are there?)			
OTHER FACTS:			
NAMES OF FAMOUS ONES			

Reflect on Learning (Choose 1 to answer)

- 1) Why do Asteroids matter to Humans? Why or Why not?
- 2) Imagine you were tasked to mine an asteroid for metals, how would you do it? What problems do you need to overcome?