

Exploring Mars Glass Tube

Anomalies

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Abstract

This practical article provides information regarding the use of Edward de Bono CoRT thinking skills to broaden and enhance critical and creative thinking skills in twice exceptional students using the Mars Glass Tube Mystery as a vehicle to explore possibilities and spark creative thinking. The exceptionalities addressed in this lesson plan are gifted learners who have one or more additional exceptionalities of slow processing speed and / or poor fine motor skills. Throughout the lesson, the Mars Mystery photos leveraged both prior knowledge and student curiosity to create an engaging activity for the participants. CoRT thinking skills provided a robust structure for guiding meaningful discussions, a means of encouraging deeper thought, and facilitating productive group discourse. The mystery-focused lesson encouraged imagination, allowing students to not only stretch independent thought but to actively participate in sharing and validating each other's ideas and to explore creativity as a way to express ideas and generate conclusions.

Key Words

Mars mysteries, tubes on Mars, twice exceptional gifted students, slow processing speed, fine motor skills, Edward de Bono CoRT Thinking Skills, arts integration

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Introduction

In our society today, appropriate education for gifted learners is crucial for maximizing opportunities for students as well as increasing the number of producers of new knowledge (Renzulli, 2012). Edward de Bono developed the Cognitive Research Trust (CoRT) Thinking Program (de Bono, 1985) to guide the direct teaching of thinking skills. One of the goals of this program is to broaden the perception of a problem so that the pool of possible solutions includes as many ideas as possible before a person selects a response. De Bono's thinking skills allow thinkers to see things more clearly, more broadly, and differently. The CoRT system contains six sets of ten thinking skills each. The CoRT Breadth skills, the initial set, forms a strong foundation for thinking and has been incorporated into this lesson. The other CoRT sets are more specialized. Two CoRT Breadth thinking skills were used in this lesson along with "Clues", a thinking skill from the Information and Feeling set of de Bono thinking skills.

As shown in Figure 1, this lesson incorporates three of the CoRT Thinking Skills: (1) Consider All Factors (CAF), which involves identifying all the factors in a situation, including factors that are not obvious or that result from different perspectives in time (past, future) or from different people or environments; (2) Clues, a thinking skill in which the

thinker examines pieces of information or fact statements that can be interpreted or combined to provide more information; and (3) First Important Priorities (FIP), a thinking skill which focuses on placing the factors, objectives, or consequences involved in order according to importance or priority. Several studies have documented the utility of the CoRT Thinking Skills system as an effective tool for organizing discussions (e.g., Gray, Elser, Klein, & Rule, 2016; Jennings, Rule, & Vander Zanden, 2014; Rule & Barrera, 2006; Rule & Stefanich, 2012). The CoRT Breadth thinking skills provide a robust structure for guiding meaningful discussions.

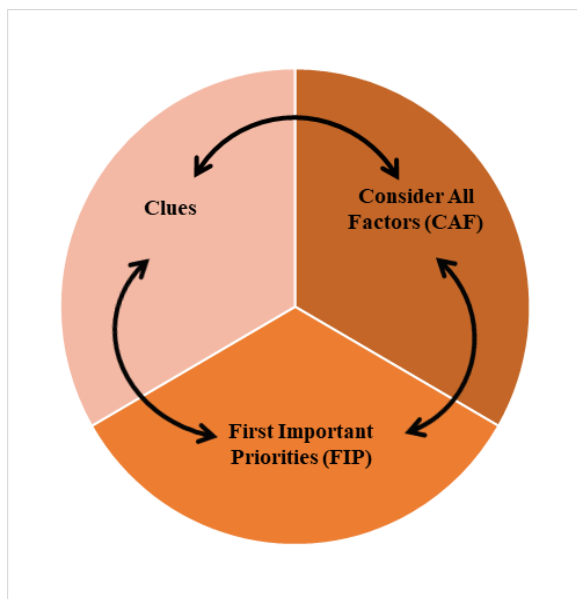


Figure 1. Edward de Bono CoRT thinking skills used in this lesson

Literature Review

This lesson focused on the anomalous glass tube-like Mars Mystery figures found in NASA photographs of the surface of the planet. The lesson was designed as an enrichment lesson for twice exceptional gifted students. The activity offered participants science concepts integrated with art. The lesson addressed the four major arts processes: Connecting, Responding, Performing/Presenting/Producing, and Creating as well as the corresponding arts anchor standards of the National Core Arts Standards (State Education Agency Directors of Arts Education, 2014). The

lesson also included such processes as problem-solving, inquiry, hypothesizing, and others that are traditionally thought of as native to STEM disciplines (Science, Technology, Engineering, and Mathematics), but which are also an inherent part of arts (Booth, 2013) and arts standards (Zhanova, 2017). Although the reported lesson was delivered to gifted adult students (high achieving graduate students), the lesson was designed to be suitable for other grade levels of students. The exceptionalities addressed in this lesson include “giftedness” or advanced ability level combined with slow processing speed and/or poor fine motor skills. This brief review of the literature focuses first on the Mars tubes and then explores the two disabilities that the lesson was designed to accommodate: gifted learners with slow mental processing speed and gifted learners with poor fine motor skills.

The Mars Mystery of Glass Tubes on Mars

Amongst a batch of over 27,500 images uploaded to the web from NASA’s Mars Global Surveyor’s onboard cameras, a great Mars mystery has surfaced. Mars enthusiasts and amateur researchers refer to these extraordinary anomalies that appear to many viewers as long tubular constructs with supporting cross-members as glass tubes or glass tunnels (Hoagland, 2009). One of the images in question, m0400291 (Mars Global Surveyor, 2009), appears to occur in what is thought by many to be an ancient seabed or dried ocean floor (Hoagland, 2009; Skipper, 2000). The tubes run approximately a mile in length and are hundreds of feet wide. Mars enthusiasts and geologists point to the series of reinforced and undamaged translucent, glasslike tubes, noting that these tubes do not appear to be natural geographical features. Geologist Ron Nicks (n.d.) believed the glass tubes to be proof of construction and believed the ribs to be composed of different materials than the tubes themselves.

NASA quickly dismissed the notion of glass tubes, discounting the anomalies as simply sand dunes and lighting variances that trick the eye. Researchers (Hoagland, 2009; Skipper, 2000) argue that these anomalies are unlike other sand dunes found on the surface of Mars as they are regularly spaced, nearly identical in length and width, while wrapping around surrounding terrain and would be unlikely to occur due

to aerodynamics, forces of wind and weathering. Documented sand dunes on Mars are irregularly spaced, vary in length, and match the color and texture of surrounding terrain (Hoagland, 2009). Researchers point to the fact that the tubes are in a location generally shielded from winds and, at certain areas, are forming underground with only portions of the structure exposed (McCann, 2001).

There are many conflicting opinions regarding the Mars glass tubes: some argue that the images do not show a convex image of tubes but a concave valley (Plait, 2008); others believe the tubes to be functional and purposeful suggesting a sump pump, water purification system, water delivery system or tunnels built for transportation (Hoagland, 2009; Skipper, 2000).

Gifted Learners with Slow Mental Processing Speed

Slow mental processing causes a reduction in the amount of information that can be considered during thought and can also be a causative factor (i.e. acting as a cause) in the development of thought disorders among individuals with exceptionalities (Saccuzzo & Schubert, 1981). Researchers (Bull & Johnston, 1997) have suggested that "Children with poor arithmetical skills show a lack of automaticity in retrieving numbers and number combinations from long-term memory, evidenced through slow item identification and through the use of slow, inefficient counting strategies rather than direct memory retrieval" (p. 6). This suggestion implies that students who process information slowly may be able to take advantage of certain strategies to increase speed and mental efficiency. Primary school teachers need to be well-prepared to identify and assist children observed to be slow to initiate a task or who seem to lack the energy to fully take part in activities at school (Lundervold, Posserud, Ullebo, Sorensen, & Gillberg, 2011).

The inclusion of four specific teaching strategies especially for the use with students who are both gifted and have an exceptionality or disability in some area can be particularly helpful (Mann, 2006). These strategies include: (1) Offering student choices of the means by which they access information as well as the ways in which they choose to communicate their knowledge; (2) Teacher's knowledge

and ability to leverage the students' interests, strengths and weaknesses to offer meaningful opportunities and provide an environment addressing student strengths and interests; (3) Opportunities for authentic learning engagement in which students find value in the tasks they are being asked to perform; and, finally, (4) Instruction should highlight conceptual learning starting with the big picture, allowing students to build their own connections as the topic is explored further (Mann, 2006).

In this project, the four strategies were applied in the following ways. (1) During the cereal box creation, the students were allowed to obtain ideas from other participants or to use their own ideas. The students were also offered choices of materials in addition to a loose structure of this hands-on project which allowed freedom of creative expression of the student ideas. (2) This project targeted a certain population of students: gifted students with possible exceptionalities. Gifted students tend to need an increased level of challenging real-world applicable projects as well as freedom of creative expression to be successful (VanTassel-Baska & Hubbard, 2016). The project offered to the participants was based on the criteria mentioned above; addressing the intellectual and creative strengths of the students, as well as their interest in mysterious anomalies in Mars photographs. The possible exceptionality of the participants was addressed through using graphic organizers. (3) The activities involved using authentic photographs of objects on Mars retrieved from the NASA web site. (4) The first set of activities allowed the students to choose which personal ideas of the group members to add to their list of ideas regarding the purpose of the objects in the photographs and what those objects represented after sharing; hence, the participants could determine how these new ideas fit the emerging organizational framework of the Mars mystery objects.

In many schools, children with slow cognitive processing speed may be disadvantaged in problem solving or task-oriented activities that necessitate quick decisions (Lundervold et al., 2011). In this project, the participants were allowed to work at their own pace with ample time allotted for generating ideas. Collaboration and revisiting of existing ideas alleviating the possible psychological pressure resulting from creative problem-solving activities that are ill-structured in



nature. Additional structure and guidance was provided through using the graphic organizer.

Gifted Learners with Poor Fine Motor Skills

Fine motor skills involve the coordination of eye-hand muscle movement. This ability includes grasping, reaching, and manipulating objects through the use of small muscles controlling the fingers, hand, and thumb. By developing these skills, a student is able to complete tasks such as writing, drawing, and buttoning (Cuffaro, 2011). Children can also control tools and objects with their hands by coordinating movement with what the eye sees. This process is called hand-eye coordination (Grissmer et al., 2010). Rule and Stewart (2002) noted that fine motor skills involve a series of movements performed in a logical sequence in such tasks as polishing shoes or silverware and in moving small objects with tweezers, tongs, or spoons. Furthermore, reading requires the use of fine motor skills controlling eye movement for word tracking; greater proficiency in this area improves mathematics and reading achievement (Grissmer, Grimm, Aiyer, Murrah, & Steele, 2010).

Generally, motor skill is comprised of three factors: speed, strength, and precision. These factors involve the action of the entire body with emphasis on muscle activity and finely-tuned coordination (Seashore, 1940). Fine motor skills are considered as primary predictors of early special education referral with kindergarten retention serving as a means of control for factors like vocabulary, auditory and visual skills, and socio-demographic (Roth, McCaul, & Barnes, 1993). In comparison to children with weak motor skills, children who have strong fine motor skills show greater improvement within the reading composite. Therefore, evidence of strong fine motor skills is considered a predictor of greater gains in sound awareness and passage comprehension (Cameron, Brock, Murrah, Bell, Worzalla, Grissmer, & Morrison, 2012). In the lesson presented here, stencils, pre-drawn figures, straws, tubes and other objects that students could trace around to help them create their figures were available. Tape was also provided to allow students to secure their paper, stencils, and objects to their desks to further aid in their ability to create figures.

The Lesson

This lesson activity has three learning objectives which include those that follow. (1) The students will be able to determine and communicate possible explanations for the existence of tube like objects on Mars through their CoRT Breadth thinking skills and artwork; (2) The students will continue to demonstrate and refine their fine motors skills through the creation of cereal box cover; and (3) The students will utilize graphic organizer to access and communicate information.

Participants

The participants in this lesson activity were 21 adults above 18 years old with a mean age of 39 years. Demographic information includes the following: regarding race and ethnicity, 15 White, 3 Black, and 3 Asian, and regarding gender, 11 males and 10 females. This group of participants constituted an adult gifted population because the students were high-achieving doctoral students. Some of these students may have had fine motor difficulties or slow mental processing speed, but these characteristics were not documented. High achieving students may have an exceptionality, e.g. a slow information processing speed, which is compensated by their increased ability in other areas (Baum, 1990; 1998)

Lesson Procedures

First set of activities. At the beginning of the first set of activities, photographs of glass tubes on Mars were shown to the participants; see Figure 2 and Figure 3 from the United States Geological Survey (USGS) / National Aeronautics and Space Administration (NASA) Mars Global Surveyor (2009). Participants were informed that the size of the glass tubes in Figure 2 was approximately one mile long and six hundred feet wide. Participants were directed to make note of the evenly spaced rib-like structures and translucent membrane-like spacing between each rib in the enlarged image in Figure 3.



A graphic organizer that incorporated the CoRT Thinking Skills was distributed to the students (see Appendix A and Appendix B). The participants were asked to complete Part 1 of the graphic organizer, shown in Appendix A. This set of questions served as an instructional aid, organizing and communicating information for those students who tend to process information at a slower rate. Participants were then asked to share their answers in small groups and were given

the choice of writing additional ideas in Part 1 of the graphic organizer. Next, participants were asked to share their responses as a whole group. Facilitators then provided the participants with clues as shown in Table 1. The facilitators asked the participants to make decisions as to what they thought the pictures represented, who or what made the objects in the pictures, and why the objects in the images are no longer being seen in new images of the Martian surface.

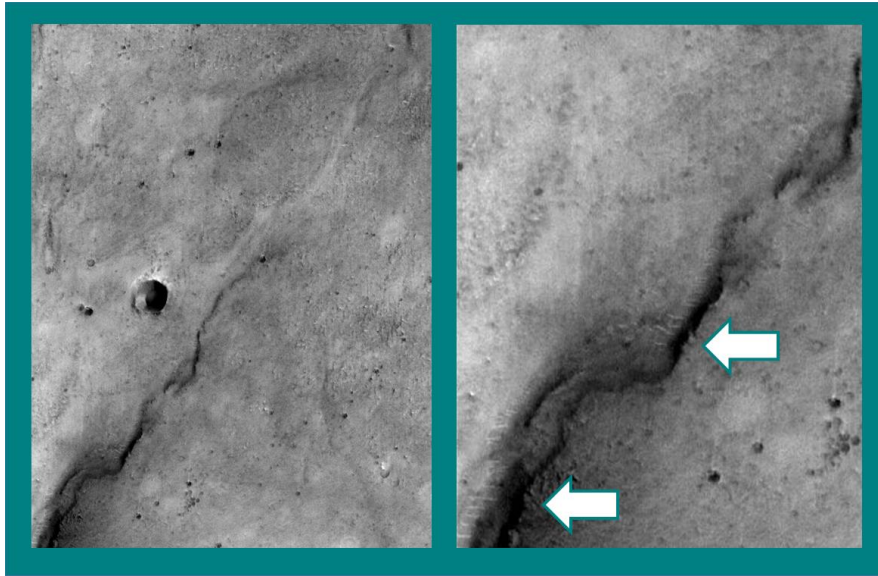


Figure 2. Tubular structure located in the Martian desert at about 40 degrees north latitude. Image at left shows a larger expanse; image at right is a close-up of the bottom left of the photo. . Photograph courtesy of USGS/ NASA (2009).

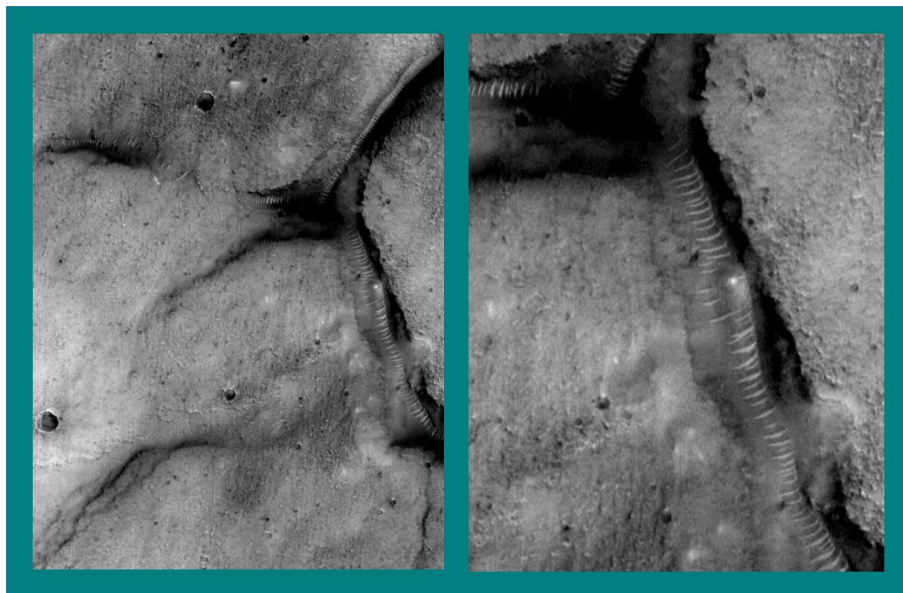


Figure 3. Enlarged image of frame MO4-00291 has appearance of rib like supports spaced between translucent intervals. Image at right is enlarged further still. Photograph courtesy of USGS/ NASA (2009).

Table 1. Clues Provided by the Facilitators

The pictures resemble:	Objects in images were created by:
Tunnel	Worms that travel underground as in the movie Dune (2006).
Worm	A giant worm lying on the surface.
Transportation System	There are underground cities and people travel through these tubes as transport.
Veins for the planet	The planet has veins for blood transport.
Drinking Straw for a giant	A giant sucks the water from the ground using the glass tubes.
Ventilation	To expel CO ₂ or a noxious element or compound.
Worm, Snake Skin	The shed skin of a snake or worm-like animal.

Second set of activities. The participants then completed Part 2 of the graphic organizer which allowed them to list the different clues or ideas that they generated or heard that led them to believe how this image was created or what its purpose was or could be. Participants took the clues that were listed and rearranged them in order from most important to least important. The most important clue was the one that led students to conclude the identity of the image. The least important clue was the clue that did not assist in image identification.

Participants were asked to bring their ideas to life by creating a cereal box front panel related to what they thought the Mars glass tubes images represented. The cover images students each made had to depict a new cereal for the breakfast market. Students were requested to give their cereal products a name based upon how the anomalous objects or structures on Mars were made or who, in their opinion, created them. Figure 4, Figure 5, and Figure 6 show participants creating their Mars cereal boxes. The facilitators provided colored markers, crayons, colored pencils, pieces of paper, stencils, tapes and some pre-drawn images to help the participants use their fine motor skills in creating their boxes. The participants were allowed to speak to others at their tables

to obtain additional ideas. An assessment was conducted on the participants' work using the rubric in Table 2.

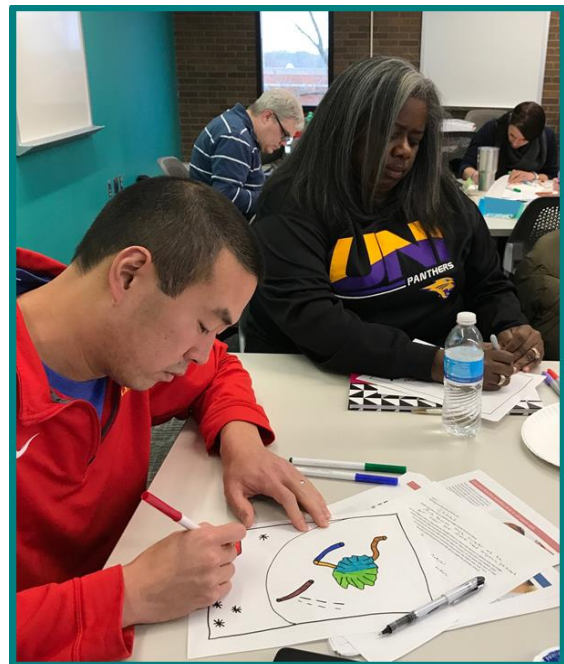


Figure 4. Student using markers on a pre-drawn template to create a cereal box front.



Figure 5. Students engaged in making their cereal box fronts.



Figure 6. Students working on the arts-integrated cereal box activity.

Table 2. *Participants' Assessment Rubric*

Not Addressing Expectations in any Way (0 points)	Beginning to Address Expectations (1 point)	Progressing toward Meeting Expectations (2 points)	Meets Expectations (3 points)	Exceeds Expectations (4 points)
Cognitive rigor No Attempt	Demonstration of foundational skills while working toward the cognitive rigor required of the grade level standard.	Progression toward the cognitive rigor required of the grade level standard.	Independent demonstration of cognitive rigor required of grade level standard.	In-depth demonstration beyond the cognitive rigor required of grade level standard.
Creativity No Attempt	Minimal effort was put into the creative design of the cereal box design.	There is use of color and effort to stay within the lines. Cereal box design shows creativity in design and use of color.	Cereal box design shows creativity in design and use of color with multiple images and design elements included in the final design.	Cereal box design showed creative uniqueness and was significantly different (in a positive way) from other student cereal boxes.
Humor No Attempt	Intended humor is attempted through the use of silly images or expressive faces.	Intended humor is incorporated into design and title.	Cereal box design incorporated multiple intended humorous aspects in the title, design or cereal description.	Design incorporated intended humorous aspects that connect the title, design and description to one central theme.
Word Play No Attempt	Word play is attempted in one form or another in the cereal box design.	Word play is included in either the title or cereal description.	Word play is utilized in a clever way tying cereal name and image together.	Multiple instances of word play found in the title, images and in the cereal description.
Abstract Ideas No attempt	Attempted communication of Abstract idea within cereal box design.	Design included abstract image element.	The cereal box design presented an abstract idea or had symbolism involved.	The cereal box design presented an abstract idea or had symbolism involved in both title and design elements.

Data Analysis

Students' responses were analyzed using the constant comparison method, a qualitative approach (Dye, Schatz, Rosenberg, & Coleman, 2000), with quantitative counts for categories to provide a sense of frequency of each response category. The responses resulted in nine major themes from the participant responses for three major thinking skill questions. A detailed thematic analysis of participants' responses will be illustrated in the result section.

Results and Discussion

Participants were given a graphic organizer that includes a series of questions. The facilitators observed the participants as they complete the graphic organizer. Figures 4, 5 and 6 present pictures of highly engaged participants during the activity. Individual responses varied greatly but several themes emerged from their responses to the selected three CoRT Breadth thinking skills. These results are explained in the next sections, organized by the thinking skills.

CoRT Breadth Thinking Skill - Consider All Factors (CAF)

With the use of a graphic organizer, the first section allowed students to identify and consider factors that could help them draw a conclusion regarding the images in the photographs that were presented to them. Six major themes were identified from individual responses (See Table 3). Fifty-two percent of the responses indicated that the Mars objects on the images appeared to be a mode of transportation. This category of responses was followed with 19% of responses indicating that structures resulted from natural processes. Some students also wrote that the images may represent a long cylindrical tube-like body or elongated legless organism. This sentiment was noted in 19% of all of the students' responses. However, 5% of the respondents concluded that the structure in the picture could constitute parts of a space exploration vehicle. Another 5% of the respondents reported that the picture showed a loop of thread. Lastly, 5% of the respondents suggested that the image looked like a human habitation.

The above responses suggest that providing students with an opportunity to identify all factors in a given situation could help with identifying a multitude of unexplored ideas. Although students were presented with clues as shown in Table 1, they also reported that the Mars structures could have been made by two additional factors i.e. parts of space exploration vehicles and natural occurrences. This idea suggests that the more students practice Consider All factors (CAF) operation, the less chances of them accepting the first considerations that immediately come to their minds.

Table 3. *Thematic Analysis of Individual Responses Using CoRT Breadth Thinking Skill – Consider All Factors (CAF)*

Major Themes	Individual Responses
Mode of transportation	Tunnel track line, transportation system, Martian tunnels, giant worms tunnels, tunnel systems, giant tunnel used to move people in underground civilization, Some type of transport or functional tube, tunnel system for transportation, tunnel system, tunnels for Martian or Martian vehicles, and transport tunnels.
Long cylindrical tube-like body organism/elongated legless organism	Snake, worm, snake skin, a worm.
Parts of space exploration vehicle	Parts of missing space rovers.
Natural occurrences	Naturally occurring erosion patterns; tunnels created by chemical processed from beneath the soil; land formation; Veins of the planet.
A loop of thread	Stitches
Human habitation	Humans living in underground cities creates tunnels.

CoRT Breadth Thinking Skill - Clues

The second set of questions allowed the students to list different clues or ideas of how the objects from the images were created or made. Multiple clues were identified in several responses which fell into five major themes as shown in Table 4. The results showed that 45% of the participants reported that the object in the image was made by extraterrestrial life or native inhabitants of Mars. The second most-frequent response given by 20% of participants

indicated that they believed the object in the image was created by a long, cylindrical, tube-like, and perhaps legless, organism. Fifteen percent of responses indicated that the structure in the image was created by natural occurrences. An equal number of respondents suggested that the formation in the image was created by astrobiologists or Philomaths, i.e someone who greatly enjoys learning and studying things. The remaining 5% of the responses suggested that the construction in the image was made by parts of space exploration vehicle.

Table 4. *Thematic Analysis of Individual Responses Using CoRT Breadth Thinking Skill – Clues*

Major Themes	Individual Responses
Extraterrestrial life or native inhabitants of Mars	Martians; Martian engineers; Martians who wanted a better way to move from one place to another; people who live on Mars or aliens; unnatural forces; Martian humans; Martians and animals in collaboration; Martians; and Martians construction company.
Natural occurrences	Naturally occurring erosion patterns; natural processes, the planet itself since the planet is alive and those are its veins.
Long cylindrical tube-Like body organism/elongated legless organism	Snake; a giant worm; long worm, a snake which is dead.
Parts of space exploration vehicle	Rover parts
Astrobiologists or Philomaths	People interested in knowing existence of life on Mars; intelligent beings; and smart people that needed to navigate the planet quickly.

CoRT Breadth Thinking Skill - First Important Priorities (FIP)

The last section of the graphic organizer allowed the students to list and arrange the clues in order from the most important to the least important. The most important clue was the one that influenced students the most in making a conclusion. Table 5 presents a thematic analysis of the most important clues reported by the participants. A majority of the respondents (57%) indicated that the most important clue constituted of special features of the image presented to them. This was followed by 24% of respondents who reported that the most important clue was the knowledge, experience,

and information about the image that were provided to them. Lastly, 19% of the respondents indicated that the placement and arrangement of the object on the planet as shown in the image was the most important clue.

The above responses suggest that the use of prioritization as a thinking skill provides an opportunity for students to get a sense of what is most important. As shown in Table 5, the students identified the following as the most important clues: (1) placement and arrangement of anomalous object on the planet in the photographic image; (2) knowledge, experience and information provided; and (3) special features. This finding might also suggest that the use of prioritization

helped students to distinguish or differentiate main clues/ideas from low-relevance components. Therefore, having students prioritize their ideas or clues could help them concentrate better and devote more time to things that are of utmost importance.

Table 5.

Thematic Analysis of Individual Responses Using CoRT Breadth Thinking Skill – First Important Priorities (FIP)

Major Themes	Most Important Clue – Individual Responses
Placement and arrangement of image	Bounded area, vary depths of the tunnel; translucent, going underground
Knowledge, experience and information provided	Other people's thought, table discussion, experience, built with a purpose, no life on mars
Special features	Outline and shape; colors, shape, image, texture, stitch patterns, size of the tube, tunnels are dry and isolated; line segment like worms; size of tubes, metallic look, bubble like on the surface

CoRT Thinking Skills and Students with Exceptionalities

As indicated by the positive results of these activities, the use of CoRT Breadth thinking skills is very helpful in instructing individuals with exceptionalities. Twice exceptional gifted students are not only gifted, but have an additional disability or exceptionality with which to contend.

Creative thinking support for gifted learners.

This set of lesson activities supported gifted learners by assisting them in generating ideas from different perspectives and by broadening their sphere of considered ideas. Through the use of fantasy, gifted learners were also able to develop their creative skills of generating original and unusual ideas,

puns and word plays, humor, emotionally expressive, animated, and aesthetically appealing drawings, titles, and captions for their cereal box fronts. Figure 7, Figure 8, Figure 9, and Figure 10 highlight many of these creative aspects of the completed cereal boxes.

In Figure 7, the top left cereal box front shows wordplay of alliteration in the repetition of t-sounds in "Tasty Tubes," as the repetition of M-sounds in the bottom left cereal box title of "Martian Mateys." The top right cereal box image creatively uses the two large circles in many ways as cereal O's or loops, as the circular interior of a tunnel, as an expressive mouth talking, and as the letter "O" in the word "Wow." The bottom right image shows many animated and moving objects in the tube with expressive faces. This drawing also shows the creative trait of showing items inside other items such as the cars moving through the tubes, as does the drawing at lower left. "Martian Mallows" at bottom left has clever word play on the word marshmallows, a common component of kids' cereal.

The top left image of Figure 8 Shows a humorous Martian character mining "chewy tunnel treads" as a breakfast treat. The motion and expressive face of the character are very creative. The top right image presents the idea of Martian tubes being blood vessels to the heart, a clever and original concept. The bottom left shows a Mars Magic Lab with the humorous scenario of the boss gathering all the money as the professor works. The bottom right cereal box has wordplay involving "MT" or "empty" that is used in the slogan "MT bowls with Martian tubular," indicating that cereal-eaters will quickly consume the cereal.

Figure 9 provides a few more examples of creative traits. The top left image says, "From the Red Planet to the Earth" and shows a wormhole with someone traveling through, a very original concept. The lettering on the Cereal title, "Martian Tunnels" at top right shows great detail and elaboration. The bottom right Mars X Cereal shows crossed tubes and the humorous ominous slogan, "Eat this and you'll never go back."



Figure 7. Cereal boxes showing creative traits



Figure 8. Additional creative examples of Student drawings.



Figure 9. A few more creative examples.

Support for students with slow mental processing or poor fine motor skills. As mentioned earlier, the graphic organizer served as an instructional aid with the incorporation of three of the CoRT Breadth thinking skills for

students who tend to process information at a slower rate. Students who needed fine motor support were provided stencils, templates, and pre-drawn images to make the task easier. Figure 10 shows several cereal box images that featured snakes or worms, an animal-related interpretation of the Mars tunes. The far-left image was made with the circle stencil. Figure 11 shows cereal box images that emerged through use of the pre-drawn template. In our lesson we made use of stencils, pre-drawn figures, straws, tubes and other objects that students could trace around to help them create their figures. Tape was also provided to allow students to secure their paper, stencils and objects to their desks to further aid in their ability to create figures.

Conclusion

Overall, the use of CoRT Breadth thinking skills proved to be an effective teaching strategy, not just limited to science education, but also to broadening creative thought. The findings of this set of activities support the premise that the glass tube can be a mode of transportation, natural occurrences, creations of extraterrestrial life, among others (Hoagland, 2009 & Skipper, 2000; Hoagland, 2009). By applying the CoRT Breadth thinking skills, students were able to identify some of the factors related to the information presented to them as well as interpret and prioritize those pieces of information.

CoRT Breadth thinking skills can provide a robust structure and guideline for meaningful discussions. CoRT Breadth thinking skills can easily be incorporated into K-12 classroom activities as a means of encouraging deeper thought and engaging students in meaningful discourse through interactive discussion, allowing all students to not only practice independent thought but to actively participate in sharing and validating each other's ideas.

Ideas for future work include implementation of this activity with K-2 students, grade 3-5, and middle school students to compare and contrast results of using the CoRT Breadth thinking skills between lower and upper elementary students as well as middle school age students.



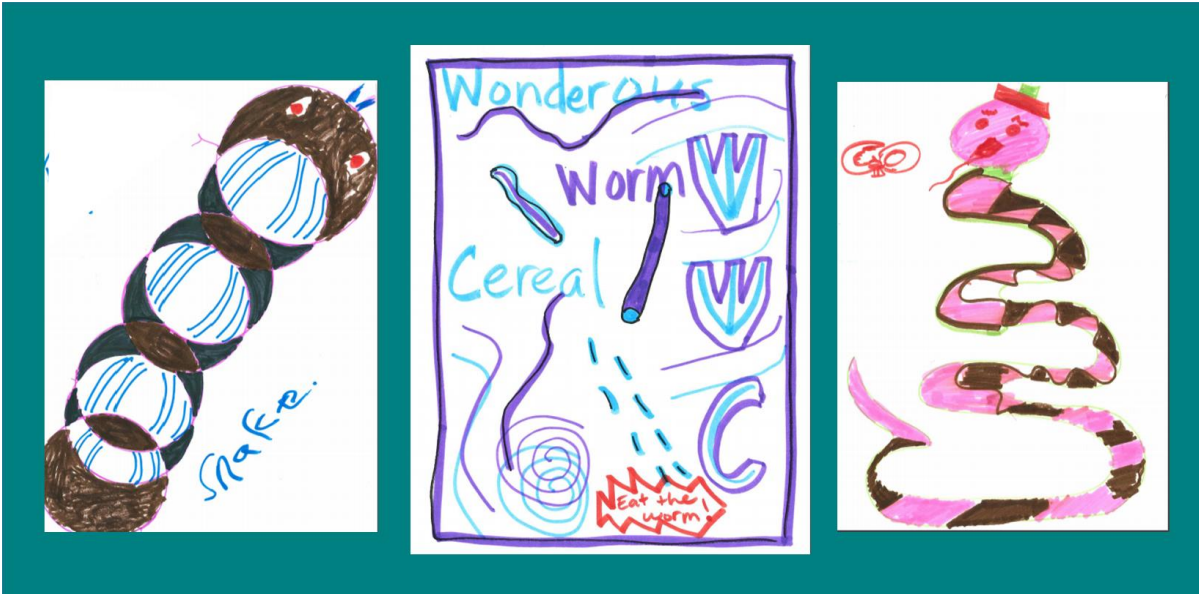


Figure 10. Snake and worm interpretations of the Mars tubes.



Figure 11. Cereal box front panels made with the pre-drawn template.

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Appendix A

Lesson Activity Questionnaire

Graphic Organizer

Name:

Part 1 of Lesson

What do you think the objects are in the picture? What factors did you consider (CAF) as you made your conclusion concerning the identity of the object? Think about your own observations and discussion with your table partner. List the things (factors) that led you to conclude what the objects were.

My own thoughts about what the pictures look like and how they were made.

1.

2.

3.

4.

My thoughts about what the pictures look like and how they were made after talking to my partner/table groups.

1.

2.

3.

4.

Additional ideas that I now have after thinking about my own thoughts, those of my partner/table group and those of my teacher.



Appendix B Part 2 of Lesson

Tell what you think the pictures are:

Explain why there are no additional images are no longer being found on Mars:

List the different clues or ideas that you thought about or heard that led you to believe how this image was created or what the object's purposes were or could be. After you write your clue explain what about the clue convinces you that your idea about the object is correct. In the space after your 5th clue, write how all of the clues led you to draw your conclusion about what the object was. Hint: Your conclusion should be what your cereal box picture and title tell us made the pictures. (Clues)

- 1.
- 2.
- 3.
- 4.
- 5.

These clues made me believe these pictures were made by:

Now take the clues you listed and rearrange them in order from most important to least important clue. The most important clue is the one that pulled you closest to your conclusion, then second and so on.

(First Important Priorities)

- 1.
- 2.
- 3.
- 4.
- 5.

