

Exploring Animal-like Images in NASA Photos of Mars Using de Bono's CoRT Thinking Skills: Alternatives, Possibilities, and Choices, Compare, and Decisions

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Abstract

The use of de Bono's CoRT Thinking Skills of "Alternatives, Possibilities, and Choices," "Compare," and "Decisions" create opportunities for students to critically think about ideas using a new lens of thinking. The lesson was designed to accommodate twice-exceptional students, gifted students with the disabilities of dyslexia and/or dyscalculia, through three of the de Bono's strategies integrated with activities. Gifted graduate students in this lesson were presented with an opportunity to explore and analyze the animal-like images from Mars using the three CoRT thinking skills. The photographs used in this lesson were provided by the Jet Propulsion Laboratory (JPL) and the National Aeronautics and Space Administration (NASA). They compared the Martian object resembling a groundhog and a crablike object with animals from Earth, while generating creative ideas regarding what these images might represent. Additionally, students participated in an arts-integrated crayon-rubbing activity. This component of the lesson provided an opportunity to practice the Compare thinking skill while identifying similarities and differences between the artwork and the photograph of the Martian crablike object and to gather ideas to support a decision. After analyzing the artwork and the photograph of the object, students used Edward de Bono's Decisions thinking skill to decide which image was more realistic, the student-created art image or the photo. The results of this lesson support the premise that the three de Bono CoRT Thinking Skills called "Alternatives, Possibilities, and Choices," "Compare," and "Decisions" help meet the needs of twice exceptional students and promote development of critical thinking skills.

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Introduction

De Bono's CoRT Thinking Skills (de Bono, 1985) provide a foundation for educators to implement new approaches to teaching complex topics and concepts. This lesson provided students with opportunities to critically examine a NASA photograph of an object on the surface of Mars resembling a groundhog and, using the de Bono Thinking Skill "Alternatives, Possibilities, and Choices" (APC), to generate ideas regarding the origins and purposes of the object. During the lesson, the participants engaged in critical comparison of two other images: the original NASA image of a crablike or spider-like formation on Mars and the students' artistic representation of the same formation. Using the Compare de Bono's Thinking Skill, students found similarities and differences between the two images. The students used the de Bono Thinking Skill of "Decisions" to make a decision about which image was more realistic based on their own

experiences. The participants used individual worksheets and worked as partners as they applied the thinking skill of Alternatives, Possibilities, Choices, Compare, and Decisions while attempting to solve the mystery of Mars animal-like images

This lesson was designed to accommodate the learning needs of gifted students with the learning disabilities of dyslexia and dyscalculia. Gifted students who have a disability are called “twice-exceptional” because they are different from the general population in being gifted, but also different in having a disability. Each component of the lesson was planned to accommodate for each exceptionality to reduce the impact the exceptionality has on the students’ ability to implement the de Bono Thinking Skills and successfully participate in other aspects of the lesson. The instructors took a creative approach to meeting the needs of each student, recognizing that not every student was impacted by one or both of the disabilities. The lesson was designed to allow customization to address the needs of students with exceptionalities.

Literature Review

This brief literature review first addresses some anomalies in NASA photos of Mars which resemble animals. Then, the two disabilities, dyslexia and dyscalculia, are discussed. This lesson was intended for twice exceptional students; the design and complexity of the lesson is intended to meet the needs of gifted students. The unique characteristics of dyslexia and dyscalculia can significantly affect student performance in the classroom. Specific strategies can be implemented in the classroom to reduce the impact of these exceptionalities and to allow gifted students with each exceptionality to succeed. Images from the Mars Curiosity Rover provided a foundation for the lesson’s arts and crafts integrated activities.

Mysterious Live Animal Images in Photographs Taken on Mars

The concept of life on Mars has long been a standing consideration of NASA and science-fiction writers. As the use of NASA’s spacecraft explorers continues to evolve, one such evolution is NASA’s Curiosity Rover. The Curiosity Rover, a part of the Mars Exploration Program, was placed on Mars in 2012 and has since been exploring and capturing images of the planet for research. While the Rover has yet to confirm life on Mars, collected samples of sediments have proven that, at one time, a freshwater lake existed (Greshko, 2016).

Many of the photos from the Mars Rovers that have been published appear to be lifelike animals or animal statues. Some researchers have identified the phenomenon associated with seeing animals in the Rover’s photographs as pareidolia. Pareidolia is the brain’s ability to see familiar pictures or images in random and abstract constructions (Wodehouse, Brisco, Broussard, & Duffy, 2018). This unique ability gives light to the many ‘animals’ people have expressed seeing within the photos collected from Mars by the Curiosity Rover (Kluger, 2015).

According to the International Science Times (2013), many images, including those of a possible rat and squirrel, have been identified on Mars. See Figure 1 for a NASA Rover image of a possible ground squirrel showing many anatomical features such as eye with white eye ring, ear, well-shaped snout, belly, legs and stubby tail. NASA has confirmed the variables discovered by the Mars Curiosity Rover created an environment once habitable for life to develop, however most pictures of animals continue to likely be caused by the sun and shadows on the many rocks covering the surface of the planet (International Science Times, 2013).

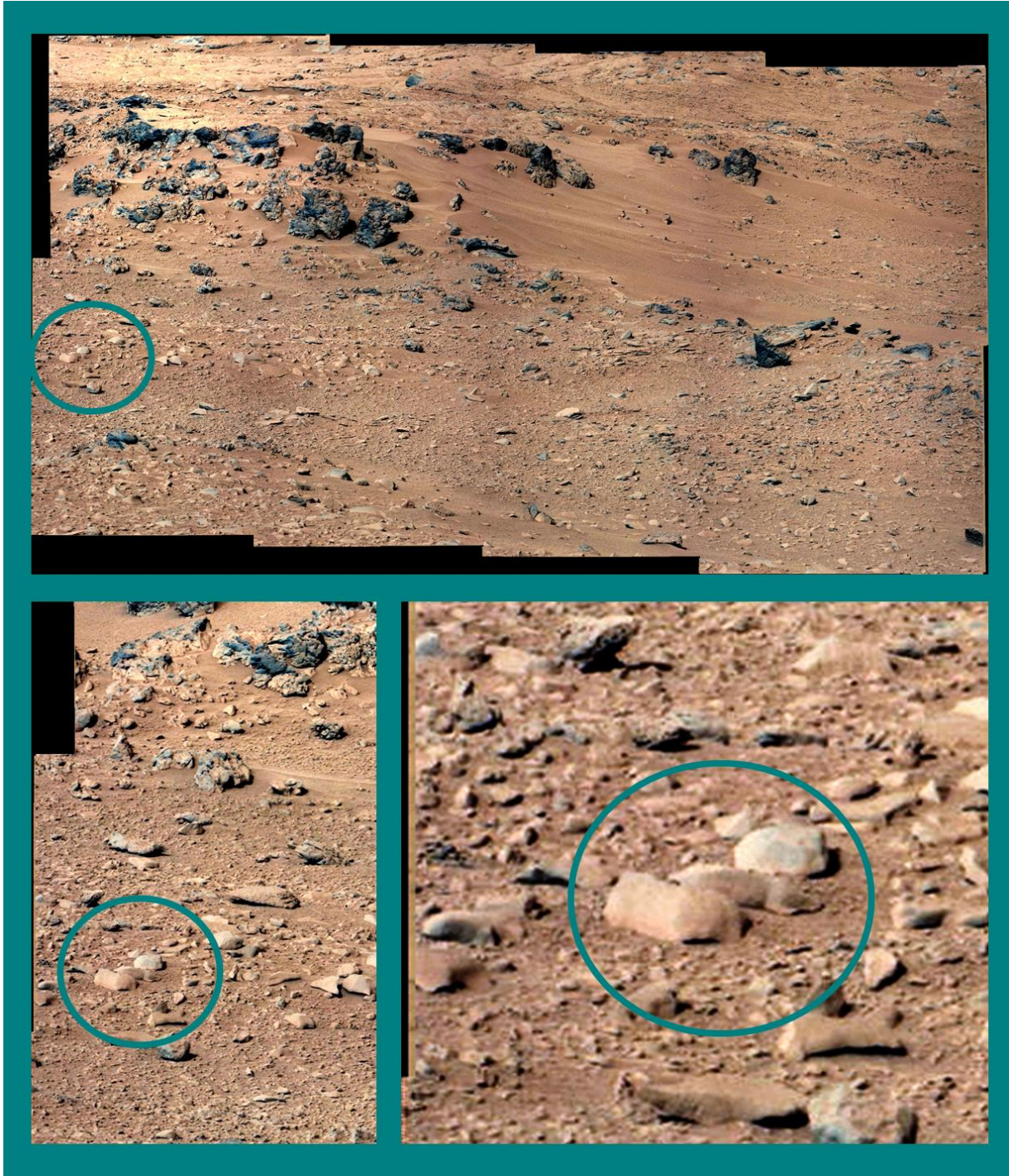


Figure 1. Possible ground squirrel crouching between rocks on Mars (JPL/ NASA, 2012). The top photograph shows the larger scene. The bottom left shows an enlargement of part of the photograph; the bottom right shows the enlarged ground squirrel. Image Courtesy NASA/JPL-Caltech.

Gifted Learners with Dyslexia

Dyslexia, meaning “difficulty with words” is a language-based learning disability which creates difficulties acquiring and developing language skills, specifically reading (Judd, 2012). Children diagnosed with dyslexia, even when provided strong educational opportunities and supportive home environments, experience difficulty learning to read, write, and spell (Westwood & Peter, 2005). Approximately 15% to 20% of the population displaying signs of dyslexia may demonstrate, “slow or inaccurate reading, poor spelling, poor writing, or mixing up similar words” (Judd, 2012).

Dyslexia, a comorbidity, is frequently diagnosed in individuals with attention-deficit disorder as well as language impairment and speech sound disorder (Peterson & Pennington, 2012). Individuals with dyslexia can be successful, even considered gifted, in areas not requiring strong language skills (Judd, 2012).

The five challenges most frequently experienced by individuals who may have dyslexia include:

1. Learning to speak;
2. Learning letters and corresponding sounds;
3. Organizing written and spoken language;
4. Memorizing number facts; and
5. Reading quickly enough to comprehend (Judd, 2012, 102).

Identifying individuals with dyslexia among those who simply do not read well reinforces the need for effective teaching strategies to help both populations of students overcome these difficulties. Strategies for teaching children with dyslexia can be applied and are helpful for all children.

The International Dyslexia Association (IDA, 2017) outlines several accommodations teachers can implement to successfully integrate students with dyslexia; and other disabilities into their classroom:

1. Simplify written directions by underlining or highlighting important parts;
2. Present a small amount of work at a time;
3. Provide additional opportunities for practice to acquire mastery skill;
4. Use explicit teaching instructions, including step-by-step instructions; and

5. Maintain daily routines in the classroom (IDA, 2017, 8-9).

Gifted Learners with Dyscalculia

Dyscalculia is a disability impacting the aptitude to navigate mathematics (Judd, 2012). The term, dyscalculia, refers specifically to difficulty with numbers (Kadosh & Walsh, 2007). Many studies have concluded that, in the Western World, dyscalculia prevails in about 5% of the population and ranges in severity. Dyscalculia is more than simply “being bad at math;” the disability encompasses a general struggle with solving even simple math problems (Kadosh & Walsh, 2007). Because this condition is relatively new to disability research, dyscalculia remediation and best practices are still being developed. Strategies such as the use of adaptive computer games have been shown to mitigate the challenges faced by people with dyscalculia (Kadosh & Walsh, 2007).

This disability impacts students over the course of their entire lives, varying in challenges it presents and changing in severity and level of impact over the course of a person’s life. Dyscalculia presents specific challenges in certain phases of development. Some of the warning signs for young children include:

1. Difficulty learning to count;
2. Trouble recognizing printed numbers;
3. Avoiding games requiring strategy; and
4. Difficulty measuring things (Judd, 2012, 90-91).

Dyscalculia is a disability which evolves and each warning sign may not manifest at the same time nor at any particular time in a student’s development. Educators can use specific strategies to assist students in navigating classroom activities to minimize the impact of dyscalculia. To help students mitigate the effects of dyscalculia when presenting them with new information or skills, educators can begin with concrete examples, and gradually move toward more abstract concepts and examples (Judd, 2012, 92). Additionally, students with dyscalculia may face challenges when organizing ideas on paper. Providing them with graphic organizers or graph paper can help learners focus through visually outlining their ideas in an organized format (Judd, 2012). Because time management can be difficult for students with dyscalculia, the use of a timer can aid in the transition

from one activity to the next. Displaying the timer on a screen to the whole class can eliminate potential psychological stress caused by the accommodation being provided to only selected students in the class, in addition to assisting all learners with transitioning from one activity to the next.

The Lesson

This portion of the Mars Mystery Project focused on the possibility of existence of live animals on Mars. NASA photos of images appearing to be a groundhog and a crab were examined. The participants used the photograph of the groundhog to create a description, and the crab was replicated by creating a crayon rubbing. Each activity was designed for twice exceptional students and integrated de Bono's CoRT Thinking Skills to engage them in critical thinking using Alternatives, Possibilities, and Choices, Compare, and Decisions. The lesson also integrated specific techniques to accommodate and minimize the impact of two disabilities, dyslexia and dyscalculia.

Participants

Twenty-one adult (14 White, 4 Black, 3 Asian; 11 male, 10 female) with a mean age of 39 years engaged with the lesson activities. These participants were high-achieving doctoral students and therefore were likely gifted individuals.

Lesson Procedures

The lesson was conducted with adult gifted graduate students. However, these activities would also be appropriate for students of other ages, especially early childhood and elementary students. This lesson focused on using de Bono's CoRT Thinking Skills: Alternatives, Possibilities, and Choices (APC), Compare, and Decision. The topic of Mars mysteries was selected to pique the imaginations of gifted students and to challenge them to compare and contrast what they were seeing in the photos with their preexisting knowledge about animals from Earth as well as generate hypotheses regarding the nature of the animal like entities in the photographs. The lesson included several distinct activities, each geared toward accommodating

twice-exceptional students and implementing the CoRT Thinking Skills.

Alternatives, Possibilities, and Choices (APC).

The lesson began with an APC-focused activity, in which students were presented with a photograph of what appears to be a groundhog, or a statue of a groundhog on the surface of Mars. The photo was taken by the Mars Rover "Curiosity" which has been on the surface of Mars since 2012. The students completed a guiding worksheet (Appendix A) and were asked to use de Bono's CoRT Thinking Skill APC to identify all the alternatives, possibilities, and choices of what this picture could represent. The Mars image was projected on the classroom screen as part of a slide presentation for the lesson. Each of the slides used bright colors as an accommodation for both, students with dyslexia and dyscalculia. This strategy helped keep the participants focused during the presentation. As an accommodation for dyslexia, students were allowed to work in pairs so any student with this exceptionality would not feel pressured to have to write all responses independently. Participants were provided with on-screen instructions and verbal instructions to maintain clarity and eliminate the need to read/re-read the instructions. Directions were also chunked into small steps or provided one at a time. Finally, an online timer was projected on the screen to allow students to effectively use time allotted for the activity. The online timer provided structure for activity transitions not only for students with dyscalculia but also for the gifted learners who may be perfectionists and tend to get stuck trying to perfect every part of their work. The teacher also announced the remaining time near the end of the activity.

Compare. During the second activity, the participants compared the Mars "groundhog" to a groundhog which might be found in the Midwest region of the United States. Figure 2 shows the landscape and a close-up of a possible groundhog on Mars. Figure 3 shows the Mars groundhog image before and after enhancement by increasing the brightness and contrast. A photo of two Earth groundhogs from Michigan was provided for comparison. This activity included a worksheet (Appendix B) in which the students were asked to individually compare the images and identify the similarities and differences between them. Once the comparison was completed, students were asked to work with

a partner to share their responses and comparisons. When working in pairs, the students circled similar descriptions on both worksheets. Similar to the first activity, the instructors used written and verbal instructions and allowed the students to collaborate to accommodate students with dyslexia who may feel stressed if asked to write a lot. Students were again

provided with an online countdown timer on the screen and verbal time reminders to accommodate any students with dyscalculia. As a final element of the second activity, the participants were offered an opportunity to share with others some of the similarities and differences between the groundhog images they identified.

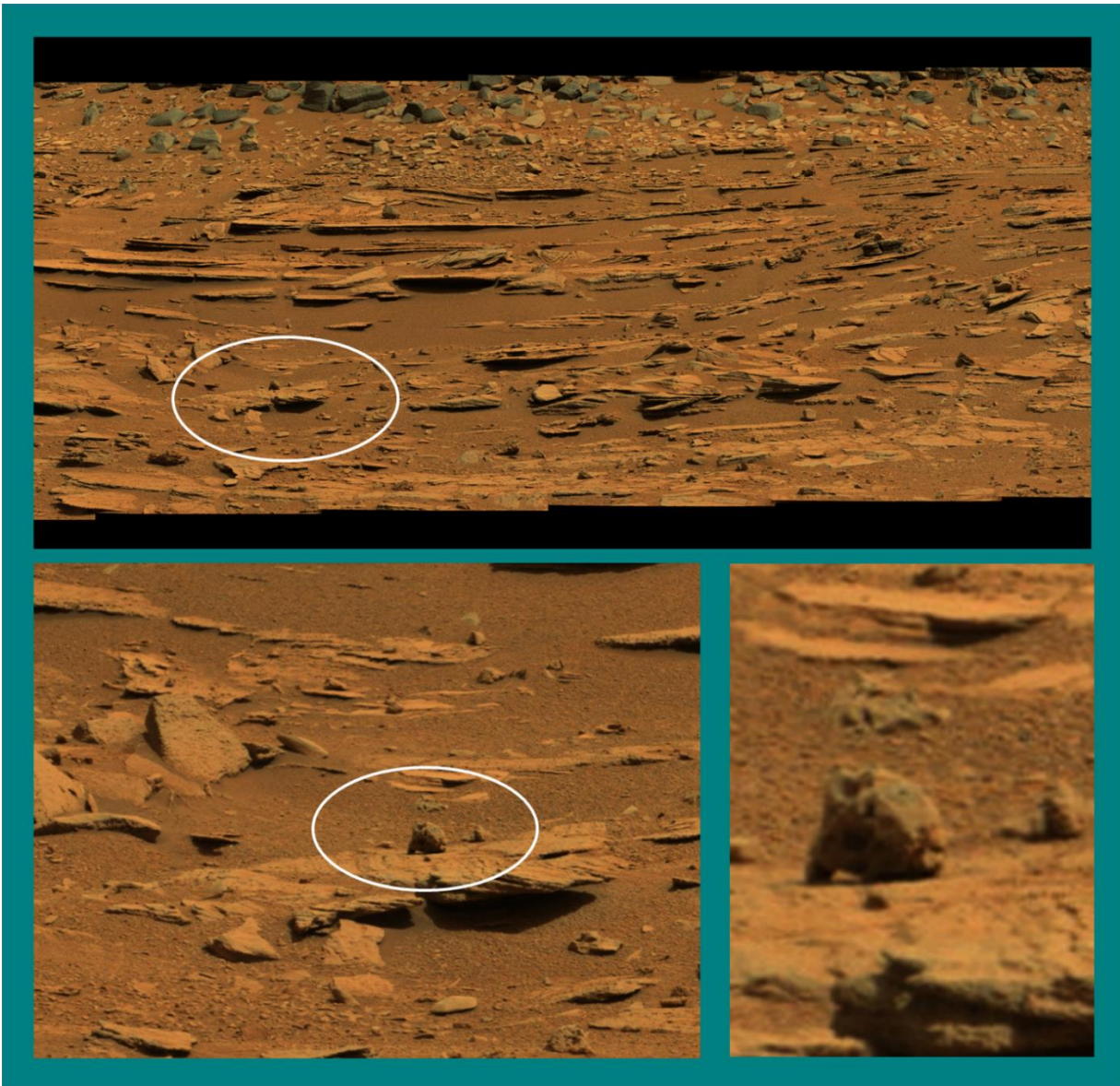


Figure 2. Part of Photograph taken by Curiosity Rover on SOL 120: PIA 16700 Wide View of 'Shaler' Outcrop, Sol 120 (JPL/ NASA, 2013). The top image is the wider landscape with the area of interest circled; the bottom left shows an enlarged view of the area of interest; the bottom right shows further enlargement. Image Courtesy NASA/JPL-Caltech.



Figure 3. Far-left image is the raw NASA photograph, as shown in Figure 2. The center image has been enhanced by increasing the contrast. The far-right image shows two Earth groundhogs and the groundhog to the rear may be in a similar pose as the Mars groundhog.

Arts Integration and Decisions. The final activity used arts integration to improve memory and application of de Bono's CoRT Thinking Skill Decisions. Students first examined a photograph of a Mars crablike object in a shallow cave. See Figure 4.

The crayon-rubbing activity used a textured template made from a cardboard square with hot glue outlines in the shape of the Mars crablike figure. Students were provided with plain white copy paper, instructed to place their paper over the cardboard template, and to use the broad side of an unwrapped crayon to make a rubbing. Figure 5 shows an example of a rubbing made by one of the students. Students were encouraged to utilize a variety of colors and allow their creativity to guide rubbing creation, rather than relying on their own experiences to determine what the image would look like upon completion.

Once finished with the rubbing, students were reintroduced to the Mars "crab;" the photo of it was projected on the classroom screen. See Figure 6. After allowing some time for students to evaluate

the image and ask questions about the image, instructors provided the participants with the third worksheet (Appendix C). The worksheet guided the learners through comparing their artwork with the projected image of the Mars "crab." The comparison activity used de Bono's Thinking Skill of Compare to find similarities and differences between the two images. Then, the learners used de Bono's Thinking Skill of Decisions to determine which image was more realistic based on the lesson experience. To accommodate students with dyslexia, the instructors provided written and oral instructions as well as the opportunity to work in a small group for additional peer assistance. Instructors used a timer and verbal countdown to accommodate for dyscalculia as well as for gifted and other students who may have been perfectionists. Learners engaged in small group discussions for approximately 10 minutes and then concluded the lesson with sharing their artwork, displaying their creativity and what they've learned after applying de Bono's CoRT Thinking Skills.



Figure 4. NASA Photograph showing the crablike object in a shallow cave. The top image shows the broader scene. The bottom left is enlarged. The bottom right shows a greater enlargement of the crablike object (JPL/NASA, 2014). Image Courtesy NASA/JPL-Caltech.



Figure 5. Example student-produced rubbing made with the rubbing template and two colors of crayons.



Figure 6. Crab image from NASA photograph described in Figure 4. The image on the right has increased brightness and contrast. Image Courtesy NASA/JPL-Caltech.

Results and Discussion

The analysis of the participants' artwork and worksheet responses as well as the instructors' observations were consistent with effective implementation of the goals of the lesson. As a result of using de Bono's CoRT Thinking Skills, the students

were able to creatively represent multiple viewpoints and identify a significant number of unique ideas through applying the Alternatives, Possibilities, and Choices skill, the Compare skill, and the Decision skill.

Table 1 provides the frequencies of the idea categories from student responses written in the bubbles of the first worksheet (Appendix A). Each bubble represented a different student idea of what the Mars groundhog could be besides a living groundhog. The most frequent responses were: an animal, rock, object, animal-water, and food. More than four students included these answers as a possibility or an alternative to the actual animal. The purpose of de Bono's APC skill was to help the participants determine as many possibilities and choices as possible. The majority of the students generated at least five distinct possibilities. The number of categories of ideas provided by the participants represents their ability to use de Bono's APC Thinking Skill when evaluating a particular element or component. The ability to see beyond what is initially presented is the cognitive goal of this skill. According to the analysis of the student works, the participants have mastered the skill and generated unique and creative ideas.

The instructors implemented a second activity in which two images were provided and students were asked to compare the similarities and differences of each image with a partner. Table 2 presents the number of similarities and differences identified by the students using the second worksheet (Appendix B). The most frequently generated similarity was the "posture" of the animal in each image. The most common difference identified was the tail, which appeared in one image and did not appear in the other. There were five similarities identified by the majority of participants: legs, face, head, proportions, and shape. Each of these similarities was mentioned in more than six student

responses. The two differences identified by a significant number of participants were environment and fur. These results indicate that the students were able to effectively use the de Bono thinking skill to analyze the images.

The participants applied the CoRT thinking skill of Compare during the arts-integrated activity when the students compared their artwork to the photograph of the Mars crablike object. Figure 7 shows examples of student artwork. Table 3 provides results of analysis of students' conclusions related to which image looked more like a crab. The majority of the students identified the Mars image as the most similar or more representative of an Earth crab, $n=14$. However, four students identified their crayon-rubbing version of the crab as more realistic. The students used de Bono's Thinking Skill of Decisions to determine which image was more realistic.

Table 1. *Photo examination of "Groundhog" Animal on Mars using Edward de Bono's CoRT Thinking Skill "Choices, Alternatives, and Possibilities"*

Category	Frequency
Animal	28
Rock	16
Object	14
Animal - Water	12
Food	4
Alien	2
Animal by product	2
Clothing	2
Structure	2
Wood	2
Instrument	1
Mineral	1

Table 2. *Photo examination of "Groundhog" Animal on Mars using Edward de Bono's CoRT Thinking Skill "Similarities & Differences"*

Category	Frequency
Legs - Similar	9
Tail - Different	9
Environment - Different	7
Face - Similar	7
Fur - Different	7
Head - Similar	6
Clear vs blurry photo	5
Proportions - Similar	5
Shape - Similar	6
Rock	4
Size - Different	4
Ears - Different	3
Color - Similar	2
Food - Different	2
Reproduces - Different	2
Shape - Different	2
Terrain - Different	2
Animal	1
Burrow or hole - Similar	1
Camouflage - Similar	1
Color - Different	1
Ears - Similar	1
Face - Different	1
Fur - Similar	1
Legs - Different	1
Posture - Different	1
Proximity of Object in Photo - Different	1

Table 3. *Photo and rubbing "crab" examination using Edward de Bono's CoRT Thinking Skill "Comparison"*

Category	Frequency
Mars Crab	14
My Crab	4
Both	1
Neither	1



Figure 7. Example student rubbings of the crablike object.

Conclusion

Different components of the lesson allowed the instructors to provide students with three opportunities to demonstrate their ability to use the following de Bono's Thinking Skills: APC, Compare, and Decisions. The diversity of ideas, features of artwork, and student responses presented in Tables 1-3, provide reason to believe that the participants successfully implemented the three de Bono's thinking skills. Interestingly, while identifying similarities and differences between two images of the groundhog, the participants managed to generate a large number of diverse ways to analyze the two images (see Table 2).

The de Bono's thinking skill of Decisions allowed students to use critical thinking to determine if the photograph or their rubbing artwork had the most lifelike crab. The responses varied from student to student showing the uniqueness of each student in the class.

The de Bono thinking skills can be implemented in a wide-range of instructional settings. This lesson was created to scaffold a complex topic and to provide the participants with different approaches to comparing and identifying alternatives, possibilities, and choices. This lesson can be easily replicated and adjusted toward a variety of curricular areas and student ages. Finally, the participants

were able to implement the three of de Bono Thinking Skills through indirect instruction, which can provide a foundation for inclusion of the de Bono Thinking Skills into more formal instructional practices.

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Appendix A

Mars Mystery - Worksheet #1



Write choices, alternatives, and possibilities of what the figure could be. Write each idea in a separate bubble.

Name of Student 1: _____

Name of Student 2: _____



Appendix B

Mars Mystery - Worksheet #2



Earth Groundhogs



Possible Mars Groundhog

Some people believe the figure on the right resembles a Groundhog. What is similar between the two photos? What is different?

Name of Student 1: _____

Name of Student 2: _____

1. _____

1. _____

2. _____

2. _____

3. _____

3. _____

4. _____

4. _____

5. _____

5. _____

Once all members at your table are complete, bring both partner pairs together. Compare your two papers. Circle words or phrases which are the same on both sheets.



Appendix C

Mars Mystery - Worksheet #3

Compare your crab rubbing to the photo of the Mars crab on the screen.

Which picture looks more like a crab to you? (Write your answer in the box.)

Explain why you think one looks more real than the other. (Write your answer in the box.)

