Coding Constellations

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Target Grade: 6th Math or STEM

Time Required: 6 hours

Standards:

Math
6.NS.C.6 Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates

- Recognize that a number and its opposite are equidistance from zero (reflections about the zero).
    - The opposite sign (-) shifts the number to the opposite side of 0. For example, -4 could be read as the "opposite of 4" which would be negative 4. In the example, -(-6.4) would be read as the "opposite of the opposite of 6.4" which would be 6.4. Zero is its own opposite.
    - Students place rational numbers on a number line or in a coordinate plane. Illustrative Math Tasks

ISTE
5a. Students formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.

Extensions Connect to:

Social Studies:

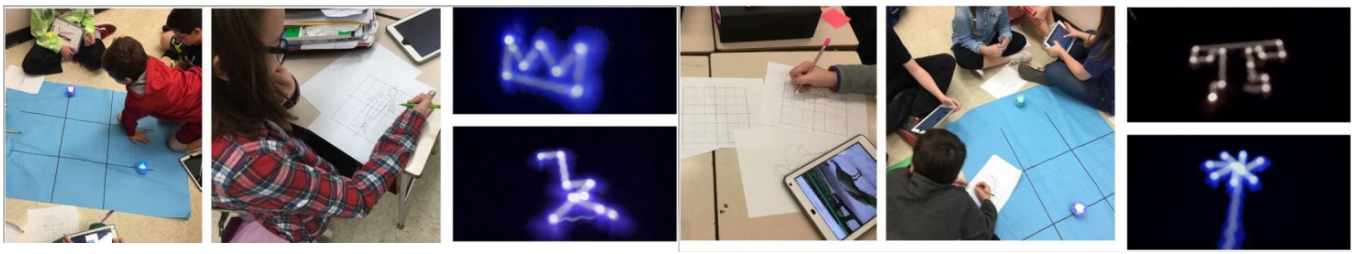
- 6.56 Describe the myths and stories of classical Greece; give examples of Greek gods, goddesses, and heroes (Zeus, Hermes, Aphrodite, Athena, Poseidon, Artemis, Hades, Apollo), and events, and where and how we see their names used today. (C, H)
- 6.57 Compare and contrast the Titans with the Olympian gods and explain the surrounding Greek mythology. (C, H)
- 6.62 Explain the rise of the Roman Republic and the role of mythical and historical figures in Roman history, including Romulus and Remus, Hannibal and the Carthaginian Wars, Cicero, Julius Caesar, Augustus, Hadrian, Aeneas, and Cincinnatus. (C, G, H, P)

Lesson Objectives:

- The students will be able to label points on a coordinate grid
- The students will be able to code a Sphero robot to follow a given path

Central Focus:

This math lesson is truly cross-curricular as it includes aspects of technology, science, social studies, and math! Students will learn about ancient mythology and its connection to constellations while practicing coordinate pairs. They will design their own constellation on a coordinate plane, and then code a Sphero robot to run the constellation. In the end, the teacher will capture the robot running its course to create a beautifully lit slow exposure photo of the constellation.



Background Information:

Students should have basic knowledge on how to graph and label points on a coordinate grid. Students should also have basic understanding of drag and drop coding, which is how the Spheros are controlled. If you as a teacher are not familiar with this type of coding, here is a video that can help. Our students are used to using programmable robots, but if yours are not, providing students with some days to play with the Spheros before beginning the project will help with the learning curve. This lesson can be adapted to any type of programmable device you might have, including Probots, Dash, Ozobot, and many more.

Materials

- Constellations hyperdoc
- Constellations graphing paper
- Sphero robots (1 for every 3 students is a minimum preferred amount)
- Graph paper
- iPad or other device to access the hyperdoc and code the Spheros
- Sphero app on each device
- Large butcher or chart paper with a coordinate grid drawn on it.
- Long exposure app or digital camera the ability to record extended exposure
- Tripod to support recording device

Instruction

Day 1: Introduction (60 min): Students will be getting a basic introduction to the history of constellations, including how they got their names.

Provide students with the attached hyperdoc.
Students will work through the hyperdoc to learn about constellations.

- First, they will watch a video on constellations.
- Then, they will plot constellations on a coordinate grid using the attached worksheets
- Then, they will research the specifics about a constellation and create a short Google slides presentation to show their knowledge.

Day 2: (60 min) Now that students have a background knowledge of constellations; they will be creating their own constellation.

- Give students a sheet of coordinate grid graph paper.
- Students should draw something that represents themselves on the graph paper.
- The drawing should not be too detailed because we will turn it into a constellation. (good examples: smiley face, heart, football, etc..)
- The drawing must be in at least 3 of 4 quadrants
- The teacher should check each student's design before proceeding
- Once the design has been approved, students should plot at least 10 points on the drawing that would help to identify the picture. The points represent the individual stars of the constellation.
- Each point on the drawing must be correctly labeled with its coordinates.

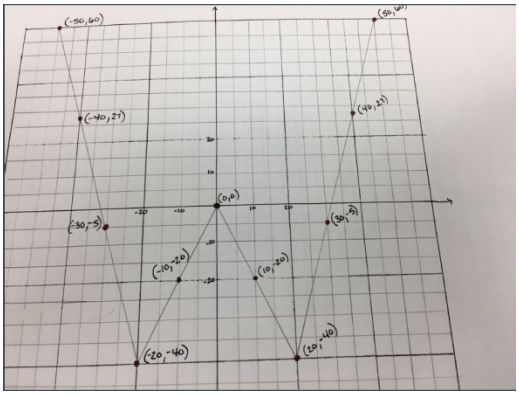
Day 3-5: Sphero Coding (180 minutes, or less, depending on ability of class)

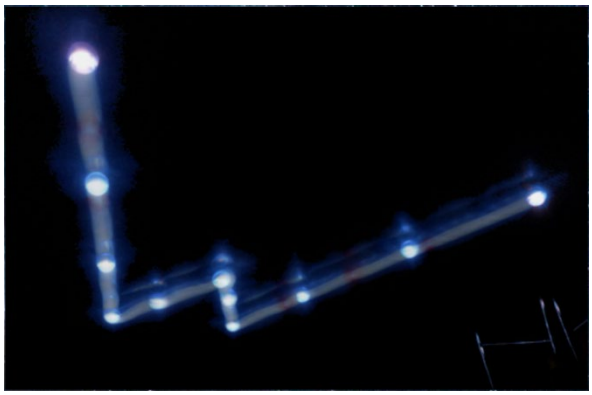
- Students should already have basic knowledge of drag and drop coding.
- The teacher will provide large butcher or chart paper with and enlarged coordinate grid (6 inch squares works well), enough for small groups with 2 Spheros per group.
- Students will take turns working on coding the path that the Sphero must drive to form their constellation.
    - Have students label the path of their constellation form 1-10 (or the highest number if they included more points)
    - Students will use the large paper to test the code for each move that the Sphero will make. They must test their coding for each section at a time in order to create the entire path.
    - Students should take turns, letting one person drive the Sphero while another codes their next section of path.
    - Students need to include at least a 5 second stop at each point so that the "stars" will be visible when recorded on camera.

- The teacher should circulate and help minor user issues as well as questioning students to help in their coding discoveries.
- Once students have completed their coding, they should test run on open floor to make sure their code is correct.

Day 6: (60 min) Recording day

- This step is optional, but makes for a fun conclusion.
- Now that the coding is complete, you can record each Constellation using a long exposure camera app (there are many free options both on the iTunes App store and Google Play).
- The Sphero has a light inside, so recording a long exposure photo in the dark makes a perfect Constellation outline.
- Set up your recording device so that it will fit the entire floor graph within the frame.
- It is important that the recording device remains motionless during recording, so a tripod is necessary.
- Have students take turns placing the Sphero on the grid. Then, have a student turn off the lights. The teacher should push record before the student starts the Sphero code.
- When the Sphero has run its entire line of code, turn off the recording device.
- Repeat this until all of your constellations have been recorded.
- Download and distribute the pictures to students so they may complete their project, or Airdrop them if using an Apple device.





Student work outside of class:

- Students will use a Google Slides template to compile all of the steps for their project
- This Slides project will be the final submission

Differentiation

Modifications:

- Students could be paired up to create their constellations, allowing them to work together to code their constellation.

- Run a test of some basic coding for your size coordinate grid. Provide a "cheat sheet" for simple moves. *Ie: this code will move the Sphero forward 2 squares, this code will move the Sphero right 5 squares.*

Extension:

- Have students write a creation myth to go along with their constellation. This is a creative way to include writing and link to Social Studies standards of Ancient Greece.
- Have students experiment with different colors and actions on the Sphero coding. Ie: can I make each star a different color?
- Students could add more stars to try to get a more detailed constellation.
- Have early finishers become peer helpers with coding.

Assessment

- Students will submit the Constellation graphing sheets from the Hyperdoc to show their understanding of plotting points on a coordinate grid.
- Students will submit a brief Google Slides presentation to show what they learned about their constellation in the Hyperdoc.
- Teacher will check student design and accuracy of the plotted points on their design.
- Teacher will do quick check ins throughout the coding process to look for common mistakes and correct major issues.
- Rubric will be used to grade all pieces of the project.

Coding Constellation Project

Here you will find everything necessary to complete your constellation project:

First: Complete all parts of the Hyperdoc found here.

That includes:

- watching the video
- graphing the constellations
- researching a constellation
- creating your Google Slides

Next:

Creating your own Constellation.

1. Using the provided graph paper, create an original image that will be the basis for your constellation. It does not have to be amazing, we will just be using the outline. Your image must be drawn in at least 3 of the 4 quadrants. Making the image important to YOU will make it easier to continue with the project. ***Take a picture of your image when you are finished.***
2. Now that you have your image, you must add the "stars". Choose at least 10 points to put stars that will provide an outline for your image. The points do not have to be exactly on your image. Look at real constellations, the stars are just a basic shape that someone has decided looks like a shape. Your stars should be able to be connected without lifting your pencil. ***Take a picture of your image when you are finished.***
3. Once you have placed your stars, you need to accurately label them with ordered pairs. Using the coordinate grid, determine the coordinates of each of your constellation's stars and write the ordered pair next to the star on your picture. ***Take a picture of your image when you are finished.***
4. Now that your stars are labeled, we will code the path of your constellation into the Sphero app to control the Sphero. (will occur in class). ***Take a screenshot of your code when finished***
5. Finally, we will record the Sphero driving the path of your constellation....in the dark. I will record the path on my iPad and airdrop the picture to your iPad. ***Save the picture of your constellation in your photo library.***

Now that the bulk of your project is complete:

- You need to compile all of your work in one place.
- I have done the outline of the work for you. You need to make a copy of this Google Slides Presentation. Using this outline, you need to enter your own information to complete the project.
- Your final project (the Google Slides Presentation) will be submitted here to be graded.

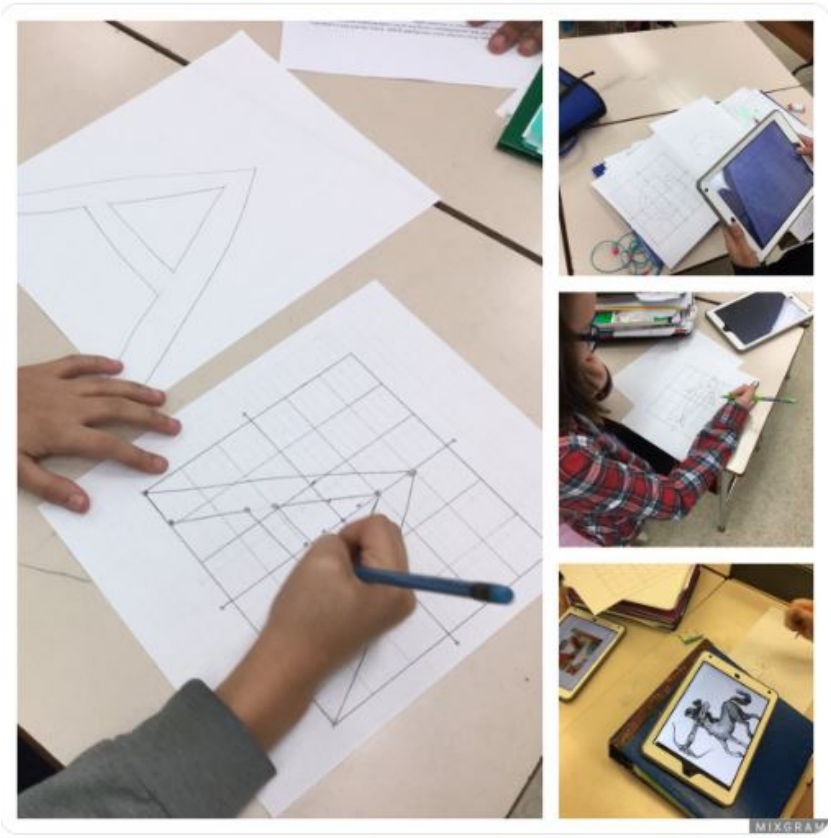
Here is an example of a completed project

Constellation Rubric

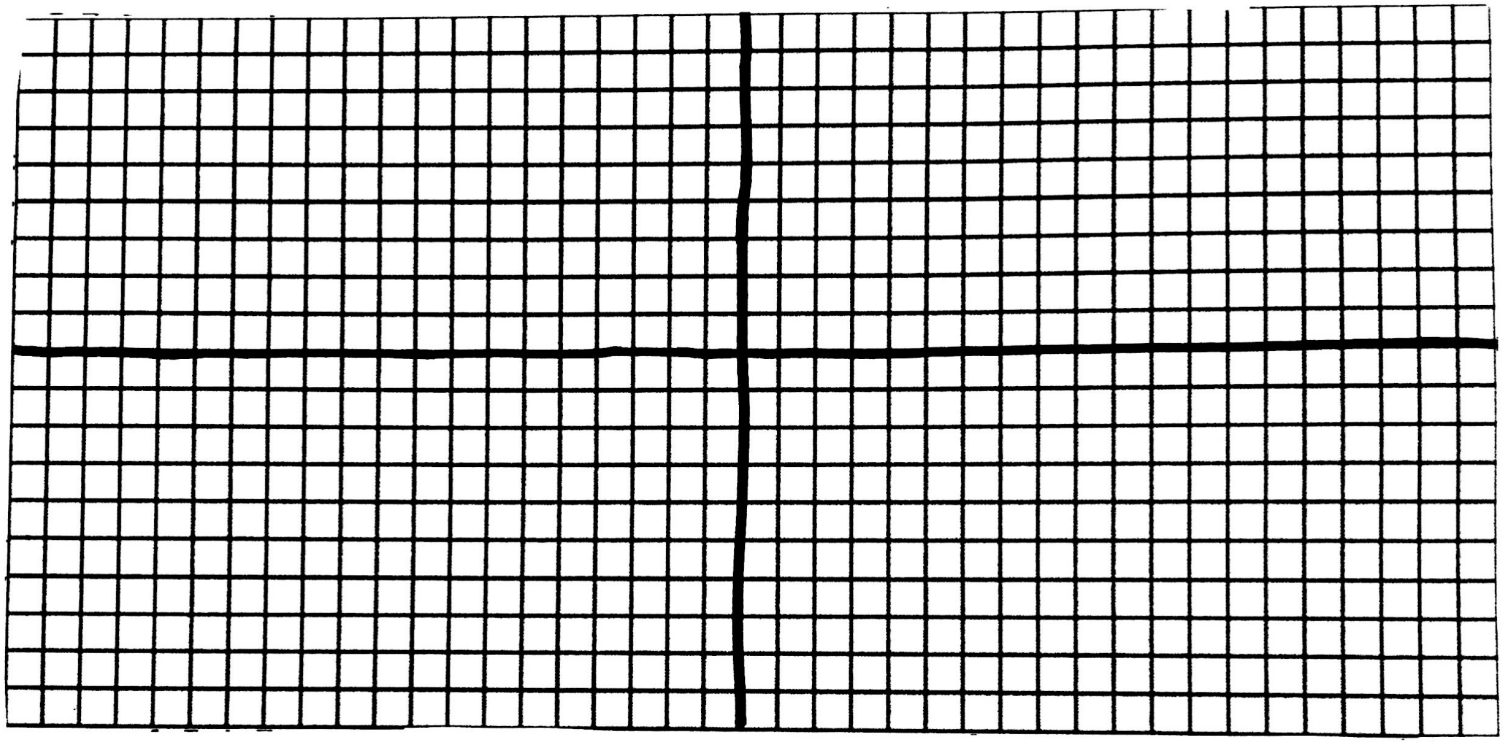
Constellation Rubric

Criteria	Ratings				Pts
Google Doc Completion	**30.0 pts** **All items were completed**	**20.0 pts** **1 item was not completed**	**10.0 pts** **2 items were not completed**	**0.0 pts** **Google Doc was not completed at all.**	30.0 pts
Google Docs graphing	**10.0 pts** **Graphing is complete and mostly accurate**	**6.0 pts** **Graphing is missing some points or lacking accuracy.**	**5.0 pts** **Graphing is mostly incomplete or inaccurate**		10.0 pts
Constellation has a name	**5.0 pts** **Full Marks**	**0.0 pts** **No Marks**			5.0 pts
Original Image	**10.0 pts** **Original image is complete and in 3 quadrants.**	**5.0 pts** **Image is incomplete or does not reach 3 quadrants.**			10.0 pts
Stars	**10.0 pts** **Image has at least 10 stars**	**5.0 pts** **Image has 5-9 stars**	**0.0 pts** **Image has less than 5 stars.**		10.0 pts
Ordered Pairs	**20.0 pts** **All ordered pairs are labeled correctly.**	**10.0 pts** **80% of ordered pairs are labeled correctly.**	**5.0 pts** **50% of ordered pairs are labeled correctly.**	**0.0 pts** **Less than 50% of ordered pairs are labeled correctly.**	20.0 pts

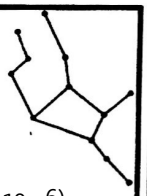
Constellation Rubric					
Criteria	**Ratings**				**Pts**
Sphero App	**10.0 pts** **Sphero App Screen shot is included**			**0.0 pts** **No Sphero App Screen Shot**	10.0 pts
Constellation	**10.0 pts** **Sphero drives path of constellation**	**5.0 pts** **Sphero path is mostly correct.**	**3.0 pts** **Sphero path is slightly correct**	**0.0 pts** **Sphero path was incorrect or incomplete.**	10.0 pts
Constellation picture	**15.0 pts** **Constellation Picture is included**			**0.0 pts** **No constellation picture**	15.0 pts
Total Points: 120.0					



To complete the star chart, first number your coordinate graph. Every square has a value of 1. Then, graph each point for the constellations using the given ordered pairs and graph paper. When you finish, outline each constellation in it's own color.

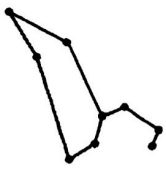


Virgo



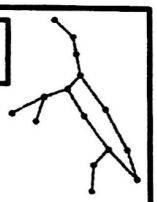
(-20, 5) (-19, 3)
(-20, 1) (-18, -2) (-16, 0)
(-16, 3) (-18, 6) (-14, -3)
(-13, -1) (-11, 0) (-13, -5) (-10, -6)

Leo



(-8, -4) (-7, -6)
(-6, -9) (-6, -5)
(-5, -8) (-5, -7)
(-4, -7) (-2, -8) (-2, -9)

Ursa Major



(1, -8) (1, -6) (2, -5)
(4, -7) (4, -5) (3, -3)
(1, -4) (0, -2) (-2, -3)
(-3, -5) (-1, -5) (1, -1)
(1, 1) (0, 2) (-2, 3)

Andromeda

(13, -8) (14, -10) (16, -7)
(17, -9) (18, -6) (19, -7)
(20, -5)

Boötes

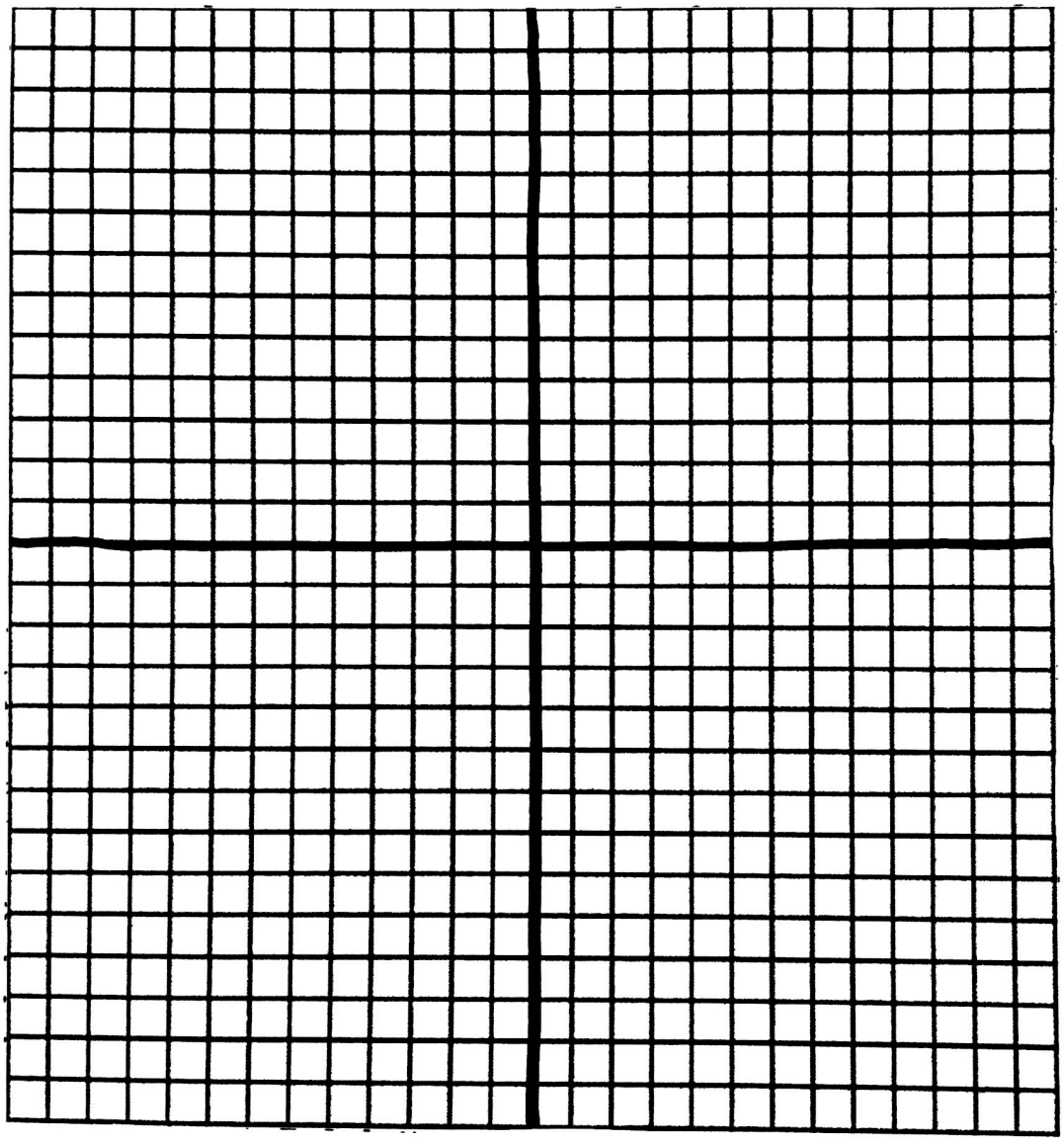
(-2, 8) (-3, 6)
(-4, 9) (-6, 7)
(-7, 8) (-9, 6) (-10, 4)

Ursa Minor

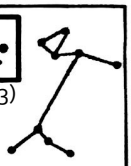
(9, 0) (9, 1) (8, 2)
(7, 3) (8, 4) (6, 5)
(5, 4)

Cassiopeia

(11, -4) (13, -4)
(14, -2) (16, -3) (16, -1)



Canis Major

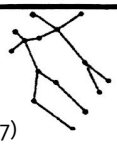


(-13, -13) (-12, -12) (-11, -13)
(-9, -14) (-10, -9) (-8, -10)
(-11, -9) (-12, -8) (-10, -7)

Canis Minor

(-13, -2) (-12, 0)

Gemini

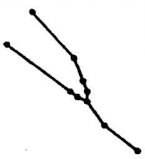


(-11, 12) (-10, 11) (-11, 10)
(-9, 11) (-9, 9) (-8, 8) (-10, 7)
(-6, 6) (-8, 5) (-9, 13) (-8, 12)
(-6, 13) (-6, 9) (-4, 8) (-5, 7)

Orion

(-2, 4) (0, 4)
(-3, 2) (-4, 2)
(-4, 0) (-3, -1) (-1, 0)
(1, -1) (3, 0) (4, -1)
(4, -2) (4, -3) (3, -4)
(2, -4) (-2, -5) (-1, -4.5)
(0, -4) (-4, -8) (1, -8)

Taurus



(2, 5) (7, 1)
(8, 0) (9, 0)
(10, -2) (13, -5) (9, 1)
(8, 2) (7, 4) (4, 7)