Activity 1: Communication Signal Simulation

Teacher Instructions:

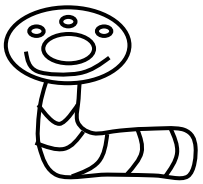
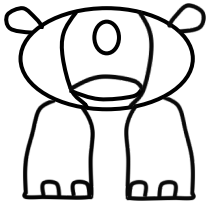
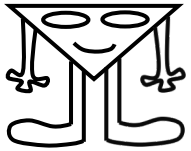
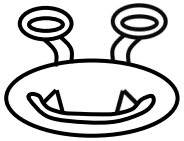
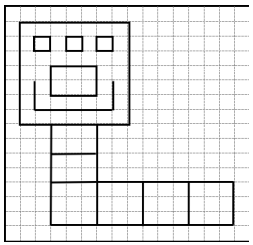
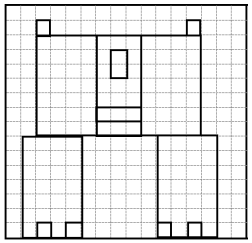
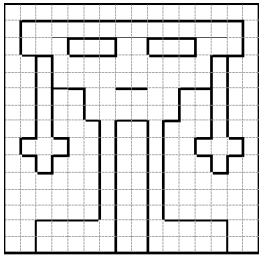
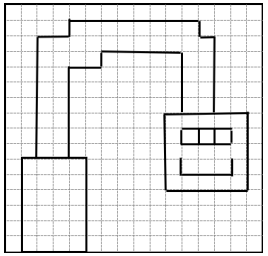
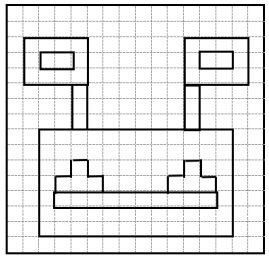
In this activity, students will simulate sending analog and digital signals, similar to the child's game of telephone," but in the form of copying a series of drawings. This activity models the key differences between digital and analog signals in their resolution and signal fidelity. Students will perform two simulations: one simulating multiple transmissions of an analog signal, and one simulating multiple transmissions of a digital signal.

In the round 1 "analog" simulation, the alien images are composed of rounded lines to represent how analog waves can have infinite values. Students will draw a copy of the original image and pass their drawing to the next student to be copied. After all 5 students have copied the analog drawing, they will compare the original and final images. They will observe how tiny changes in each drawing result in significant distortion in the final image.

In the round 2 "digital" simulation, the alien images are composed of straight lines that follow the grids on the handout, representing how digital signals are composed of quantized, or a limited number of, values. When students compare the images that were transmitted via digital "signals", they will notice that there is little distortion in the digitally-transmitted image even after multiple transmissions, unlike what they observed when they transmitted the image using an analog signal. In the digital round, they would have had to make a large error to make a significant change in the image.

Materials:

- Scissors
- Tape or glue
- A black pen or fine tip marker (students should not be allowed multiple attempts to recreate the image)
- A copy of each of the 5 digital and 5 analog aliens per table (one alien type per human.)

	Quark	Lepton	Hadron	Gluon	Boson
Analog images are composed of rounded lines to represent that analog waves can have infinite values					
Digital images are composed of straight lines that follow the grids on the handout representing how digital signals are composed of quantized values					

Activity 1: Communication Signal Simulation

Teacher Set Up:

1. Organize into groups of 5 in a circle around a table. (Five is the number of aliens provided in the set, and also provides optimum opportunities for students to draw the assigned aliens.)
2. At each table, give each student a different analog alien page. Hold the digital versions until later. There are 5 different alien drawings. Each group should have one of each of the 5 types of aliens. The students should not show their aliens to one another.
3. After the students complete the analog round of drawings, give each student the digital version of the same alien they started with the first time. For example, the student who had "Quark" in the analog round should be given "Quark" again in the digital round.

Communication Signal Simulation Student Directions:

We are going to simulate the sharing of a message over time and distance. This activity requires passing a paper from person to person, having each person replicate a drawing on it, then passing it on to the next person at your table. Passing the paper and replicating the drawing simulate the time and space over which signals travel. In the first part of the activity, we'll simulate analog signals. In the second part, we'll simulate digital.

1. Cut the paper along the dotted line and tape the 2 halves end to end.
2. In the grid immediately to the right of your alien, use a pen or marker to redraw the alien image to the best of your ability. You are not allowed to erase or correct your drawing. You will be given 2 minutes to complete your drawing.
3. After the 2 minutes, fold the original alien image behind the paper so that only your new drawing can be seen.
4. Pass your paper to your left. Each paper pass represents the message traveling over time and distance. When a new alien is passed to you, don't look at the part folded under.
5. In the grid immediately to the right of the redrawn alien, use a pen or marker to redraw the alien image you can see to the best of your ability. Do not erase or correct your drawing. You will be given 2 minutes to complete your drawing. Fold the alien image you copied behind the paper so that only your new drawing can be seen.
6. Repeat steps 4-5 until the alien you originally drew returns to you.
7. Analyze the progression of initial image to the last drawing. Record your observations in the Student Observation Sheet.
8. Repeat the entire simulation again with the digital round alien images.

Analog Round Post Activity Questions:

Unfold your alien drawings and observe the images during the activity.

1. Compare the original image to the final drawing. Identify and describe and similarities and differences between the 2 images.
2. Observe the progression of drawings during the activity. Identify and describe what changed during each drawing.

Digital Round Post Activity Questions:

Unfold your alien drawings and observe the image during the activity.

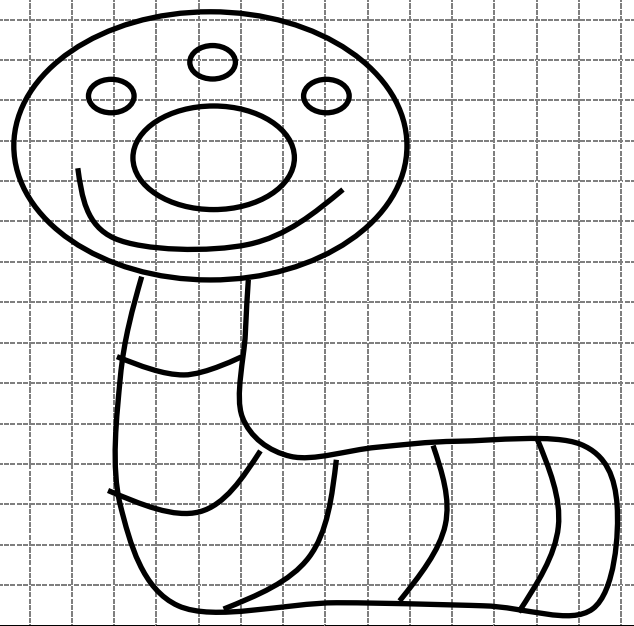
3. Compare the original image to the final drawing. Identify and describe and similarities and differences between the 2 images.
4. Observe the progression of drawings during the activity. Identify and describe what changed during each drawing.

Analog & Digital Round Comparison:

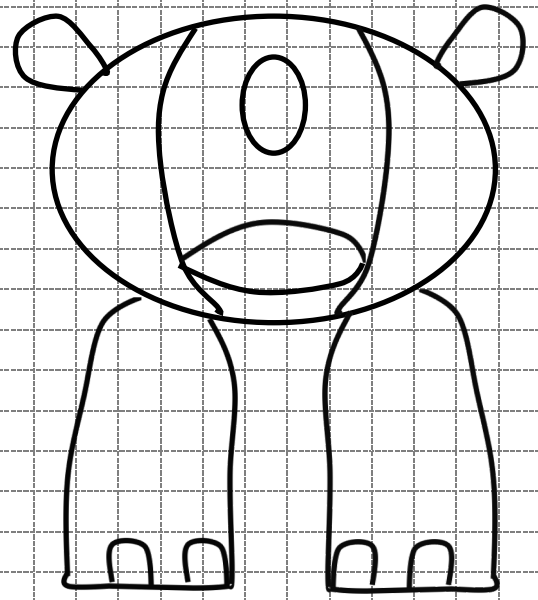
Compare the images from round 1 and round 2 activity.

5. Which round resulted in a more accurate final drawing? Support your choice with evidence from the activity.

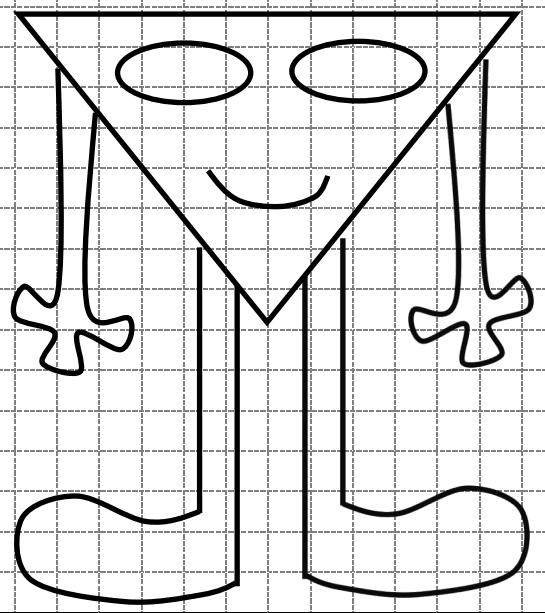
Name: _____ **Round:** *Analog* **Creature:** *Quark*



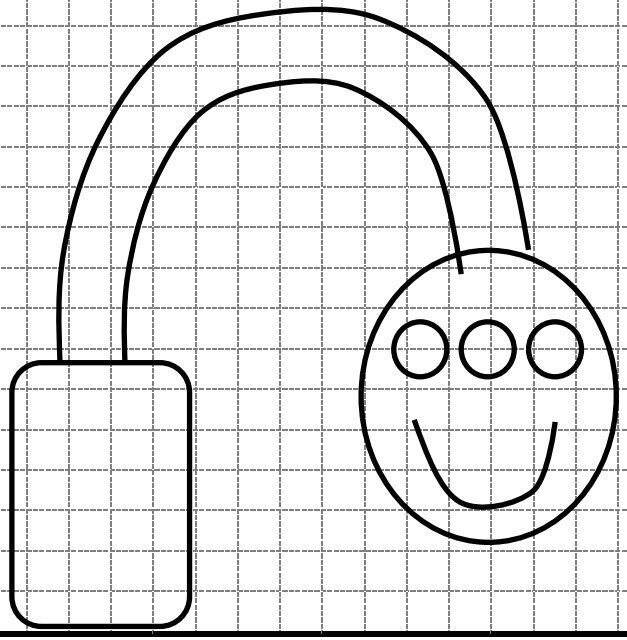
Name: _____ **Round:** *Analog* **Creature:** *Lepton*



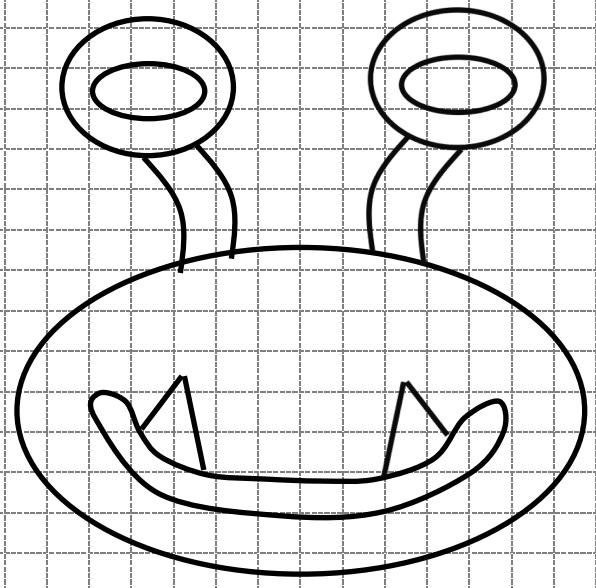
Name: _____ **Round:** *Analog* **Creature:** *Hadron*



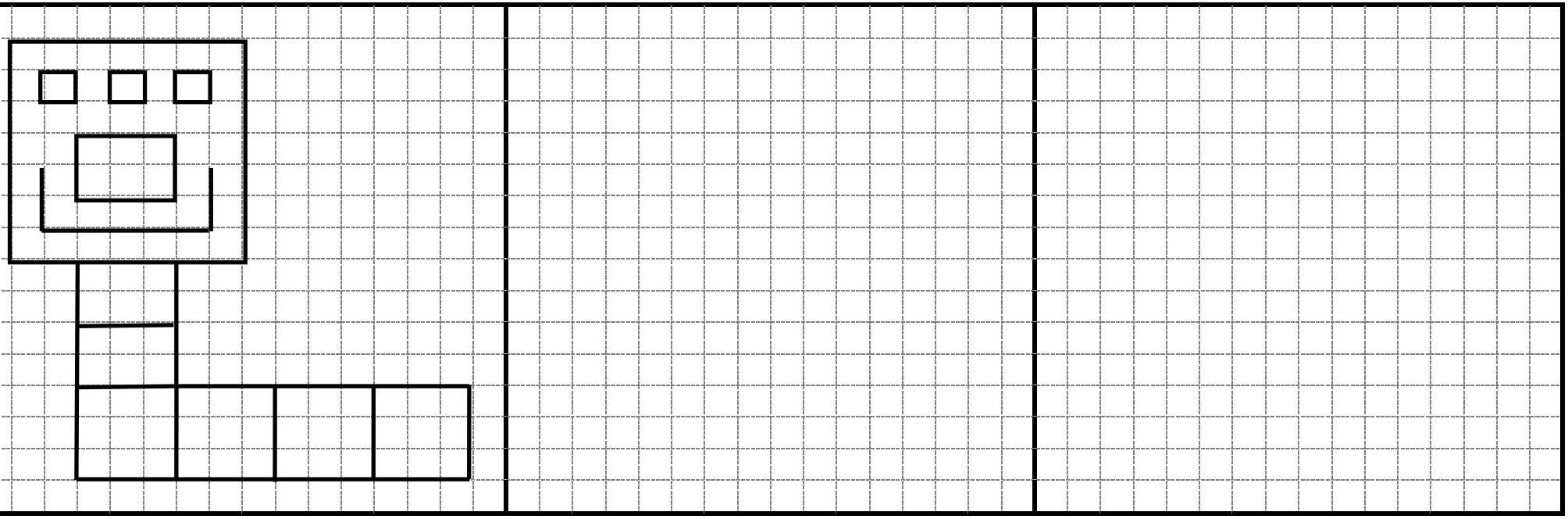
Name: _____ **Round:** *Analog* **Creature:** *Gluon*

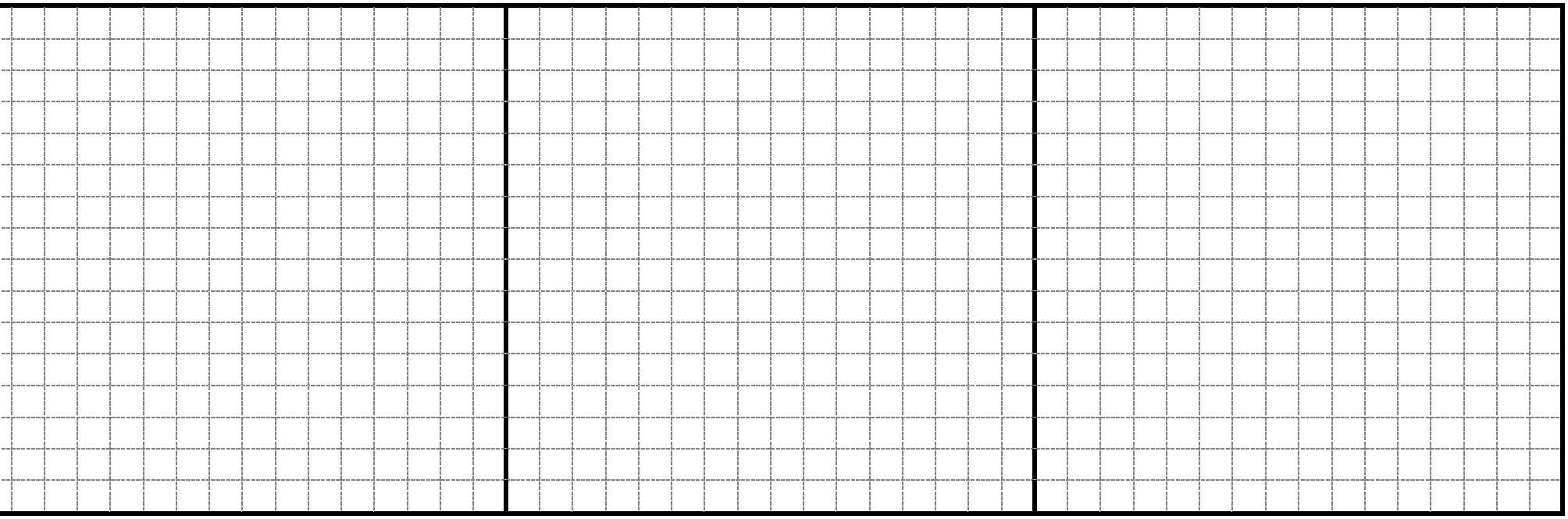


Name: _____ **Round:** *Analog* **Creature:** *Boson*

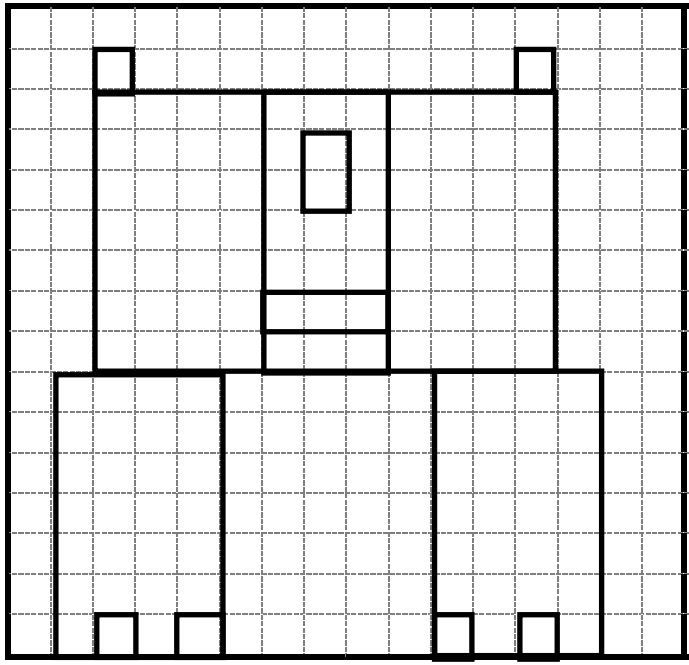


Name: _____ **Round:** *Digital* **Creature:** *Quark*

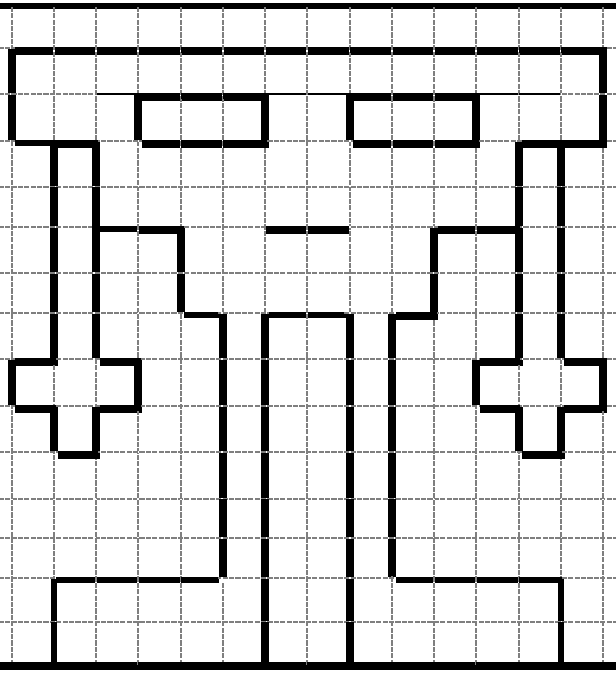




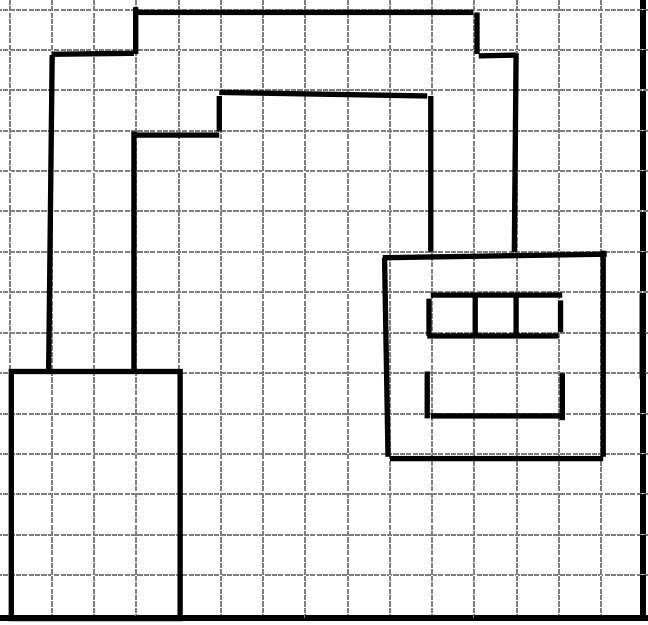
Name: _____ **Round:** *Digital* **Creature:** *Lepton*



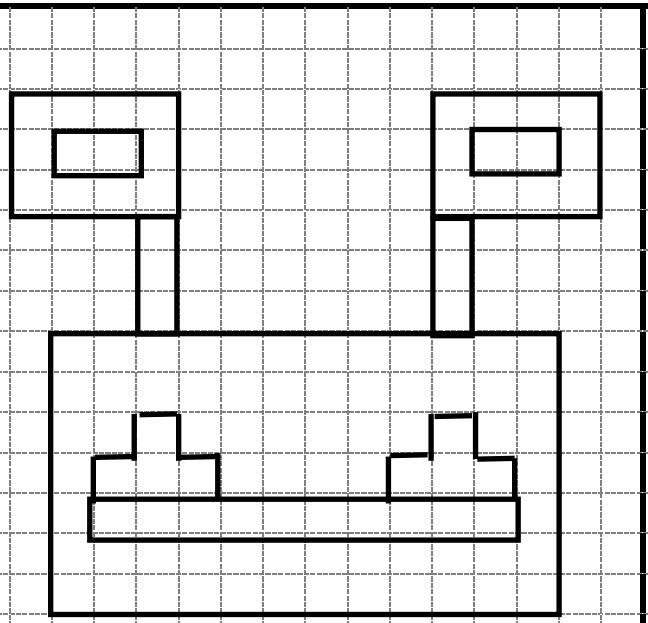
Name: _____ **Round:** *Digital* **Creature:** *Hadron*



Name: _____ **Round:** *Digital* **Creature:** *Gluon*



Name: _____ **Round:** *Digital* **Creature:** *Boson*



Name: _____ **Blank**