Near-Earth Object Student Handout

Name: ___ Date: ___

Directions: Students read the prompts and answer in complete sentences. Distance learning adaption is for students to fill in the yellow sections.

Part 1: Why Does Curiosity Lead Us to Space?

Section A: Thinking about space

1. When do you **think** were you first curious about space? Explain in detail as much as you remember. ___

2. How often do you **think** space **connects/ interacts** with Earth? Explain in detail. ___

3. How do you **think** space can specifically affect your life today? Explain your thinking. ___

Section B: The Aerospace Corporation

4. What do you **notice** or **observe** about The Aerospace Corporation message? ___

Section C: Citizen Science Application

5. Students get a computer/ tablet and go to the link, Zooniverse Asteroid Hunters

6. What did you learn about identifying asteroids? ___

7. How might citizen science be useful in other research projects? ___

8. How does this connect to our idea of science being discovered daily and that everyone can be a scientist? ___

Part 2: How Do Scientists Identify Near-Earth Objects?

Section D: Vocabulary Development

Vocab	Official Definition	Image: Draw a picture to represent the vocab word
1. Object: The thing	1. Main item (object primary designation)	1.
2. Close-Approach (CA): Path next to Earth	**2.** Pathway that is near Earth	2.
3. Close-Approach (CA) Date: When is the object going to arrive closest to Earth	**3.** Date and time (TDB) of closest Earth approach. "Nominal Date" is given to appropriate precision. The 3-sigma uncertainty in the time is given in the +/- column in days_hours:minutes format (for example, "2_15:23" is 2 days, 15 hours, 23 minutes; "< 00:01" is less than 1 minute).	3.
4. CA Distance Nominal (LD | au: How close is the object to Earth compared to the distance of Earth to the Moon	4. The most likely (Nominal) close-approach distance (Earth center to NEO center), in LD (Lunar Distance) and au.	4.

5. CA Distance Minimum (LD | au): The closest the object to get to Earth with possible error added in	5. The minimum possible close-approach distance (Earth center to NEO center), in LD (Lunar Distance) and au. The minimum possible distance is based on the 3-sigma Earth target-plane error ellipse.	5.
6. V relative (km/s): How fast is it going compared to Earth	**6.** Object velocity relative to Earth at close-approach.	6.
7. V infinity (km/s): How fast is the object going compared to empty space	**7.** Object velocity relative to a massless Earth at close-approach.	7.
8. H (mag): How big is the asteroid	**8.** Asteroid absolute magnitude (in general, smaller H implies larger asteroid diameter). **Undefined for comets**.	8.
9. Estimated Diameter: How big is the estimated diameter of the asteroid	**9.** Diameter range (min - max) estimated from the asteroid's absolute magnitude (H) and limiting albedos of 0.25 and 0.05.	9.

10. Au: The distance between the Earth and the Sun **11. LD:** The distance between Earth and the Moon	**10.** One Astronomical Unit (au) is approximately 150 million kilometers (see glossary for definition). **11.** One Lunar Distance (LD) is approximately 384,000 kilometers (see glossary for definition).	10. 11.

Section E: Near-Earth Objects

9. What do you **think** a near-Earth object is? ___

10. What do you **think** a fireball is? ___

Section F: Near-Earth Object Careers

11. List out three things from the video that you find interesting, new, or have a question about.
    1. ___
    2. ___
    3. ___

Section G: Fireballs

12. Students get a computer/ tablet and go to NASA Fireballs. Play and investigate what all the buttons and zoom features do. Then circle which area your teacher is having you focus on from the list:

    -Date ranges
    -Impact size ranges in kt
    -Latitude and Longitude ranges
    -Energy ranges
    -Velocity ranges

13. Change the dates to be the most recent. Then zoom in and take a **screenshot** of your observations of fireballs. Insert your screenshot here. ___

14. What are **two** specific things you notice or observe about the fireballs for your section? Explain in detail. ___

15. What do you **think** you could do if you could **alter**/ **change** and keep the objects from hitting Earth? What would you do/ change and why? ___

Section H: Defending Earth

18. What keywords/ vocabulary do you think will help scientists and engineering investigate NEO and keep Earth safe? ___

19. What if we could change whether a NEO becomes a fireball, what would you do to keep a NEO from hitting Earth? Tell your story in detail. ___

Section I: NEO Deflection App

20. Students get a computer/ tablet and go to the link: https://cneos.jpl.nasa.gov/nda/nda.html

21. Experiment with all the following options. Write what **happens** when you change each of these:
    a. Delta-V Mode ___
    b. Intercept Mode ___
    c. Time of Deflection ___
    d. Simulated near-Earth objects ___
    e. Density (Intercept Mode) ___
    f. Beta (Intercept Mode) ___
    g. B-Plane ___