Nuclear Chemistry Card Sort

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Grade: 9-12

Lesson Duration: 45-60 minutes

Materials Needed:
- Media for Venn Diagram (e.g., poster board, white board, butcher paper, electronic devices)
- One copy of the list of nuclear chemistry concepts/nuclear chemistry concept cards provided in this lesson plan
- Envelope for storing cut-up list/cards

Background Information:
Students should be able to describe the basic structure of an atom and have a basic understanding of nuclear notation.

Lesson Objective:
Students will be able to
- Describe the basic principles of nuclear chemistry.
- Discern between diagrams and representations of nuclear equations and processes.
- Use context clues to correctly categorize nuclear events.

Instructional Process:
All informative resources should be made available to the students so they can categorize the concepts (e.g., notes, text books, Internet).

This lesson is best suited as an introduction activity for the beginning of the nuclear chemistry unit and/or as a review activity at the end of the nuclear chemistry unit.

Students should be organized into groups of 3-4 to complete this activity. Each student group should create and label a three-circle Venn diagram on the teacher-designated media. (Refer to the examples provided in figure 1 and at the end of this lesson plan.)

Each group should receive one copy of the list of nuclear chemistry concepts/nuclear chemistry concept cards, which they will cut up into individual cards.

Once students have their diagrams drawn and cards cut out, they should place the nuclear chemistry concepts cards into one of three categories on the diagram: fission, fusion, or nuclear decay.

At the completion of the activity, students will submit evidence of their final product (Figure 2) by emailing a picture to the teacher or through some other means deemed appropriate by the teacher.

Once students have submitted their final products, they should place the cut-up list/cards in the provided envelope to be used by future students (Figure 1).

Assessment/Follow-up:
Preliminary assessment will occur formatively through verbal feedback while the students are working and following completion.

At the end of the nuclear chemistry unit, students can self-assess their understanding of or review the concepts by performing the activity a second time and comparing their results to those in their initial attempt.

Alignment with Next Generation Science Standards DISCIPLINARY CORE IDEA:
HS-PS1-8: Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
[Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.]

SCIENCE AND ENGINEERING PRACTICES:
Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

CROSSCUTTING CONCEPTS:
- Patterns
- Energy and Matter

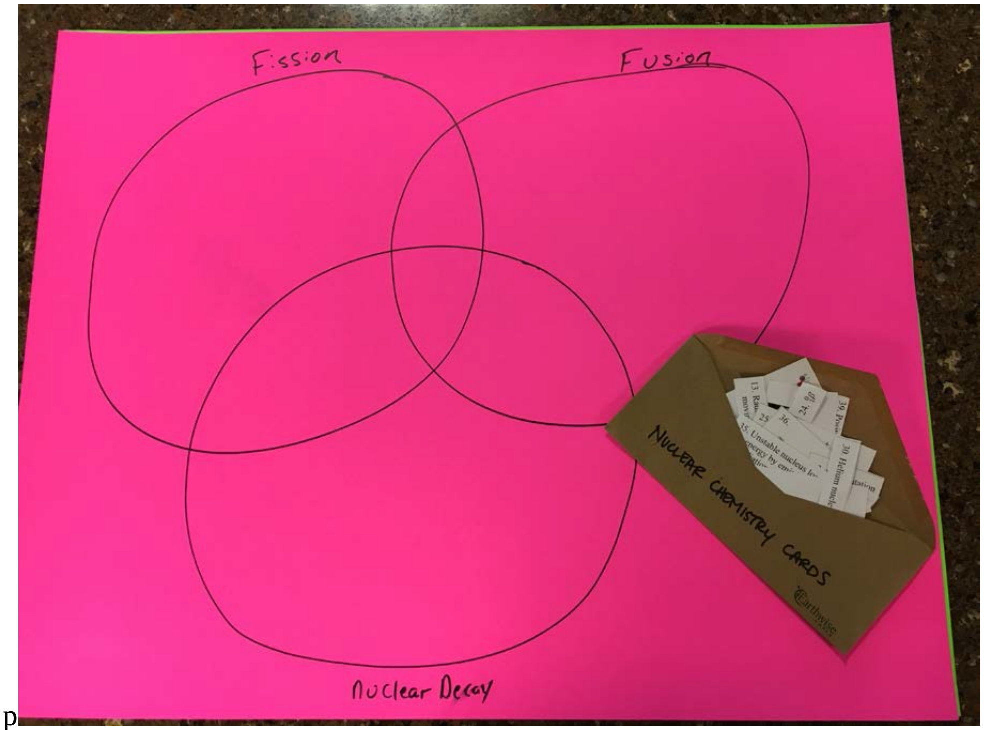

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Figure 1. Basic activity set-up.

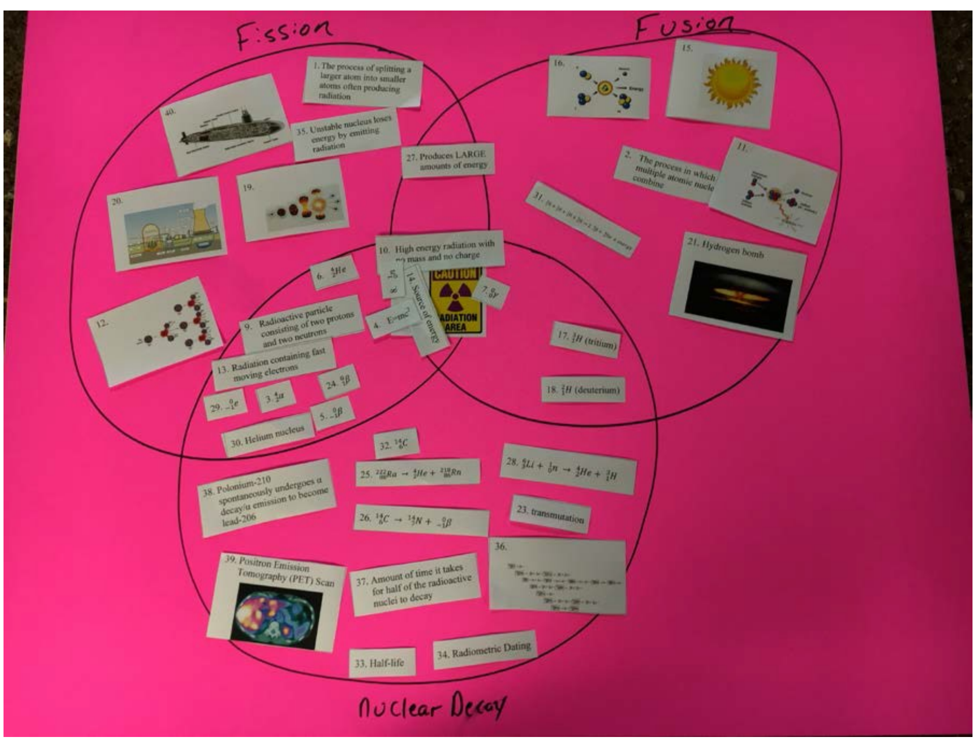
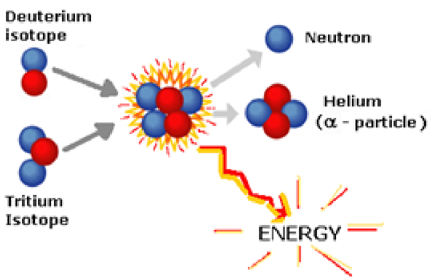
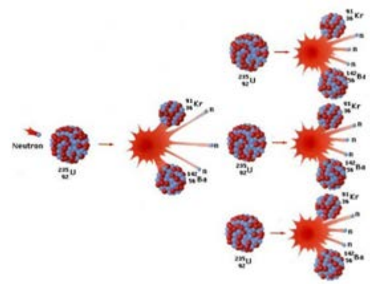
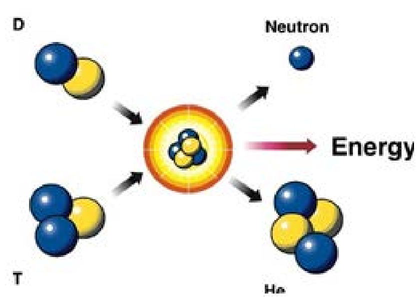
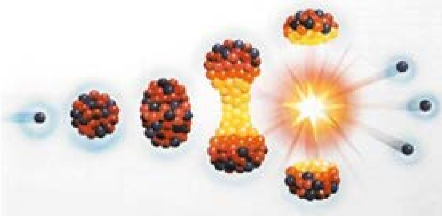
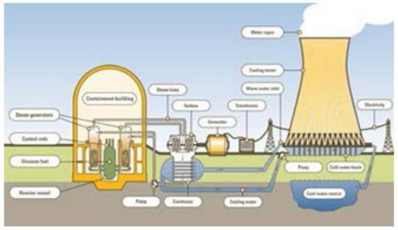
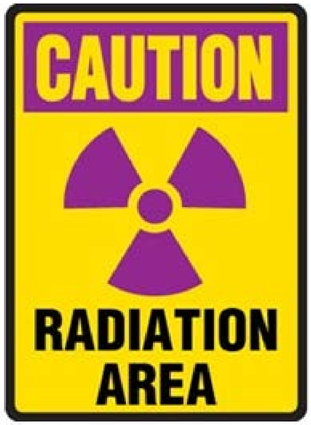


Figure 2. Example of final product.

List of nuclear chemistry concepts/nuclear chemistry concept cards

1. The process of splitting a larger atom into smaller atoms often producing radiation	2. The process in which multiple atomic nuclei combine
3. $\frac{4}{2\alpha\alpha}$	4. $E = mc^2$
5. $\frac{0\beta\beta}{-1}$	6. $\frac{{}^{4}HHHH}{2}$
7. $\frac{{}^{0}\gamma\gamma}{0}$	8. $\frac{{}^{1}nn}{0}$
9. Radioactive particle consisting of two protons and two neutrons	10. High energy radiation with no mass and no charge
 11.	 12.
13. Radiation containing fast moving electrons	14. Source of energy
 15.	 16.

<table>
<tr><td>17. $\frac{3HH\ \text{(tritium)}}{1}$</td><td>18. $\frac{2HH\ \text{(deuterium)}}{1}$</td></tr>
<tr><td>19. </td><td>20. </td></tr>
<tr><td>21. </td><td>22. </td></tr>
<tr><td>23. Transmutation</td><td>24. $\frac{0\beta\beta}{1}$</td></tr>
<tr><td>25. $^{222}_{88}RRRR \rightarrow {}^{4}_{2}HHHH + {}^{218}_{86}RRnn$</td><td>26. $^{14}_{6}CC \rightarrow {}^{14}_{7}NN + {}^{0}_{-1}\beta\beta$</td></tr>
<tr><td>27. Produces large amounts of energy</td><td>28. $^{6}_{3}LLLL + {}^{1}_{0}nn \rightarrow {}^{4}_{2}HHHH + {}^{3}_{1}HH$</td></tr>
<tr><td>29. $\frac{0HH}{-1}$</td><td>30. Helium nucleus</td></tr>
<tr><td>31. 1H + 1H + 1H + 1H → 2 0β + 4He + $HHnnHHeeeeee$</td><td>32. ^{14}CC</td></tr>
</table>

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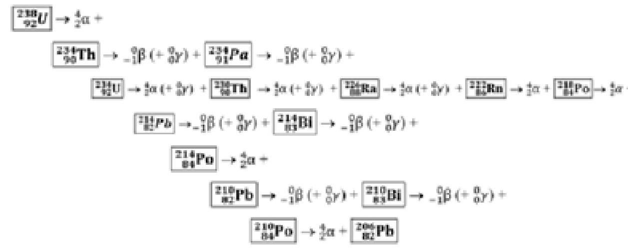
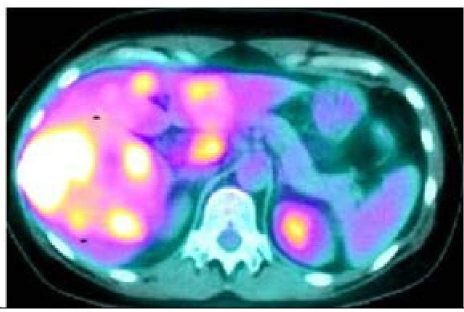
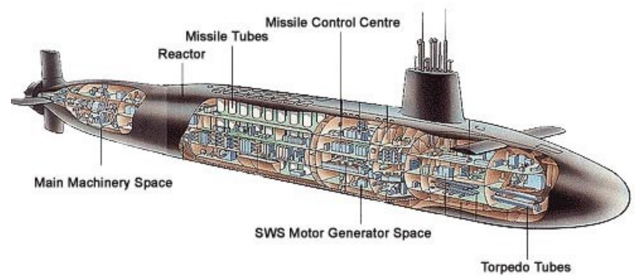
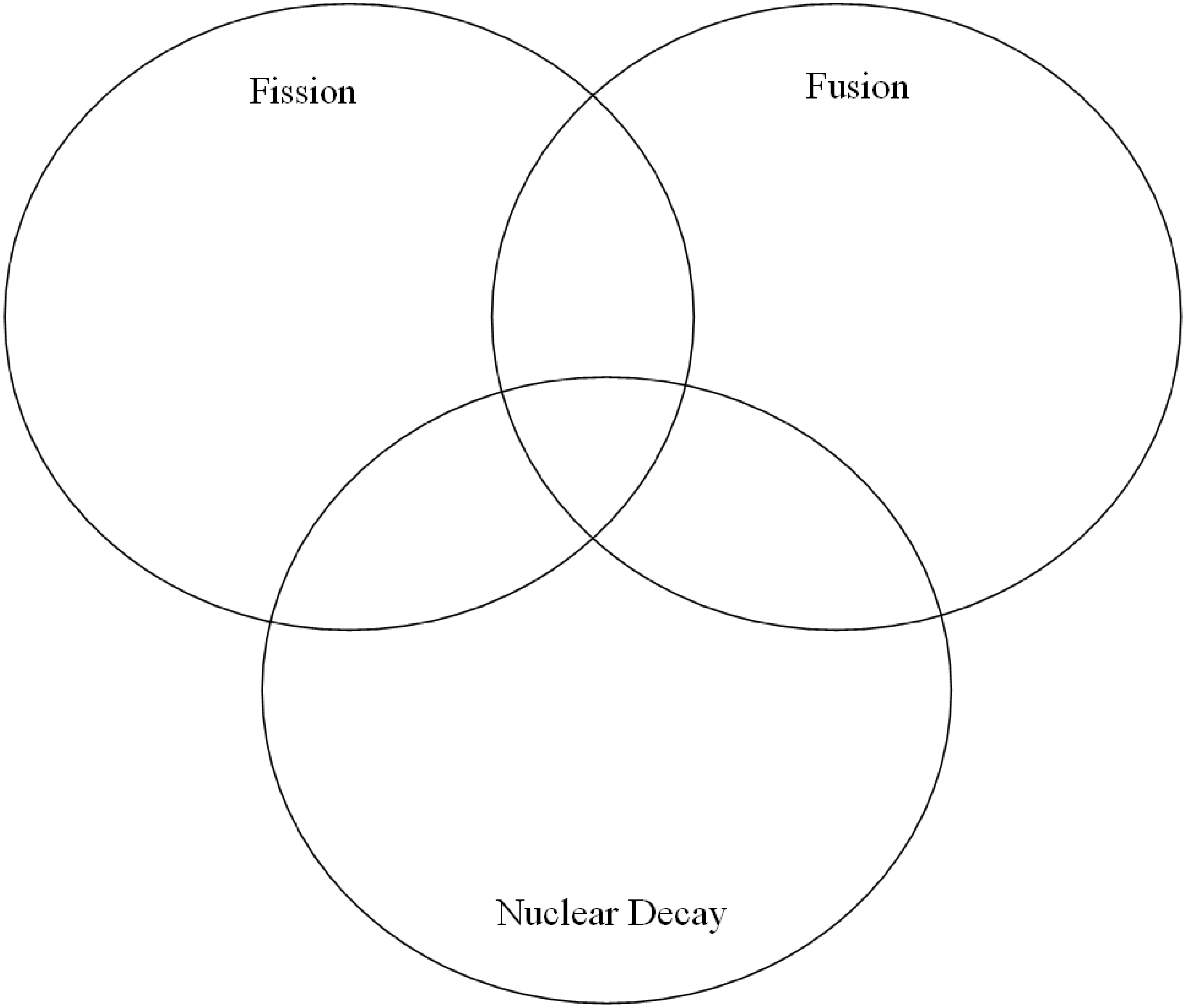
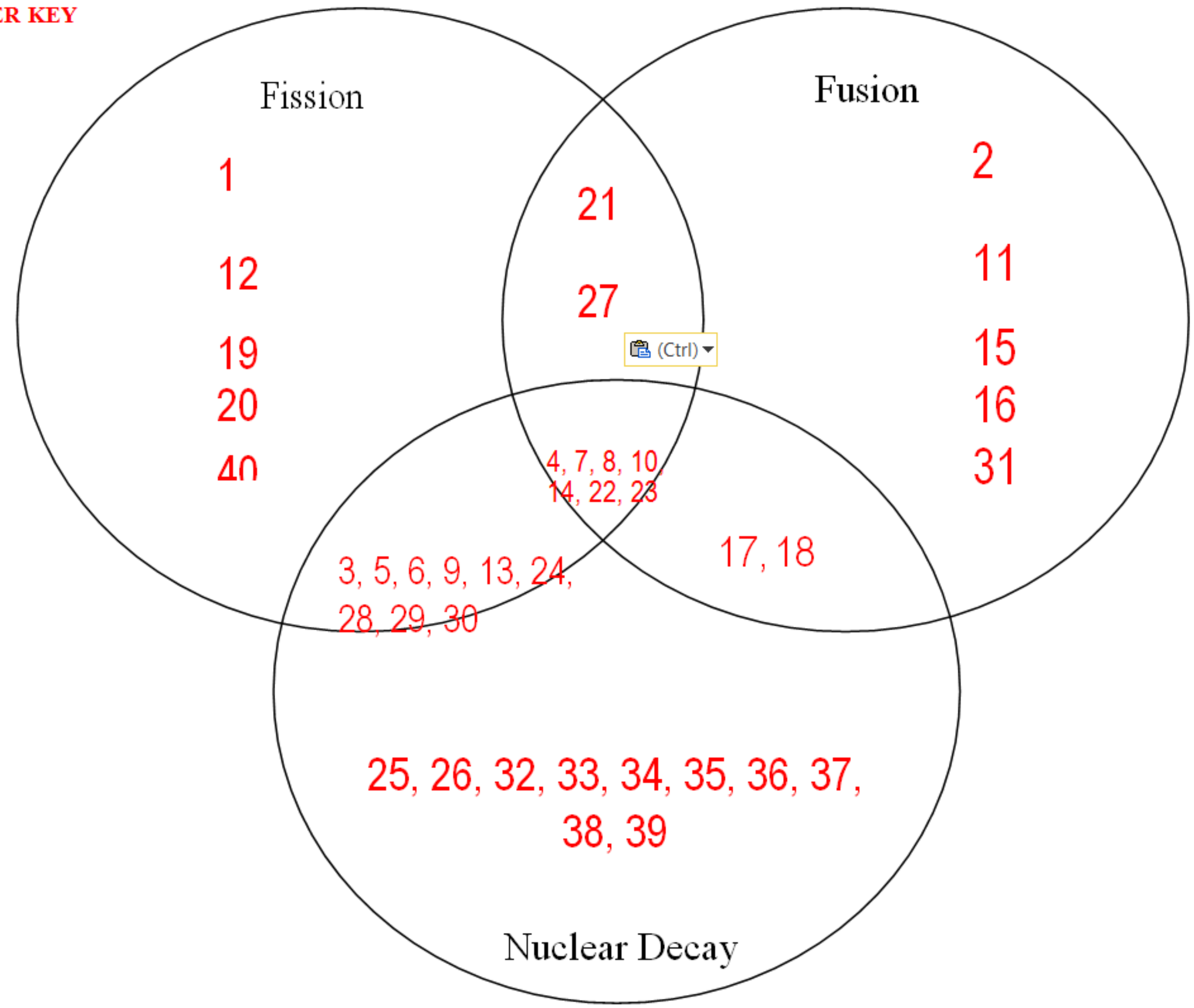
33. Half-life	34. Radiometric dating
35. Unstable nucleus loses energy by emitting radiation	36. 
37. Amount of time it takes for half of the radioactive nuclei to decay	38. Polonium-210 spontaneously undergoes α decay/ α emission to become lead-206
39. Positron Emission Tomography (PET) Scan 	40. 


Fission
Fusion
Nuclear Decay

TEACHER KEY


Fission
1
12
19
20
40
21
27
Fusion
2
11
15
16
31
4, 7, 8, 10,
14, 22, 23
3, 5, 6, 9, 13, 24,
28, 29, 30
17, 18
25, 26, 32, 33, 34, 35, 36, 37,
38, 39
Nuclear Decay