Integrating IMMEX Problem Solving and Technology into the Curriculum

Required Reading


The IMMEX Problem-Solving Assessment System

- Is a web delivered, interactive assessment tool;
- Integrates subject specific content and problem solving into real-world scenarios; and
- Provides long-term performance data for both students and teachers so that assessment is formative and ongoing.

Introduction to IMMEX Problem Solving

The three key components of an IMMEX simulation are:

1. **Prologue**: A summary of the problem;
2. **Problem Space**: Interpretive and informative data in the form of menu items; and
3. Epilogue: A summary of the logic to the solution.

Figure 1: Sample Prologue and Epilogue From True Roots Problem Set

Things to Consider in Integrating Technology into the Classroom

- **Teacher Considerations**
  1. Learning Outcome(s)
  2. Curriculum
  3. Students’ Cognitive and Affective Development.

- **Student Considerations**
  1. Related Content Preparation
  2. Learning Styles/Multiple Intelligences
  3. Grade Level Appropriateness
  4. Affective: Motivation, Interest

- **School Considerations**
  1. Professional Development
  2. Technology Plan & Student Outcomes
  3. Technical Support
  4. Hardware/Software
Considerations for Integrating IMMEX into the Classroom

- **How can IMMEX problem sets be integrated into your curriculum?**
  1. Pretest
  2. Posttest
  3. Teaching/Learning
  4. Assessment
  5. Problem-solving Practice
  6. Use a one or multiple clones per implementation
  7. Work individually or in pairs

- **How does a teacher prepare to integrate and implement IMMEX problem solving into instruction?**
  1. **Prepare students** by engaging students in hands-on, problem-solving activities that will foster deep understanding of “core” curricular content.
  2. **Secure and schedule access to computers with Internet connection** if your classroom is not fully equipped.

  *In order to run IMMEX on the Web, you will need one of the following browsers:*
  - Microsoft Internet Explorer 5.5 SP2 or above, Preferably OR
  - Netscape Navigator/Communicator 4.6 or above

  *In order to access IMMEX search-path maps, you will need:*
  - Adobe Acrobat Reader 4.0 or above

  3. **Select a problem set** that aligns with your current standards-based curriculum.
4. **Review problem set** thoroughly by actually solving one or more cases to become immensely familiar with content and problem space in order to facilitate student learning.

5. **Stage problem set** at least two weeks in advance of desired implementation.
   
   http://day.immex.ucla.edu/IMXWeb/Staging/StagingRequest.asp

6. **Prepare** copies of **student data organizers** for students to take notes during problem solving. Data organizers tailored to individual problem sets are available to use as is or modified to address the unique needs of your students

7. **Assign IMMEX ID/passwords/affiliation** to students and have students record for usage throughout the year. Keep a record for future reference and data analysis.

- **What should students know before they engage in IMMEX problem solving?**

**I. Logging In Information**

1. **Affiliation** - School, Organization, Program, etc., must be chosen from the drop-down list on the login page.

2. **Login ID** - Most IDs are alphanumeric. You may want to point out which characters are numbers vs. letters so zeros are not confused with O's.

3. **Password** - IDs and passwords are not case sensitive.

**II. The Structure of an IMMEX Problem Space**

1. **Prolog/Case History** - the opening scenario/set of conditions that determines the problem to be solved. You may return to the Prolog/Case History at any time.

2. **Content** - this is the information delivered in the menu items.

3. **Solutions List** - this is the list of possible answers to the problem. Each problem set is assigned a Number of Attempts at a solution (usually 2).
   
   - **NOTE:** Once you've chosen to view the Solutions List, you must select a solution to proceed. You may not go back.

4. **Epilog/Problem Summary** - If you arrive at a correct solution, or exhaust your number of attempts, you will have completed the case. A link to an Epilog or Problem Summary will be presented. In many cases this summary will give you the correct answer and indicate a successful strategy.
III. Key Features of IMMEX Problem Sets
- Students should be aware that IMMEX exercises are delivered in "sets" one case at a time. This means that students may not be given the same problem to solve as their neighbor.
- Each case in a problem set uses an identical menu structure; however the information delivered by a menu item may change from case to case. It may appear that a student is asked to solve the same case more than once; however students will not receive a case twice before they have completed every case in a problem set.

IV. The IMMEX Scoring System
- You will be charged to view certain menu items. You will only be charged the first time you view information. You may review information as often as you like without changing your score.
- The Solutions List will cost you each time you view it.

V. Unique Characteristics of IMMEX on the Web
- If you log out before completing a problem, when you log back in, you will return to the same case, score and menu item you were at before you logged out.
- Unless specified otherwise, you will automatically be logged out after 20 minutes of inactivity.

What will you do with your students the day(s) after solving IMMEX problem sets?

1. Discuss strategies, major concepts.
2. Discuss questions that students have.
3. You may engage students in a variety of search-path map activities. Sample search-path map activities can be found at the IMMEX website at:

http://www.immex.ucla.edu/K-12Education/SPMAct.htm
• What should a teacher consider and do in order to ensure that s/he is utilizing best classroom practices when integrating IMMEX problem solving into the curriculum?

1. IMMEX Problem sets work best when they fit the curriculum.

2. By integrating IMMEX problem solving “regularly” at least once a month, students develop more efficient problem-solving strategies.

3. Utilizing the IMMEX assessment tools to engage students in self-assessment and metacognition on a “regular” basis has been shown to improve students’ problem-solving skills.
Aligning IMMEX to the Curriculum

In preparing to assist teachers with integrating IMMEX simulations into their curricula, let’s identify IMMEX problem sets that you would like to review and create complementary, sample lesson plans. First, identify a content area that you would like to explore. Brainstorm standards-based curricular topics that would normally be taught in the course. Include at least six curricular topics. Record your “selected” curricular topics in column two. Next, review the list of problems in the IMMEX Problem-Set Profiles on pages 43 to 47 and select a problem set that complement each topic. Record the titles of problem sets that you would like to examine in column one. Identify and list at least three complementary hands-on activities that will engage students in exploring deeper levels of understanding the topic(s) or concept(s). Save your notes for the “mentorship & IMMEX integration planning” activity.

<table>
<thead>
<tr>
<th>PROBLEM SETS</th>
<th>STANDARDS-BASED CURRICULAR TOPICS</th>
<th>COMPLEMENTARY ACTIVITIES</th>
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<tr>
<td>PROBLEM SET 1</td>
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Aligning IMMEX to the Curriculum

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<td>TARGETED GRADE LEVEL:__</td>
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</table>
# Aligning IMMEX to the Curriculum: Sample Grade 10 Biology

## Problem Set 1: True Roots

### Standards-Based Curricular Topics
- Molecular Basis of Heredity: Human Genetics

### Complementary Activities
1. DNA Profile of a “Missing Person” Online Simulation Activity
2. Blood Typing Simulation Lab
   - Simulation of ABO Genetics BioKit®
3. Three Generation Genetic Family Tree Project

## Problem Set 2: Which Plasmid is it?

### Standards-Based Curricular Topics
- Molecular Basis of Heredity: From genes to protein

### Complementary Activities
1. Plasmid Mapping Exercises
   - See plasmid mapping under classroom resources.
2. Exploring Electrophoresis of DNA Lab
3. DNA Recombination and Transformation Lab
   - DNA Recombination and Transformation Kit®, E-Z Gene Splicer

## Problem Set 3: Creeping Crud

### Standards-Based Curricular Topics
- Biological Evolution and Interdependence of Organisms: Viruses and Microorganisms

### Complementary Activities
1. Bacteria Cultures Lab
2. Virtual Bacteria ID Lab
3. Bacteriophage Culture Lab
   - Bacteriophage Culture Set A, Basic
## Aligning IMMEX to the Curriculum: Sample Grade 11 Chemistry

### PROBLEM SET 1

**Vu-du-volume**

**TARGETED GRADE LEVEL:** 9-12

**STANDARDS-BASED CURRICULAR TOPICS**

- Structure and Properties of Matter

**COMPLEMENTARY ACTIVITIES**

1. Kitchen Chemistry (Density) Labs
   - [http://aa.uncwil.edu/reeves/onlinelabs/density/index.htm](http://aa.uncwil.edu/reeves/onlinelabs/density/index.htm)

2. Bad Science in “Raiders of the Lost Ark.”
   - [http://www.labarchive.net/labdb/get.tcl?experiment_id=165](http://www.labarchive.net/labdb/get.tcl?experiment_id=165)

3. Determining the sugar content in a beverage

### PROBLEM SET 2

**Stoich-it-2-me**

**TARGETED GRADE LEVEL:** 11 - AP

**STANDARDS-BASED CURRICULAR TOPICS**

- Chemical Reactions

**COMPLEMENTARY ACTIVITIES**

1. Balancing chemical equations
   - [http://www.dun.org/sulan/chembalancer](http://www.dun.org/sulan/chembalancer)

2. Comrades, Start your airbags
   - [http://ist-socrates.berkeley.edu/~chem1a/labmanual/expt2.htm](http://ist-socrates.berkeley.edu/~chem1a/labmanual/expt2.htm)

3. Synthesis and empirical formulas
   - [http://www.labarchive.net/labdb/get.tcl?experiment_id=227](http://www.labarchive.net/labdb/get.tcl?experiment_id=227)

### PROBLEM SET 3

**Hazmat Holiday Special**

**TARGETED GRADE LEVEL:** 9 - 12

**STANDARDS-BASED CURRICULAR TOPICS**

- Chemical Reactions

**COMPLEMENTARY ACTIVITIES**

1. Identifying an unknown based on a profile
   - [http://www.labarchive.net/labdb/get.tcl?experiment_id=44](http://www.labarchive.net/labdb/get.tcl?experiment_id=44)

2. Flame Tests
   - [http://www.labarchive.net/labdb/get?experiment_id=52](http://www.labarchive.net/labdb/get?experiment_id=52)

3. pH of Various Salts
   - [http://www.boe.qacps.k12.md.us/boe/...HYDROLYSISOFSALT.pdf](http://www.boe.qacps.k12.md.us/boe/...HYDROLYSISOFSALT.pdf)
Sample Implementation Plan

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<thead>
<tr>
<th>CURRICULAR TOPIC</th>
<th>IMMEX Problem</th>
<th>Month</th>
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<tbody>
<tr>
<td>Genetics</td>
<td>True Roots GeneQuest</td>
<td>October</td>
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<td>Biochemistry: Enzyme Action</td>
<td>EnzymeMania</td>
<td>November</td>
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<tr>
<td>Biochemistry</td>
<td>Macromol</td>
<td>December</td>
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<td>Molecular Biology</td>
<td>Which plasmid is it?</td>
<td>February</td>
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<td>Animal Behavior</td>
<td>Transformation</td>
<td>March</td>
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<td>Physiology</td>
<td>Rapture of the Deep</td>
<td>April</td>
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<td>Disease Transmission</td>
<td>Creeping Crud</td>
<td>May</td>
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Sample Implementation Calendar

<table>
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<tr>
<th>May 2001</th>
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<td><strong>Monday</strong></td>
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<td>1</td>
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<td>14</td>
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<tr>
<td>Time: All Day</td>
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<td>Period: 1-6</td>
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<tr>
<td>Problem: How Dense EUT (Kg/L)</td>
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<td>21</td>
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<td><strong>Teacher:</strong> Hillary Vaughn</td>
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<td>Time: All Day</td>
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<tr>
<td>Period: 1-6</td>
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<tr>
<td>Problem: True Roots</td>
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<tr>
<td>28</td>
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<td><strong>Teacher:</strong> Hillary Vaughn</td>
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<tr>
<td>Time: All Day</td>
</tr>
<tr>
<td>Period: 1-6</td>
</tr>
<tr>
<td>Problem: Overall Goals</td>
</tr>
</tbody>
</table>
Making a Staging Request for IMMEX Implementation

Teachers should submit a staging request online for IMMEX problem sets that they would like to use with their students at least two weeks in advance of desired implementation. Teachers will get an emailed response verifying the (1) problem set requested; (2) IDs, passwords, and affiliation for the number of students requested; (3) duration of access to the problem set(s) as requested; and (4) ID/password for Teacher’s access to students’ performance data. **Note that once ID/passwords/affiliation have been assigned, students and teachers will get the same ID/passwords/affiliation on future requests.** Using the same ID/passwords/affiliation enables the tracking of students’ progress on a series of problem sets throughout the year. Hence, it is highly recommended that teachers and students record ID/passwords/affiliation for use throughout the school year. [http://day.immex.ucla.edu/IMXWeb/Staging/StagingRequest.asp](http://day.immex.ucla.edu/IMXWeb/Staging/StagingRequest.asp)

The following information should be provided.

1. Select **IMMEX problem set(s).**

2. Complete **contact information,** such as name, email, phone, school info., etc.

3. Complete **course information,** such as course title and level, grade level, number of students, class periods, etc.

4. **Date(s) and time(s)** you would like students to have access to problem set(s).
Sample Curricular Unit for Integrating an IMMEX Problem Set

IMMEX Problem Set: True Roots
Grade Level: 10
Curricular Unit: Genetics
Standards Addressed: NSES--Life Science: Molecular Basis of Heredity: From Genes to Protein
Objectives: By the end of this unit, students will

- Explain how cells pass on traits from parents to offspring;
- Calculate the probability of potential genotypes of offspring for selected “common” traits using Punnett squares and the application of principles of Mendelian genetics; and
- Interpret pedigrees of selected “common” traits.

I. Projects on Mendel’s Contribution to Genetics

1. Storyboard
2. Conversation with Gregor Mendel
3. Newspaper Article on Mendel’s Discovery
4. TV Report on Mendel’s Discovery (Video)

II. Blood Typing Simulation Lab

III. Fingerprinting Lab

IV. Three Generation Genetic Family Tree
IMMEX on the Web Interactive Problem Solving

I. Logon to the IMMEX Website at:

http://www.immex.ucla.edu

II. Logon to IMMEX on the Web Catalog of Problem-Solving Simulations

- Select in Affiliation = Kentucky ARSI Resource Collaborative

- Enter ID = 02ARSI__; Enter Password = ARSI

(2-Digit Number) Use ID/password/affiliation assigned for homework.

III. Select IMMEX Problem Set

You will have access to Demo Users. Read profiles of problem sets prior to making your selections. Choose problem sets that you consider prime candidates for using with teachers. To access subsequent cases in a problem set, click on the icon, Problem Sets, in the navigation tools at the bottom of the screen. See section 5 below.
IV. Read the Prologue Carefully to Identify the Challenge

**LEONICE'S TRUE ROOTS**

**PROLOGUE**

Leonica has just completed an extensive study of genetics in a high school biology class. While analyzing these generational family traits, Leonice realizes her personal traits are not consistent with either family member. Leonice has always looked and felt different from her siblings. This raises questions of doubt about her origins and Leonice begins to wonder if her mum and dad, Mr. and Mrs. Watson, are truly her biological parents.

While searching for her true roots, Leonice discovered there was a fire at the hospital on the day she was born. The pediatric ward was hastily evacuated for about three hours. This incident made Leonice even more curious and determined to verify if Mr. and Mrs. Watson were indeed her biological parents. Leonice discussed the dilemma with her friends who have promised to help.

You are a friend and would like to help find her true parents. You will join Leonice, visit family and experts, then analyze various data. Use your understanding of genetics to assist your friend to find her "TRUE ROOTS."


- Each IMMEX problem-set has two types of problem-space navigation tools:
  1. **Navigation Tools I:** Menu bars for negotiating the problem environment to gather data, and
  2. **Navigation Tools II:** A navigator bar which provides score, "solve," Log in and out and the ability to re-select another clone/case of the same problem or an entirely new problem-set.

IMMEX Problem Space

**Note:** To access subsequent cases in a problem set, click on the icon, **Problem Sets**, in the navigation tools at the bottom of the screen.
VI. Access Performance Assessment Data After Problem Solving

You may:
1. Download your search path map.
   Or
2. View and read the problem summary with a summary of the solution logic.
   Or
3. Scroll through read items you ordered that are listed chronologically.
IMMEX Data Analysis: Teachers’ AID

1. Logon to IMMEX Data Analysis Tools using the **Login for Data Analysis** tool on the IMMEX homepage (http://www.immex.ucla.edu). Teachers get access to their classes’ data only. Since you do not have existing class data, you will use a “special” pass that will be valid for today only!

2. Complete **ID/Password**. Teachers get access to their classes’ data only. Since you do not have existing class data, you will use a “special” pass that will be valid for today only! AFFILIATION IS NOT NEEDED. Click on LOGON.

3. To access student performance data use the **Teachers’ Aid** icon in the main menu bar.

4. Select **Classes** from the menu bar.
5. Select a teacher’s class. For today’s activity, select Dr. Sprang’s Period 3 AP Chemistry Class (2001). Her students generally use an average of nine IMMEX problem sets during an academic year.

6. The class overview page presents snapshot of how a class is performing on IMMEX problem sets collectively and provides you with hyperlinks to additional data on individual or groups of students.

Components of Teachers’ Aid Class Overview Page

i. Statistics on Completion Rates of Class

![Statistics on Completion Rates](image)

ii. Performance Index of Class

(Number of Simulations Solved vs. Number Simulations Completed)

![Performance Index](image)
### iii. Individual Students’ Problem-Solving Performances

<table>
<thead>
<tr>
<th>Performance Index</th>
<th>Alias</th>
<th>Problems Performed</th>
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### iv. Access to Database of Class Performance Data for Additional Statistics
7. Select a student from the list. When you select a student’s ID, you will get a **performance index chart** and a **performance record** with all simulations completed by the student. You can also view a student’s performance on individual cases of a problem set by simply clicking on the link for the case in column two, **Problem**. You can also download a search-path map.

Today, we will view and analyze problem-solving performances for the following students.

<table>
<thead>
<tr>
<th>Student ID</th>
<th>Student ID</th>
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<tbody>
<tr>
<td>01CA3SPRA 05</td>
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<tr>
<td>01CA3SPRA 11</td>
<td>01CA3SPRA 27</td>
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OBJECTIVES
At the end of this session, Resource Teachers will:

1. Describe at least three approaches to use IMMEX search-path maps to foster students’ ability to analyze, monitor, and reflect on their thinking;
2. Explain at least 4 problem solving strategies that novice problem solvers employ; and
3. Identify at least three strategies to use with students who are experiencing difficulty with problem solving.

This hands-on, interactive, metacognitive training module is designed to provide Resource Teachers with proven strategies to foster students’ ability to analyze, monitor, and reflect on their thinking, knowledge, and actions as they engage in complex, real-life problem solving in a technology-rich environment. Utilizing the power of technology and the IMMEX problem-solving assessment software, visual displays of students’ step-by-step problem-solving approaches, called search-path maps, will be used as metacognitive tools for students to conduct self evaluations of their thought processes and content knowledge while solving computer-based simulations from the IMMEX catalog of pre-college problem sets. For this session, the problem set RootsQuest will be used as an introduction to IMMEX problem solving and metacognition.

To obtain an overview of IMMEX problem solving, the content and logic of RootsQuest, Resource Teachers will work in cooperating learning teams of two to solve the computer-based simulation, RootsQuest. Resource Teachers will be challenged to determine the most effective strategy one may employ to arrive at the correct solution to RootsQuest. Upon completion of solving RootsQuest, Resource Teachers will divide into collaborating teams of four to conduct an in-depth assessment of archived, search-path maps of students’ problem-solving approaches on RootsQuest. Resource Teachers will identify the most likely difficulty the student is experiencing and make recommendations for a viable solution to address the student’s problem. Each group of four Resource Teachers will evaluate four students’ search-path maps with the accompanying sequential data selections. For each search-path map, Resource Teachers will compose a brief summary of the problem-solving deficit that the student is demonstrating and the proposed recommendations for instructional intervention, including specific strategies the student can use in future problem solving. This session will culminate with a class discussion on the practical application of advances in research on metacognition in the classroom and the potential impact of providing metacognitive training for students.
Figure 1: RootsQuest Template

Figure 2: Answer Key

<table>
<thead>
<tr>
<th>Cases/Clones (Parallel Forms)</th>
<th>Correct Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Search for Roots</td>
<td>MR. AND MRS. IKEDA</td>
</tr>
<tr>
<td>My True Roots</td>
<td>MR. AND MRS. WATSON</td>
</tr>
<tr>
<td>Quest for Roots</td>
<td>MS. WANNAMAN</td>
</tr>
<tr>
<td>Rootless in L.A.</td>
<td>MR. AND MRS. DALLAS</td>
</tr>
<tr>
<td>Roots</td>
<td>MR. AND MRS. CAYETANO</td>
</tr>
</tbody>
</table>
Figure 3: Student A

Student: IAAR28
Case: ROOTLESS IN L.A.
Status: Not Solved
Score: 550
Solution: MR. AND MRS. CAYETANO
Start Time: 10/10/2001 08:42:57
End Time: 10/10/2001 08:42:57
Elapsed Time: 00:00:00

Sequence of Selections

NONE
I. Assessment

A. Identify the Problem
What is the primary problem(s) with Student A’s approach? Briefly and concisely explain.

II. Intervention

B. Recommend a Solution
How would you help Student A? Briefly and concisely describe the steps you would take to assist Student A. Include specific strategies that you would recommend that Student A consider in future problem-solving exercises.
Figure 4: Student B

Sequence of Selections

1. BLOOD TYPING
2. MR. & MRS. WATSON
3. PUNNETT SQUARE
4. MR. & MRS. WATSON
5. DICTIONARY
6. FINGERPRINTS
I. Assessment

C. Identify the Problem

What is the primary problem(s) with Student B’s approach? Briefly and concisely explain.

II. Intervention

B. Recommend a Solution

How would you help Student B? Briefly and concisely describe the steps you would take to assist Student B. Include specific strategies that you would recommend that Student B consider in future problem-solving exercises.
Sequence of Selections

1. BLOOD TYPING
2. FINGERPRINTS
3. PEDIGREE
4. PUNNETT SQUARE
5. LEUCINE...
6. MR. & MRS. WATSON...
7. MR. & MRS. CAYETANO...
8. MR. & MRS. DALLAS...
9. MR. & MRS. IKEDA...
10. MS. WANNAMAN...
11. LEUCINE..
I. Assessment

A. Identify the Problem
What is the primary problem(s) with Student C’s approach? Briefly and concisely explain.

II. Intervention

B. Recommend a Solution
How would you help Student C? Briefly and concisely describe the steps you would take to assist Student C. Include specific strategies that you would recommend that Student C consider in future problem-solving exercises.
Figure 6: Student D

Sequence of Selections

1. WATSON'S FAMILY**
2. LEUCINE*
3. MR. & MRS. WATSON*
4. MR. & MRS. CAYETANO*
5. MR. & MRS. DALLAS*
6. MR. & MRS. IKEDA*
7. MS. WANNAMAN*
8. LEUCINE*
9. GENETIC COUNSELOR
10. GENETICIST
11. ADMISSIONS CLERK
12. OBSTETRICIAN
13. PEDIATRIC NURSE
14. LEUCINE*
15. MR. & MRS. CAYETANO'S CHILD*
16. VITAL STATISTICS
17. MR. & MRS. IKEDA*
18. LEUCINE*
19. MR. & MRS. WATSON*
20. MR. & MRS. CAYETANO*
21. MS. WANNAMAN*
I. Assessment

A. Identify the Problem
What is the primary problem(s) with Student D’s approach? Briefly and concisely explain.

II. Intervention

B. Recommend a Solution
How would you help Student D? Briefly and concisely describe the steps you would take to assist Student D. Include specific strategies that you would recommend that Student D consider in future problem-solving exercises.
Figure 7: Student E

**Sequence of Selections**

1. GENETICIST
2. GENETIC COUNSELOR
3. POLICE
4. SCHOOL OFFICIAL
5. ADMISSIONS CLERK
6. OBSTETRICIAN
7. PEDIATRIC NURSE
8. GRANDPARENTS
9. AUNT AND UNCLE
10. COUSIN
11. LEUCINE*
12. DICTIONARY
13. VITAL STATISTICS
14. LEUCINE*
15. MR. & MRS. WATSON*
16. MR. & MRS. CAYETANO*
17. MR. & MRS. DALLAS*
18. MR. & MRS. IKEDA*
19. MS. WANNAMAN*
20. LEUCINE...
21. MR. & MRS. WATSON...
22. BLOOD TYPING
23. MR. & MRS. CAYETANO...
24. MR. & MRS. IKEDA...
25. MS. WANNAMAN...
26. LEUCINE...
27. MR. & MRS. CAYETANO'S CHILD*
28. MR. & MRS. DALLAS' CHILD*
29. MR. & MRS. IKEDA'S CHILD*
30. MS. WANNAMAN'S CHILD*
31. MR. & MRS. DALLAS...
I. Assessment

A. Identify the Problem

What is the primary problem(s) with Student E’s approach? Briefly and concisely explain.

II. Intervention

B. Recommend a Solution

How would you help Student E? Briefly and concisely describe the steps you would take to assist Student E. Include specific strategies that you would recommend that Student E consider in future problem-solving exercises.
When assessing students’ problem solving, consider the following:

1. Did the student distinguish between relevant vs. irrelevant data?
2. What is the total time spent on problem solving?
3. Did the student invest adequate time in analyzing data relevant to solving the problem?
4. Does the sequence of data selections follow a recognizable logic?
5. Can you identify gaps in logic and content knowledge?
6. What is the primary problem-solving strategy employed by student?
7. Using a peer-reviewed scoring guide, can you categorize the problem-solving strategy?
8. Have you considered engaging students in self-assessment of problem solving using search-path maps as a metacognitive tool?
9. What is the most appropriate instructional intervention for the student?
Steps of Metacognitive Training

**Summarizing: What is the meaning?**

- What is the important information?
- What is the trivial information?
- What are you supposed to find out?
- What do I really know about this information?
- Does the information make sense when I put it in my words?

**Formulating a Question: What additional information do I need?**

- What else do I need to know?
- Is there something I do not understand?
- Are there other interpretations?
- Where can I go to find the needed information?

**Clarifying: Is the information clear now?**

- Find answers to questions.
- State revised understanding.
- Do you understand information now?
- Did additional information make it clearer?

**Predicting: What are my predictions about this information?**

- What are possible interpretations of the information?
- Choose an operation for solving the problem (e.g., hypothesis testing, elimination strategies, use of data and evidence, etc.)
- What do I predict will be presented next?
- Based on evidence, what are possible solutions?
- Based on evidence, what solutions are not possible?
- Can this solution make sense based on what I know to be true?
- Is a solution possible and likely?
- Based on my predictions, where should I go for additional information?
Metacognitive Training: Strategies to Avoid

1. Circular Reasoning
   ✓ E.g. What is gravity? Tendency for object to fall to the ground.
   Why objects fall? Because of gravity.

2. Hasty Generalizations
   ✓ E.g. Relying on too small sample size or unrepresentative samples

3. Too Much Credence On:
   ✓ Bold Statements
   ✓ Rumors
   ✓ Hearsay
   ✓ Anecdotes

4. Logical Fallacies
   ✓ E.g. If A, then B.
   B occurs. Can’t conclude A occurred.

5. Failure to Abandon Hypothesis Even if Obviously Wrong
   ✓ E.g. Trick question; magic; superstition
### IMMEX Problem-Solving Data Organizer

**Prologue Notes:** What is the problem?

<table>
<thead>
<tr>
<th>Menu Item (s)</th>
<th>Information Gathered</th>
</tr>
</thead>
</table>

**My Solution:**

**Epilogue Notes:** Summarize the logic you used to solve the problem.
**IMMEX AND TECHNOLOGY**

**IMMEX Problem-Solving Data Organizer**

**IMMEX Problem Set 2**

**Prologue Notes:** What is the problem?

<table>
<thead>
<tr>
<th>Menu Item (s)</th>
<th>Information Gathered</th>
</tr>
</thead>
</table>

**My Solution:**

**Epilogue Notes:** Summarize the logic you used to solve the problem.
### Prologue Notes: 
*What is the problem?*

<table>
<thead>
<tr>
<th>Menu Item (s)</th>
<th>Information Gathered</th>
</tr>
</thead>
</table>

### My Solution: ______________________________________________________

### Epilogue Notes: 
*Summarize the logic you used to solve the problem.*
IMMEX Problem-Solving Data Organizer

IMMEX Problem Set 4

Prologue Notes: *What is the problem?*

<table>
<thead>
<tr>
<th>Menu Item (s)</th>
<th>Information Gathered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

My Solution: ______________________________________________________

Epilogue Notes: *Summarize the logic you used to solve the problem.*
Prologue Notes: *What is the problem?*

<table>
<thead>
<tr>
<th>Menu Item (s)</th>
<th>Information Gathered</th>
</tr>
</thead>
</table>

My Solution: ______________________________________________________

Epilogue Notes: *Summarize the logic you used to solve the problem.*
## Prologue Notes:

*What is the problem?*

<table>
<thead>
<tr>
<th>Menu Item (s)</th>
<th>Information Gathered</th>
</tr>
</thead>
</table>

## My Solution:


## Epilogue Notes:

*Summarize the logic you used to solve the problem.*
<table>
<thead>
<tr>
<th>IMMEX Problem</th>
<th>Problem to be Solved</th>
<th>Problem Solving Strategy</th>
<th>Grade Level</th>
<th>No. of Cases</th>
<th>Content Embedded</th>
<th>Avg. Time</th>
<th>Instructional Use</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Desperately Seeking Solutions</td>
<td>What is the identity of the mystery solution—a potentially hazardous substance?</td>
<td>Space splitting</td>
<td>AP Chemistry, Grades 11-14 Chemistry</td>
<td>38</td>
<td>Conductivity, Electrolyte, Flame Test, pH, Indicators, Physical properties, Chemical properties, Solubility rules, Reduction Reactions, Oxidation Reactions, Acid/Base properties, Predicting Products Skills</td>
<td>40 Minutes</td>
<td>Instruction, Enrichment, and Assessment</td>
<td></td>
</tr>
<tr>
<td>Duck Run</td>
<td>What element has been dumped in a local duck pond?</td>
<td>Classification, deduction</td>
<td>Grades 9-10, Chemistry</td>
<td>12</td>
<td>Electrons in valence level, states of matter, metal/nonmetal properties, and chemical characteristics of elements.</td>
<td>13 Minutes</td>
<td>Assessment</td>
<td></td>
</tr>
<tr>
<td>Elemental Mystery</td>
<td>What is the identity the element that was stolen?</td>
<td>Deduction and Elimination</td>
<td>Grades 7-9, Science/Chemistry</td>
<td>3</td>
<td>Chemistry, Periodic Table, Elements, Density, Reaction</td>
<td>20 Minutes</td>
<td>Assessment</td>
<td></td>
</tr>
<tr>
<td>Freak in the Factory</td>
<td>What is the identity the unknown chemical from a sample collected at the scene of the crime?</td>
<td>Elimination</td>
<td>AP Chemistry, Grades 11-12, Chemistry</td>
<td>96</td>
<td>Molecular chemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazmat Holiday Special</td>
<td>What is the identity of the unknown?</td>
<td>Deduction and Elimination</td>
<td>Grades 10-11 Chemistry</td>
<td>13</td>
<td>Chemistry, Qualitative Analysis, Compound Identification</td>
<td>20 Minutes</td>
<td>Assessment Great Intro to IMMEX Simulation</td>
<td></td>
</tr>
<tr>
<td>How dense are you?</td>
<td>Can you determine the density of the piece of metal given to you as a gift?</td>
<td>Analysis and Conclusion</td>
<td>Grade 8 Science/Chemistry</td>
<td>15</td>
<td>Volume, density</td>
<td>20 Minutes</td>
<td>Assessment Great Intro to IMMEX Simulation</td>
<td></td>
</tr>
<tr>
<td>Robonaut</td>
<td>What metal and power source can be used to build a space explorer under a given set of conditions?</td>
<td>Elimination</td>
<td>Grades 11-12, Chemistry</td>
<td>5</td>
<td>Metal Characteristics, Density, Change of State (M.P. and B.P.), Chemical Reactivities, Usable Energies</td>
<td>40 Minutes</td>
<td>Assessment</td>
<td></td>
</tr>
<tr>
<td>Rust Never Sleeps</td>
<td>How much air had been left in a container?</td>
<td>Deduction and Synthesis</td>
<td>Grades 10-11 Chemistry</td>
<td>6</td>
<td>Mass, gas laws, oxidation numbers</td>
<td>20 Minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trendy</td>
<td>What is the identity of the unknown element?</td>
<td>Recalling the general periodic trends, students will determine the element via comparison of general trends with specific data.</td>
<td>Regular Chemistry, Honors Chemistry, AP Chemistry, First Year College Chemistry</td>
<td>56</td>
<td>Physical data concerning elements, common ores of elements, vocabulary of orbitals, energy levels, electron configurations, properties of elements.</td>
<td>40 Minutes</td>
<td>Teaching, Assessment, Enrichment</td>
<td></td>
</tr>
<tr>
<td>IMMEX Problem</td>
<td>Problem to be Solved</td>
<td>Problem Solving Strategy</td>
<td>Grade Level</td>
<td>No. of Cases</td>
<td>Content Embedded</td>
<td>Avg. Time</td>
<td>Instructional Use</td>
<td></td>
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</tr>
<tr>
<td>Stoichiometry</td>
<td>What is the stoichiometric relationship between the partially identified compound and reagent X? What is chemical formula?</td>
<td>Deduction and Synthesis</td>
<td>Grades 11-12 Chemistry AP Chemistry</td>
<td>29</td>
<td>Cases are available for both ionic and covalent (hydrocarbon) compounds. Oxidation numbers, chemical formulas, naming compounds, limiting reactants, single / double replacement, combustion reactions, stoichiometry, moles, mass, density, molarity, ideal Ga</td>
<td>20 Minutes</td>
<td>Assessment Enrichment</td>
<td></td>
</tr>
<tr>
<td>Vu Du Volumes</td>
<td>What is the identity of the gem the geologist found? What is the market value of the gem?</td>
<td>Deduction and Synthesis</td>
<td>Grades 9 – 12 Chemistry</td>
<td>12</td>
<td>Density, mass, volume, measurement.</td>
<td>35 Minutes</td>
<td>Assessment</td>
<td></td>
</tr>
<tr>
<td>What killed Lenny?</td>
<td>What is the identity of the compound that killed Lenny?</td>
<td>Elimination</td>
<td>Grades 9 – 12 Chemistry</td>
<td>16</td>
<td>Chemical nomenclature, particulate analysis, subatomic properties, atomic mass.</td>
<td>30 Minutes</td>
<td>Assessment</td>
<td></td>
</tr>
</tbody>
</table>

**LIFE SCIENCE & GENERAL SCIENCE**

<table>
<thead>
<tr>
<th>IMMEX Problem</th>
<th>Problem to be Solved</th>
<th>Problem Solving Strategy</th>
<th>Grade Level</th>
<th>No. of Cases</th>
<th>Content Embedded</th>
<th>Avg. Time</th>
<th>Instructional Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti Body</td>
<td>What is the cause of symptoms reported from a patient of one of the very busy staff physicians?</td>
<td>Elimination</td>
<td>Grades 10-12 Honors Biology or AP Biology</td>
<td>20</td>
<td>Immune system cells, immunoglobulins (antibodies), antigens (allergens, viruses, bacterial toxins, tumors), allergy skin tests, electrophoresis and ELISA diagnostic techniques.</td>
<td>40 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>Classroom Detective I</td>
<td>Who stole the sweater?</td>
<td>Elimination</td>
<td>Grade 4, Science</td>
<td>3</td>
<td>Logic, distinguishing chromatograms, fingerprints, shoeprints and fibers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classroom Detective II</td>
<td>Who stole the lunch money?</td>
<td>Elimination</td>
<td>Grade 4, Science</td>
<td>3</td>
<td>Logic, distinguishing chromatograms, fingerprints, shoeprints and fibers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commotion in the Ocean</td>
<td>Can you identify the sea animal?</td>
<td>Elimination</td>
<td>K-Grade 1, Life Science</td>
<td>6</td>
<td>Animal characteristics</td>
<td>20 Minutes</td>
<td>Introduction, Assessment</td>
</tr>
<tr>
<td>Creeping Crud</td>
<td>What is the causative agent, mode of transmission, and origin of the disease afflicting residents from five U.S. states?</td>
<td>Deduction and Synthesis</td>
<td>Grades 9-12, Biology</td>
<td>4</td>
<td>Disease transmission by Virus, Bacteria, Protozoa, Fungus; Parasitism, Commensalism, Arthropod Vectors</td>
<td>30 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>Dino Dinoflagellate</td>
<td>Can you identify parts the malfunctioning organelle?</td>
<td>Analysis and Elimination</td>
<td>Grade 9-10, Biology</td>
<td>10</td>
<td>Structure and function of organelles</td>
<td>25 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>IMMEX Problem</td>
<td>Problem to be Solved</td>
<td>Problem Solving Strategy</td>
<td>Grade Level</td>
<td>No. of Cases</td>
<td>Content Embedded</td>
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</tr>
<tr>
<td>Eco Rangers</td>
<td>What is the identity of the captured animal?</td>
<td>Elimination</td>
<td>Grades 2-3, Life Science</td>
<td>6</td>
<td>Characteristics of Animals, Habitats</td>
<td>20 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>Forensic Investigation</td>
<td>Who committed the murder?</td>
<td>Elimination</td>
<td>Grades 9 – 11, Biology</td>
<td>1</td>
<td>Blood Typing, Plant Chromatography, DNA, Karyotype, RFLP Analysis, pH</td>
<td>30 Minutes</td>
<td>Assessment, Great Intro to IMMEX Simulation</td>
</tr>
<tr>
<td>FrankenFoods</td>
<td>Which plant has been defectively bio-engineered, which gene is involved, and at what point in gene expression has an error occurred?</td>
<td>Deduction and Elimination</td>
<td>Grades 10-12, Honors Biology or AP Biology</td>
<td>1</td>
<td>Gene expression, gel electrophoresis, PCR, Northern blots, ELISA, vaccines, immune response, genetic engineering.</td>
<td>40 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>Island Survival</td>
<td>Using the available seeds and limited space, what crops will yield the most food to sustain all four survivors on the uncharted, uninhabited island for at least a year?</td>
<td>Manipulation of Multiple Variables and Synthesis</td>
<td>Grades 6 – 8, Science</td>
<td>6</td>
<td>Harvest Time, Yield, Caloric Needs, Pests, Rainfall, Temperature</td>
<td>40 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>MicroQuest</td>
<td>What are the metabolic processes affected by this potentially new antibiotic?</td>
<td>Analysis, Synthesis, Deduction</td>
<td>Honors Biology, Biology, Grades 10 -12</td>
<td>13</td>
<td>Mode of Antibiotic Action, Microbiology, Molecular Biology</td>
<td>40 Minutes</td>
<td>Assessment and Enrichment</td>
</tr>
<tr>
<td>Puffy Paramecium</td>
<td>What is the identity of the missing organelle?</td>
<td>Elimination</td>
<td>Grades 9 - 10, Life Science</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roger Rabbit</td>
<td>Who committed the crime?</td>
<td>Elimination</td>
<td>Grades 6 - 8, Science</td>
<td>3</td>
<td>Forensic science, chromatography, identification of mystery powders, fiber and hair identification</td>
<td>60 Minutes</td>
<td>Assessment, Great Intro to IMMEX Simulation</td>
</tr>
<tr>
<td>Roots Quest</td>
<td>Who are Leucine’s biological parents?</td>
<td>Elimination</td>
<td>Grades 8-9, Life Science</td>
<td>5</td>
<td>Genetics; Blood Typing, Genotype, DNA, RFLP Analysis</td>
<td>30 Minutes</td>
<td>Teaching, Assessment, Enrichment</td>
</tr>
<tr>
<td>True Roots</td>
<td>Who are Leucine’s biological parents?</td>
<td>Elimination, Data Reduction</td>
<td>Grades 9 – 12 Biology</td>
<td>5</td>
<td>Genetics; Blood Typing, Genotype, DNA, RFLP Analysis</td>
<td>40 Minutes</td>
<td>Teaching, Assessment, Enrichment</td>
</tr>
<tr>
<td>Ugly Gel</td>
<td>What is the technique error of the DNA fingerprint?</td>
<td>Elimination</td>
<td>Grades 9 – 12 Biology</td>
<td>14</td>
<td>DNA Fingerprint (RFLP) particularly; micropipetting, gel electrophoresis, and gel staining.</td>
<td>40 Minutes</td>
<td>Assessment and Enrichment</td>
</tr>
<tr>
<td>Which plasmid is it?</td>
<td>What is the identity of the plasmid in the smeared, labeled container?</td>
<td>Elimination</td>
<td>Advanced Placement Biology, Grades 10-12</td>
<td>21</td>
<td>The primary concepts embedded in Plasmids are Molecular Genetics, Endonucleases, Molecular size, and electrophoresis.</td>
<td>20 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>IMMEX Problem</td>
<td>Problem to be Solved</td>
<td>Problem Solving Strategy</td>
<td>Grade Level</td>
<td>No. of Cases</td>
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<tr>
<td>--------------------------------</td>
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<tr>
<td>Buffy’s Millennium Party</td>
<td>What did Zoey and Carson purchase with $120 on their shopping spree in preparation for Buffy’s Millennium Party?</td>
<td>Calculations and Synthesis</td>
<td>Grade 7, Math</td>
<td>6</td>
<td>Decimals, fractions, percentages</td>
<td>30 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>Math Wars</td>
<td>Which of the surrounding ships in the area hit the USS John F. Kennedy?</td>
<td>Elimination Process</td>
<td>Grade 9 or 10 Algebra 1 and/or Geometry</td>
<td>6</td>
<td>Coordinate planes, Pythagorean theorem, distance formula, linear equations, area of a circle, and logic.</td>
<td>50 Minutes</td>
<td>Assessment and Enrichment</td>
</tr>
<tr>
<td>Millionaire Island</td>
<td>Can you locate the correct treasure and find the key to open the chest?</td>
<td>Elimination</td>
<td>Grades 11-12 Math</td>
<td>8</td>
<td>Distance formula, Pythagorean theorem, conics, systems of equation, functions, order of operation, sequences and radical expressions.</td>
<td>30 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>Mineral on 34th Street</td>
<td>Can you identify the mineral given clues describing different mineral properties?</td>
<td>Compare and contrast, prioritizing, critical thinking, and can be used for cooperative groupings.</td>
<td>Grades 4-6 Physical Science</td>
<td>12</td>
<td>Visual, physical, and kinaesthetic observations, a working knowledge of mineral properties.</td>
<td>30 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>Monster Mash Marathon</td>
<td>Who came in first in Mrs. Elvira’s class?</td>
<td>Elimination</td>
<td>Grades 3-4 Math</td>
<td></td>
<td>Fractions, Addition, Subtraction</td>
<td>20 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>Naval Battle</td>
<td>Which of the surrounding ships in the area hit the USS John F. Kennedy?</td>
<td>Elimination Process</td>
<td>Grade 9 -10 Algebra 1 and/or Geometry</td>
<td>6</td>
<td>Coordinate planes, Pythagorean theorem, distance formula, linear and parabolic equations, area of a circle, and logic.</td>
<td>50 Minutes</td>
<td>Assessment and Enrichment</td>
</tr>
<tr>
<td>Paul’s Pepperoni Pizza</td>
<td>How may pizzas should you order to feed the hungry baseball team?</td>
<td>Calculation and Synthesis</td>
<td>Grades 2-3 Math</td>
<td></td>
<td>Addition, Subtraction, Multiplication, and Division</td>
<td>Assessment</td>
<td></td>
</tr>
<tr>
<td>IMMEX Problem</td>
<td>Problem to be Solved</td>
<td>Problem Solving Strategy</td>
<td>Grade Level</td>
<td>No. of Cases</td>
<td>Content Embedded</td>
<td>Avg. Time</td>
<td>Instructional Use</td>
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<tr>
<td>Quince</td>
<td>Who stole the Quinceañera’s present her grandmother gave her and where on the ranch did she hide it?</td>
<td>Data Synthesis and Elimination</td>
<td>Grades 11-12, Math</td>
<td></td>
<td>Graphing, solving linear equation, converting measuring units, applying mathematical formulas: Slope, mean, mode, midpoint, distance, and areas of circles and squares.</td>
<td>35 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td></td>
<td>You return from an emergency phone call and your friends were gone, but left money on the table to pay for the bill...Who did not contribute to the dinner bill?</td>
<td>Calculation, Elimination</td>
<td>Grades 4-5, Math</td>
<td>9</td>
<td>Addition, subtraction, fractions</td>
<td>15 Minutes</td>
<td>Assessment</td>
</tr>
</tbody>
</table>

**PHYSICAL SCIENCE**

<table>
<thead>
<tr>
<th>IMMEX Problem</th>
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</thead>
<tbody>
<tr>
<td>Blast to the Past</td>
<td>Which of 5 vehicles (with varying mass, horsepower, etc.) will accelerate to the desired speed at the end of a given distance?</td>
<td>Mathematical analysis of data, elimination.</td>
<td>Grades 11-12 Physical Science</td>
<td>17</td>
<td>Kinematics, power, Newton’s Laws, weight, kinetic energy, English to metric conversions.</td>
<td>35 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>Foss Iss Boss</td>
<td>Can you locate the epicenter of the earthquake, identify the organism that has left the fossil, and identify the geologic time period in which the organism lived?</td>
<td>Classification, sequencing, Analysis</td>
<td>Grades 9–10, Physical Science</td>
<td>64</td>
<td>Earthquakes (locating the epicenter), fossils, geologic time, radiocarbon and radiometric dating.</td>
<td>20 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>In the Dark</td>
<td>In order to collect all of the Halloween treats, can you build an electrical circuit using the materials and specifications given?</td>
<td>Deduction and Synthesis</td>
<td>Grades 4-6, Physical Science</td>
<td></td>
<td>Electrical circuits</td>
<td></td>
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</tr>
<tr>
<td>K’nex Yankees</td>
<td>Based on the vehicle specifications given, which vehicle do you think will win the race?</td>
<td>Analysis, Deductive Reasoning</td>
<td>Grades 11-12 Physical Science</td>
<td>9</td>
<td>Measurements of mass, speed and other characteristics of vehicles, interpretation of charts and data tables.</td>
<td>30 Minutes</td>
<td>Assessment</td>
</tr>
<tr>
<td>Solar System Settlers</td>
<td>Can you help the family of lost aliens find their new home?</td>
<td>Calculation and Synthesis</td>
<td>Grades 4-7 Physical Science</td>
<td></td>
<td>Property of Planets</td>
<td>20 Minutes</td>
<td>Assessment</td>
</tr>
</tbody>
</table>
Notes: Day 1
Notes: Day 2
Notes: Day 4