



We PRODUCE

- P- Problem**
- R- Reduce and Simplify**
- O- Organize and Observe**
- D- Discover**
- U- Understand**
- C- Cooperate**
- E- Educate and Communicate**

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Table of Contents

	<u>Page</u>
Curriculum Unit Overview - narrative	#3
Summary Chart	#4
Section One Science and Engineering	#5
Section Two Mathematics	#11
Section Three Communication	#17
Transfer Activities	#4,7,14,19, 22
Appendix	#23

We PRODUCE

Curriculum Unit Overview

Summary

This unit is designed for any organization or individual that wishes to be effective by using techniques learned through the use of the scientific method. It is designed for use by students in middle school and high school. This unit will traditionally take three weeks to complete in a fifty-minute period or 2 weeks in a 90- minute period.

Big Picture

Students will view a clip of a car accident and brainstorm a T-chart that shows on one side the possible problems associated with the clip and on the other side of the chart solutions to the listed problems. When we lack problem solving skills whether in the workplace or in life to and from work or at home we are more susceptible to injury or accident.

Preparation for the Unit

Work with media specialist to:

1. Secure the copyright and tape the commercial needed from television. It is a seat belt commercial.
2. Teacher should make arrangements to get in the library on the days needed for Science ALT-2 and Communication ALT-2

Overview

On the following page is a summary of the unit including brief summaries of each Authentic Learning Task (ALT). This table provides an overview of the tasks in the unit sections and shows how the activities in the different teaching areas relate to each other.

We PRODUCE Curriculum Unit Summary

Science and Engineering	Mathematics	Language/Communication
<p>ALT 1 - Dichotomous Key: Chaos to Order Classification and organization will be the focus when students make their own dichotomous keys.</p>	<p>ALT 1 – Mystery Matter Hands-on activity designed to lead students to make inferences and analyze data by looking at a situation analogous to an atom.</p>	<p>ALT 1 – Keep it Simple! Students will take a section of the text and reduce the knowledge down to present it to other students in the class.</p>
<p>ALT 2 – Up, Up and Away Students will design their own rockets, build the rocket, and fly it. Students will use basic engineering and building techniques.</p>	<p>ALT 2 – How was your flight? Students will use TI-83 calculators to analyze the data obtained from the rocket flight. They will graph their findings.</p>	<p>ALT 2 – Look at my Data! Students will take the data obtained in the use of TI-83's in ALT 2 and share it with others in the class by using several different approaches.</p>

Transfer Activity

All ALT 1's have a separate transfer activity that sums up the learning for that particular ALT. In the transfer activity for all ALT 2's, students will take a field trip during the school year to the WPAFB Research Laboratories to see how the use of the scientific method while doing a scientist's daily job becomes an integral part of the Space Program. Students will go in groups of no more than 10 students at a time and the tours will be coordinated through Bill Harrison of the PRTG.

Section One: Science and Engineering

ALT One: Dichotomous Keys: Chaos to Order!

Summary

The teacher will play a game with the class in which he/she tells the students that the teacher is thinking of a particular student and the students can ask yes or no questions of the teacher.

Then the students will work in pairs on the Salamander dichotomous key. Later the students construct their own dichotomous key to identify every student in the class.

Competencies

1. Classification- Students, using the dichotomous key, will be able to identify the salamanders using with no more than two errors. Students will be able to construct a dichotomous key that any student can use to identify correctly every student in the class.
2. Written Report – Each student will turn in a written report in the correct format. Report should be in pencil; writing should be legible; no cross outs ; few spelling errors; correct punctuation
3. Teamwork – Students should be on task and courteous to teacher and other students. Students should be careful with equipment and property

Time

The time is approximately 100 minutes

Materials

Salamander dichotomous key handout.

Instructions

1. Teacher and class discuss organization and classification and play yes/no game.
2. Students work in pairs on salamander dichotomous key and on constructing their own key of class members.

Evaluation/Assessment of Student's Competency

1. Students will trade papers with another group to see if dichotomous keys they created are workable.
2. Teacher will grade salamander results to ensure that there are no more than two errors. This can be done in class before the students conduct their own dichotomous key. Students exceeding two errors will continue working until they get it right.

Closure

1. Class discussion will address what the students learned about classification, whether there is more than one way to do it, if "trichotomous" keys could be constructed and why organization and classification are important skills.

Transfer Activity- Dichotomous Key

Summary

Students will make up their own dichotomous key to answer the following question: Fred is from a country where there are no home conveniences. He comes to the U.S. and his told to identify a TV, chair, table, microwave, and computer. Make up a dichotomous key that will help Fred identify these items.

Competencies

1. Classification- Students will be able to construct a dichotomous key that any student can use to identify correctly the items above.
2. Written Report – Each student will turn in a written report in the correct format. Report should be in pencil; writing should be legible; no cross outs ; few spelling errors; correct punctuation.

Time

The time is approximately 30 minutes

Materials

None needed. Question above can be put on blackboard.

Instructions:

Students are instructed to do the following at home: Fred is from a country where there are no home conveniences. He comes to the U.S. and his told to identify a TV, chair, table, microwave, and computer. Make up a dichotomous key that will help Fred identify these items.

Evaluation/Assessment of Student's Competency

1. Teacher will evaluate the student's papers to see that their dichotomous keys are correct.

Closure

Class discussion will address what the students learned about classification, whether there is more than one way to do it, if "trichotomous" keys could be constructed and why organization and classification are important skills. Additional discussion will focus on whether dichotomous keys will be useful if they only identify some of the items that can be found. In this case, there are many household appliances and conveniences. Would a key like this be useful if you needed to look for these items among many other items.

Section One: Science and Engineering

ALT Two: Up, Up and Away

Summary

Students will build a rocket from a 2-liter bottle that contains water. The students will collect data from the flight to use with the ALT-2 from the mathematics section. Students will use the center of mass and center of gravity to determine how to best design their rocket for flight.



Competencies

1. Students will learn the basics for design of a rocket. The length of flight for the rocket will determine the level of competency.
2. Students will do data collection for their own rockets. The students need to measure the amount of water used, the length of the flight, the total time in the air and the mass of the rocket.

Time

The time is approximately 2 , 90 minute periods

Materials

2-Liter bottle for each 2 students

Cardboard for wings or fins

Poster board for a nose cone

Sand to weight the nose cone

Duct tape

Scissors

Graduated cylinder

Water

Rocket launcher that will launch a standard 2-Liter bottle

Air compressor

Stop watches

Long measuring tape, preferably 50 meters

4- Stakes for marking known distances at 20 m, 35 m, 45 m, 55 m

Instructions

1. Students are allowed to choose their own partner for this activity because it requires that students bring items from home.
2. Students need to decide which students will bring the items needed to build their rockets.
Suggested items to bring are listed above in *Italics* but the materials depend upon the design chosen for the rocket.
3. The first day students will learn concepts of rocket building such as how to find the center of pressure by using the center of gravity for the rocket. They should then go into the library for the remainder of the period to use the Internet access and resource books to help them with the design of their rockets. They should then sketch their design, get teacher approval and decide with their partner who will bring which materials needed the next day. *This is ideal to begin on Friday to give students the weekend to get the materials.*
4. Students will begin the building process the following day. Once students have completed their designs, they will go outside and launch their rockets. Students should keep record of the following information for their own rockets. Mass of the rocket, amount of water used in the rocket for propulsion, distance traveled by the rocket, and total time in the air.
5. After the first launch, students will return to the classroom to modify their designs and then go back out to do a second launch. Students should get a second set of data to compare to the first set.

Evaluation/Assessment of Student's Competency

Students will be graded on how well they work within their group on the following scale.

6- worked well with other student, participated throughout experiment, brought necessary materials for the group.

5- worked with the other student for the duration of the project, only participated when coaxed to do so, remembered to bring materials.

4- did not work with the other student for the duration of the project, only participated when coaxed to do so, remembered to bring materials.

3- did not work with the other student for the duration of the project, only participated when coaxed to do so, did not remember to bring materials.

2- did not work with the other student for the duration of the project, rarely participated when coaxed to do so, did not remember to bring materials.

1- did not work with the other student for the duration of the project, did not participate when coaxed to do so, and did not remember to bring materials.

The other aspect of the grade will be based on the flight, which is a group grade.

- 6- over 60 meters
- 5- between 50-60 meters
- 4- between 40-50 meters
- 3- between 30-40 meters
- 2- between 20-30 meters
- 1- less than 20 meters

The scores will be the better of the two launches.

Closure

This activity will lead in to the mathematics ALT-2 when we use the data obtained and begin to correlate the numbers associated with the launches.

Section Two: Mathematics

ALT One: Mystery Matter

Summary

Students examine film canisters and determine physical properties of the containers and the contents. The canisters contain different numbers of identical metal nuts. In the end the students are able to determine the mass of one nut and how many nuts are in each container. The students are also able to examine the rolling behavior of the containers, magnetic nature of the contents, etc. The work they do is similar to experiments that were done to ascertain the nature of chemicals and atoms.

Competencies

1. Comparing - students accurately describe rolling, and spinning behavior empty canister and those containing nuts. Students determine if canisters contain magnetic or nonmagnetic items and something about the nature of the items.
2. Calculate and interpret data- students will measure the mass to .01g and determine the number of nuts in each container.
3. Written Report – Each student will turn in a written report in the correct format. Report should be in pencil; writing should be legible; no cross outs ; few spelling errors; correct punctuation
4. Teamwork – Students should be on task and courteous to teacher and other students. Students should be careful with equipment and property

Time

The time is approximately 100 minutes

Materials

Each group of 4 students will need 2 film canisters (one empty and one containing some metal nuts), one balance, 4 student worksheets. Teacher should put one nut in one film canister and different numbers of nuts in some of the others. All containers should then be taped shut with approximately the same amount of tape.

Instructions

1. Teacher hands out worksheet and lab instructions.
2. Students read worksheet and teacher gives oral instructions.
3. Students go into groups

4. Students do lab work at their seats
5. Student put their results on the blackboard.
6. Students analyze the class data in order to answer the questions on their lab worksheets.

Evaluation/Assessment of Student's Competency

1. Teacher will walk around to the groups and check on their work and ask them questions at the places marked "checkpoints" on their lab sheet. As a group, students should be able to correctly answer the teacher's questions.
2. Students written reports are graded with 80 percent considered an acceptable level of performance.

Closure

Class discussion will address group's conclusions, sources of error, the difference between fact and theory, observation and inference.

ALT One: Handout One

(Mystery Matter)

Mystery Matter

Write Question and Answer:

1. For each of the following situations, tell whether you can directly observe the conditions or if you must use indirect methods. **Explain.**

- A. Living human brain
- B. Dead human brain
- C. Atoms
- D. Speed of moving cars
- E. Ocean bottom

Examine the containers in front of you. Each group will be given two containers, one empty and one with some mass inside.

2. Use your magnets. Are the contents magnetic? How do you know?
3. Do the containers contain magnets or just magnetic material? How do you know?
4. Roll the containers down a ramp made with your book. Do they both roll with the same speed?
5. Which container rolled the fastest, the empty one or the one containing something?
6. Did the containers roll with constant speed?
7. Did the containers steadily increase speed or did they roll in a jerky fashion?
8. Spin the containers. Does the empty one spin the same as the one with some mass?
9. Using your empty containers and the one with something in them, write down a procedure for determining the mass of the contents of the container containing some mass.

Check with your teacher

10. Find the mass of the contents of the container. Round your answers to the .01 place.

****Write your mass data on the blackboard****

One of the containers only had one item in it. Which group had this container?

11. Explain your answer to number 10.
12. How can you determine how many items are in the containers?

Check with your teacher

Make a chart listing the group number and how many items were in the container?

13. What was different about the contents of each container?
14. Do you think your container contains a metal or a nonmetal? How do you know?
15. Summarize everything you know about the contents of the containers.
16. From what you did in this lab, explain how scientists can make inferences and theories about things that they can not directly observe?

Transfer Activity

ALT One: Mystery Matter

Summary

Students construct a mystery box that they bring into class. Other groups of students investigate the box and report on properties of the contents of the mystery box.

Competencies

1. Observing, hypothesizing, testing - Students will study the box and use magnets, balances, and their senses to record factual data and hypotheses as to the contents of the box.
2. Oral Report – Students will report on their observations and conclusions.
3. Teamwork – Students should be on task and courteous to teacher and other students. Students should be careful with equipment and property

Time

The time is approximately 50 minutes in class and 50 minutes at home

Materials

Students will provide their own materials for mystery boxes

Instructions

Students are instructed to construct their own mystery box with several objects inside.

Evaluation/Assessment of Student's Competency

1. Students bring in a mystery box that is sealed containing several objects. Full credit given if this is done. Partial credit if not sealed or not containing several objects.
2. Orally the students should report on all their observations and what they think might be in the box.

Closure

Class discussion will address group's conclusions, sources of error, the difference between fact and theory, observation and inference. Discussion could include high tech ways of learning the contents of the box, such as MRI, x-rays, tiny cameras, etc.

Section Two: Mathematics

ALT Two: How was your flight?

Summary

Students will use the data obtained in the Science ALT-2 to create charts and graphs that allow the information to be easily viewed and lead students to results comparison.

Competencies

1. Students will use TI-83 calculators to graph time versus distance to determine the velocity. They will also graph three other aspects of their launch.
2. Students will use the calculators to graph distance versus water used to find the best amount of water to use for the furthest distance.

Time

One 90 minute period is needed for maximum value.

Materials

A class set of TI-83 calculators would be best or one calculator that could be viewed by the entire class on a screen.

Data from the ALT-2 Science experiment

Instructions

1. Students should write their own group's data on the black board for the class to use.
2. Students will take their own data and work with the same partner to compile the information into the calculators and first a time distance graph should be gotten by the entire class to be viewed.
3. Students should be lead into the velocity connection. Talk about which group had the highest and lowest velocity. Have students reproduce the graph on a piece of paper and put in their lab notebooks.
4. Students should then make a distance versus amount of water graph to determine who had the longest distance and how much water was ideal. Copy into the lab notebooks.
5. Students should then make a mass verses hang time and a mass verses distance graph and reproduce those into their notebooks.

Evaluation/Assessment of Student's Competency

1. Students will be graded on how they work with their partner to complete the graphs.
2. Student graphs will be graded on a 1-6 scale.

- 6-Completed all graphs accurately
- 5-Completed graphs with only minor mistakes
- 4-Completed all graphs with major mistakes
- 3-Completed only three graphs
- 2-Completed only two graphs
- 1- Completed only one graph

Closure

This ALT leads into ALT-2 Communication in the use of the graphs produced here will be transferred to the shared file on the computer network and students will be able to use their TI graphs to make a Power Point to share the information with other class members.

Section Three: Communication

ALT One: Keep it Simple!

Summary

Students are assigned sections of chapter or other material to teach to the class. They work in groups of four to prepare a lesson and administer a quiz. They then grade the quiz. The method of teaching is generally an oral/written presentation using the blackboard. However, they may use other methods, such as power point or lab activities, if they choose. Their lessons should last approximately 10 minutes.

Competencies

1. Simplification and Organization- Students will read the section and write down short notes to present to the class.
2. Written quiz – Each group will assign a short quiz in the correct format. Quiz should be in pencil or typed; writing should be legible; no cross outs ; no spelling errors; correct punctuation
3. Teamwork – Students should be on task and courteous to teacher and other students.
4. Oral presentation- Volume should be adequate. Students should demonstrate a serious, proper demeanor for the presentations.

Time

The time is approximately 150 minutes

Materials

Any written material

Instructions

1. Students are put in groups of four
2. They read the material, and prepare a teaching presentation.
3. They administer a short quiz and grade it in class by having students switch papers. They compute median score.
4. Students being taught and teacher evaluate the student teachers. Student teachers evaluate themselves.

Evaluation/Assessment of Student's Competency

1. The students and teacher will evaluate the student teachers' performance as A. very good B. adequate C. needs improvement in the following areas:
 - a. Volume
 - b. Clarity of expression
 - c. Proper demeanor
 - d. Effectiveness in teaching
2. The student teachers as a group will evaluate their own performance as above and will evaluate the median scores on the quiz and comment on the results.

Closure

Class discussion on teaching as a method of learning and simplification.

Transfer Activity- Keep it Simple

Summary

Students are assigned a reading section and are to summarize it in bullet form with at least one drawing.

Competencies

- 1.Simplification and Organization- Students will read the section and write down short notes in bullet form with at least one drawing
- 2.Written report –Report should be in correct form. It should be in pencil; writing should be legible; no cross outs; few spelling errors; correct punctuation

Time

The time is approximately 30 minutes

Materials

Reading section from book or magazine

Instructions:

Students are instructed to do the following at home:

1. Students are assigned a reading section
2. They are to make bulleted notes with at least one drawing

Evaluation/Assessment of Student's Competency

1. Teacher will evaluate the student's papers to see if they correctly summarize the reading selection.

Closure

There will be discussion on simplification and quick note taking as an aid in studying.

Section Three: Communication

ALT Two: Look at my Data!

Summary

Students will go to the library to use the computers for making a power point presentation that compiles and introduces their findings to the other students in the class. At this point we will discuss why students may have disagreements on which group made the “best” rocket.

Competencies

Although many students may be familiar with Power Point, a refresher lesson may be needed to allow students to make the most effective use of their time. Critically analyzing data is another aspect of this lesson along with discovering how and why we publish results of our experiments.

Time

The time is approximately 2- 90 minute periods

Materials

One computer for each group of two
Capability to show Power Point presentations to the entire class once we return to the classroom.

Instructions

1. Students will go to the library with their partner from the Science ALT-2.
2. Students will be given prior instructions in the classroom on the making of a Power Point presentation.
3. Students may use their own creativity to produce a presentation that they will give to the class the following day.
4. The presentation must include each of the following but may include any extra items the student may want to include.
 - a. Name of the rocket group, be creative
 - b. Materials used in your rocket
 - c. Data table on your flight
 - d. Graph of the class data, you may choose any of the four graphs to use or you may include all graphs

- e. Summary of what each graph used represents and your interpretation of the graph
 - f. Choose the group in the class that you feel had the “ best” rocket. The choice must be backed up by facts from the data.
5. The following day, students will present their presentation to the class.

Evaluation/Assessment of Student’s Competency

Students will be graded on the following rubric for their presentation.

- 6-Presentation contains all suggested items and may contain extra information
- 5-Presentation is missing one aspect of the information that should have been included
- 4- Presentation is missing two aspects of the information that should have been included
- 3- Presentation is missing three aspects of the information that should have been included
- 2- Presentation is missing four aspects of the information that should have been included
- 1- Presentation is missing five aspects of the information that should have been included

Closure

At this point, students should have followed the entire scientific method by doing the six projects listed. Students will be ready to do the transfer activity listed on page four of the module that allows for a field trip to the Propulsion Research Directorate at WPAFB.

Transfer Activity for ALT 2 of Science and Engineering, Mathematics and Communication Combined

Summary

Students will take a field trip to the Research Labs located at Area B of the Wright Patt Air Force Base.

Competencies

1. Students will tour a major aerospace research facility and talk with scientists about the research and equipment.

Time

A three hour tour

Materials

Bus requisition

Chaperones- parents would be the best volunteers

Permission slips and emergency medical forms

Instructions:

1. Give permission slips out at least two weeks prior to the field trip. Make sure students know they may not go if the forms are not in. Also at that time ask for parent volunteers.
2. Have a clear date in mind for students to turn in the forms. Be sure to tell students.
3. Get the bus requisition letter turned in ASAP.
4. Verify the date with the Research Directorate.
5. Once volunteers are in place, send them a time schedule.
6. Go on the trip and enjoy

Evaluation/Assessment of Student's Competency

Students will write a journal entry on their experience on the trip.

Closure

Students will be able to use the insight gained as a decision tool when preparing for their future. Could aerospace research be their career choice??

Appendix One: ALT-1 Science Attachments

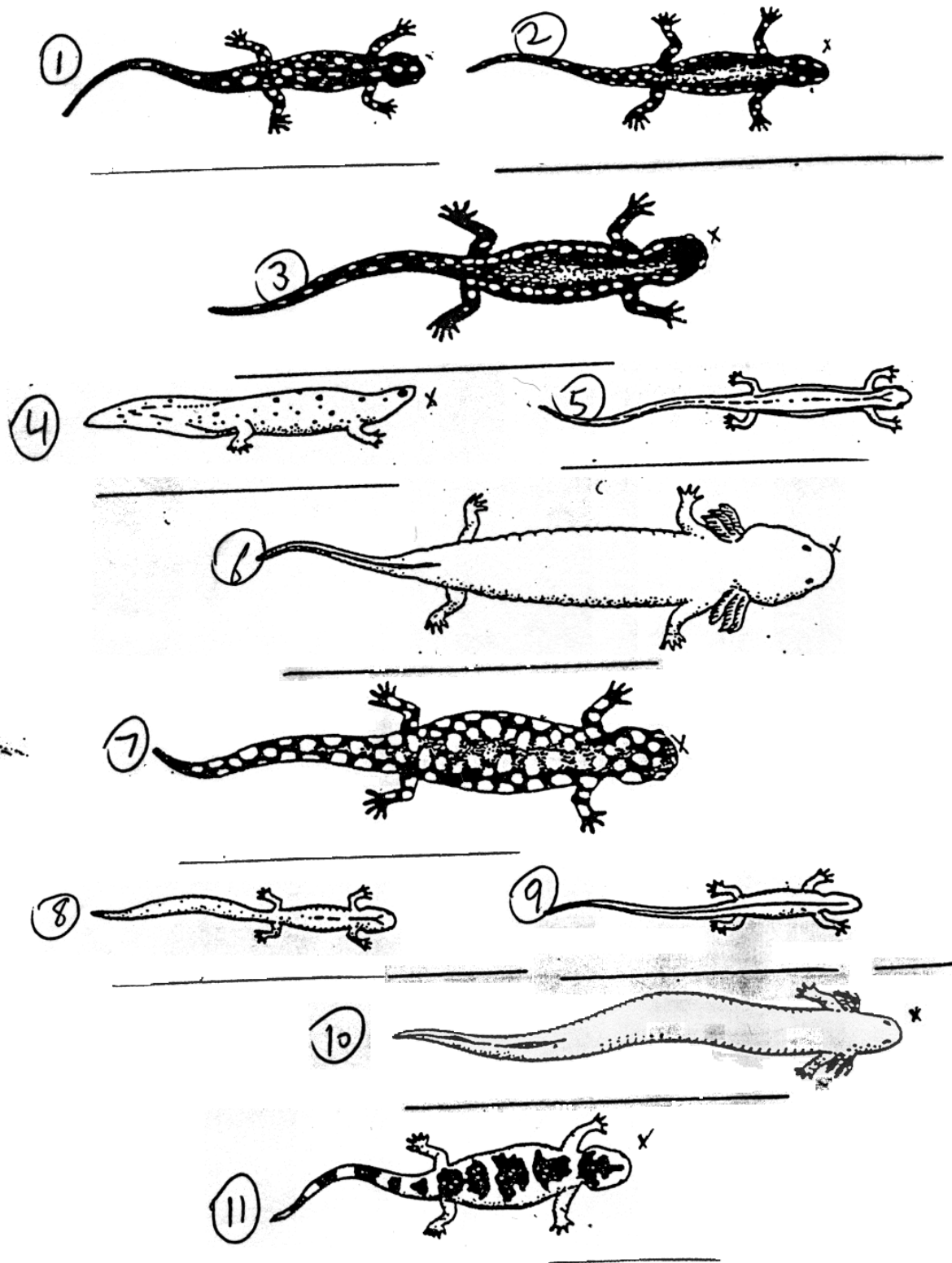


FIGURE 3-2 Types of Salamanders

Using this key, place the names of the salamanders that describe the correct one under its picture

FIGURE 3-3 Classification Key to Certain Salamanders

1	a Hind limbs absent	<i>Siren intermedia</i> , siren
	b Hind limbs present	Go to 2
2	a External gills present in adults	<i>Necturus maculosus</i> , mud puppy
	b External gills absent in adults	Go to 3
3	a Large size (over 7 cm long in Figure 3-2)	Go to 4
	b Small size (under 7 cm long in Figure 3-2)	
4	a Body background black, large white spots irregular in size and shape completely covering body and tail	<i>Ambystoma tigrinum</i> , tiger salamander
	b Body background black, small round white spots in a row along each side from eye to tip of tail	<i>Ambystoma maculatum</i> , spotted salamander
5	a Body background black with white spots	Go to 6
	b Body background light color with dark spots and/or lines on body	Go to 7
6	a Small white spots on a black background in a row along each side from head to tip of tail	<i>Ambystoma jeffersonianum</i> , Jefferson salamander
	b Small white spots scattered throughout a black background from head to tip of tail	<i>Plethodon glutinosus</i> , slimy salamander
7	a Large irregular black spots on a light background extending from head to tip of tail	<i>Ambystoma opacum</i> , marbled salamander
	b No large irregular black spots on a light background	Go to 8
8	a Round spots scattered along back and sides of body, tail flattened like a tadpole	<i>Triturus viridescens</i> , newt
	b Without round spots and tail not flattened like a tadpole	Go to 9
9	a Two dark lines bordering a broad light middorsal stripe with a narrow median dark line extending from the head onto the tail	<i>Eurycea bislineata</i> , two-lined salamander
	b Without two dark lines running the length of the body	Go to 10
10	a A light stripe running the length of the body and bordered by dark pigment extending downward on the sides	<i>Plethodon cinereus</i> , red-backed salamander
	b A light stripe extending the length of the body, a marked constriction at the base of the tail	<i>Hemidactylium scutatum</i> , four-toed salamander