Larry Fodder and the Chalice of Power: Teacher Guide

Subject: Chemistry
Grade Level: High School 10th and 11th Grade

Case Summary

Can Larry elude his bullies and become all-powerful?

A young boy, Larry Fodder, inadvertently stumbles upon an ancient artifact of unimaginable power. The problem is he only has a piece of it and he needs to find the rest. He is hoping that the piece will provide a clue to the location of the Chalice because it does have some interesting stuff on it. If only he could find the cup and drink from it, he could be done with his bullying issues at school.

Credits

This case was written by Lindsay Garcia (Science Teacher, Sprayberry High School, Cobb County, Marietta, GA) and Meena Ganesan (Science Teacher, Stephenson High School, Dekalb County, Stone Mountain, GA). Authors may be contacted at Lindsay.Garcia@cobbk12.org or Meena_Ganesan@fc.dekalb.k12.ga.us

Material in this unit has been accumulated from multiple sources. Some of the material is original and some of the activities have been borrowed.

Lab activity modified from:
Smith, T., Commander, J., Etre, K., & Stein, K. (2013). Salty ceramics lab. Presented at The Science Behind Art Conservation Teacher Workshop, Emory University, July 8-12, 2013.

Learning Objectives

1. Investigate facts in the scenario's problem, formulate a hypothesis and a solution to the problem in the scenario, and connect scenario to real-world uses.
2. Apply concepts of naming rules and correctly identify ions and combine to write chemical formula as well as IUPAC names.
3. Predict ionic compound formulas from ions and deduce ions involved from chemical name.
4. Investigate types of ions involved in compounds and experimentally identify the unknown ions present.
5. Research using academic sources the real-world uses of ionic and covalent compounds as well as salts and identify household sources as well as industrial, medicinal, or technological uses of salts.

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Georgia Performance Standards

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

a. Exhibit the above traits in their own scientific activities.
b. Recognize that different explanations often can be given for the same evidence.
c. Explain that further understanding of scientific problems relies on the design and execution of new experiments, which may reinforce or weaken opposing explanations.

SCSh3. Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.
b. Develop procedures for solving scientific problems.
c. Collect, organize and record appropriate data.
d. Graphically compare and analyze data points and/or summary statistics.
e. Develop reasonable conclusions based on data collected.
f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh6. Students will communicate scientific investigations and information clearly.

a. Write clear, coherent laboratory reports related to scientific investigations.
b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data
c. Use data as evidence to support scientific arguments and claims in written or oral presentations.
d. Participate in group discussions of scientific investigation and current scientific issues.

SC1. Students will analyze the nature of matter and its classifications.

b. Identify substances based on chemical and physical properties.
c. Predict formulas for stable ionic compounds (binary and tertiary) based on balance of charges.

Assessment

- Students will be assessed based on their evaluation of the problem, and participation in a group discussion of the scenario provided at the beginning of the PBL and their thorough completion of the box chart to brainstorm the issue. (Box Chart worksheet located under resources)
- Students will investigate the rules of naming compounds and differences between ionic and covalent compounds by applying the rules while playing games to develop names and chemical formulas.
- Students will be assessed on their accurate investigation and identification of positive test results for certain ions.
- Students will research real-world uses of ionic compounds, covalent compounds, and salts and present the findings to class to broaden everyone's understanding of how these materials are used in various ways.

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Implementation Strategy

Time	Activity	Assessment
Day 1: 1 min 5 mins	• Read Scenario 1 (Note: print and cut the scenarios into separate sheets so that the students do not receive both of them at the same time) • Think-pair-share (think individually, pair with a partner to discuss and come to a consensus, then share with the class) to analyze the facts and questions posed	Student's participation in group discussion
Day 1 cont'd: 1 min 5 mins 10 mins	• Read Scenario 2 • Have students fill in their own box chart • Think-pair-pair-share (think individually, pair with a partner to discuss and come to a consensus, then pair with another couple of two and discuss amongst the four of them and come to a consensus, finally share with the class) to analyze the facts and questions posed	Pose questions such as: • What could this stuff be? • What caused it? • How was it formed? • What could it tell us about the artifact? • How could we investigate it? • What else do we need to know about it?
Day 1 cont'd: 15 mins	• Teacher will show some pictures of ceramics and salts through projector to drive the discussion forward without giving too much information away. Note: PowerPoint from Michael C. Carlos Museum conservators with pics located under camera icon in salts section http://carlos.emory.edu/sites/default/files/misc-pdfs/salts_images.pdf	Students participate in group discussion further analyzing the scenario with more details and turn in their box chart.

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Day 2: 30 mins	• Students perform Part 1 of the Salts Lab (materials provided under resources) • Note: The lab requires ceramic to be prepared approx. 5 days before students conduct this lab in class for salt preparation and drying. It would be beneficial to give some of the lab groups Epsom salt and some Sodium chloride.	Lab Report
Day 2 cont'd: 20 mins	• Lab groups should discuss what ions were found present on the ceramic artifact piece they had. They should then look up where in the world that type of pottery is found so they can figure out where to look for the Chalice of Power. • Map of pottery around the world should be displayed on the board for students to identify their pottery and where it is located (provided in resources and student materials) *Note: Make sure you make it clear that ions are not found in specific locations on Earth. This map is factitious and is created to fit the case. However, conservators and conservation scientists can use the proportion of elements and/or compounds to source material. Clarify to ensure misconceptions are cleared up. Some examples are provided in the resources.	Participation and correct identification of ions and location around the world. Students will submit the ions on their piece and the location of the Chalice.

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Day 3 and 4 As long as you want to spend	• Students, working individually, will go on a scavenger hunt to find chemicals in the world around them and how they are used. They will classify them, label them with chemical formula and name, then research how these compounds are used in the real world. They can then present their findings to the class to broaden our understanding of chemistry in the real world. (Instructions and rubrics provided under student materials)	Rubric at bottom of project instructions in student materials and below

Grading Rubric: For Salts Scavenger Hunt

Project Part	Items Completed	Points
Part 1	2 pts for each label found	_____ / 10
Part 2	10 pts for accurate chemical formulas 10 pts for accurate IUPAC name 10 pts for accurate rules for each type of compound 10 pts for neatness/creativity	_____/ 10 _____/ 10 _____/ 10 _____/ 10 _____/ 40 Total for Part 2
Part 3	10 pts for Where it is found? 10 pts for How it is prepared? 10 pts for How it is used? 10 pts for Importance in industry and society 10 pts for proper writing skills	_____/ 10 _____/ 10 _____/ 10 _____/ 10 _____/ 10 _____/ 50 Total for Part 3

Total Project Grade _____/ 100

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Facilitator Guide

- When looking at the map of pottery, make sure you make it clear that ions are not found in specific locations on Earth and this map is merely showing distribution of cultural pottery and not ions. It is not 100% realistic.

- Bloom's Critical Thinking Cue Questions:

  http://www.curriculuminstitute.org/conference-archives/handouts/CCSSO%20Que%20Questions.pdf

Resources

Sourcing
http://archaeology.about.com/od/skthroughsp/g/sourcing.htm

http://www.geochemicalresearch.com/about-sourc.html

http://www.answers.com/topic/sourcing-archaeological-materials

Pottery Identification – Where should Larry look for the Chalice?

The map below was crumpled into the bottom of the trunk. Larry reconizes that the map shows Europe and the Mediterrean but he has never heard of these cultures.

Some of the symbols written faintly in pencil seem familiar: Mg^{+}, SO_4^{2-}, NO_3^{-}, and Cl^{-}.

Mg^{+} ion: The soil in Fumine contains large amounts of manganese.

SO_4^{2-} ion: The soil in Apiarius contains large amounts of sulphates

NO_3^{-} ion: The soil in Snakeleton contains large amounts of nitrates.

Cl^{-} ion: The soil in Erisedium contains large amounts of clorides.

Depending on which type of ion you identify in the lab, you can figure out which type of pottery the Chalice is and where it will be located.

Use the map below to determine what area of the world and what country you should hunt for the Chalice of Power. Modern country lines have been added for you. Where are you and your expedition team headed on your adventurous search for power? Include this in your lab report conclusion.

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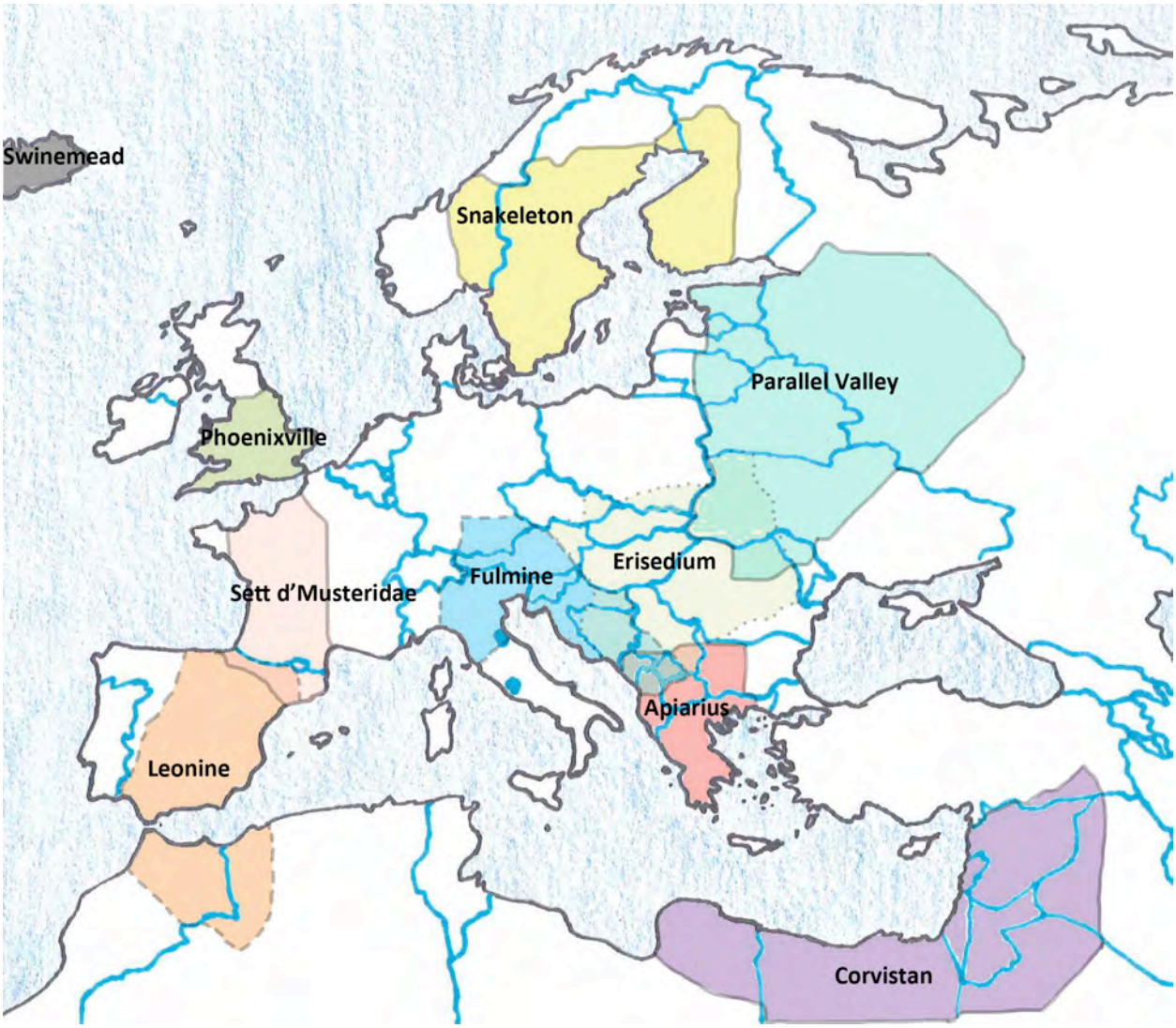

Disclaimer: Ions are not actually distributed across the surface of Earth in this fashion. This idea has been dramatized to fit the story line.

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Larry Fodder and the Chalice of Power: Scene 1

Larry found himself running through the halls of his school desperately trying to get away from two bullies tearing after him. He was running so fast he wasn't sure if his feet would keep up with him. He kept turning down hallways left and right trying to shake the two guys chasing him because he knew what would happen if he were caught and he didn't want to go through that again. At this point, he had made so many turns and hurtled himself through so many random doorways that he was no longer sure where he was or where he was going. All he knew is that the big goofy bullies were running out of steam. Just a few more turns and he would lose them.

All of a sudden he burst through a set of doors and found himself in some sort of steam room. The steam room was huge and went really far back into a cavernous hole so Larry figured he could hide from his pursuers. He ducked behind some machinery just as the two evildoers thrust open the doors. At this point they were out of breath so they just belted out, "you can't hide forever Loser Larry…we'll see you in class tomorrow." And with that the two boys left him alone in the darkness to fret about their next meeting.

As Larry started to come out of hiding from his crouched position, he noticed a box shoved in a corner underneath the radiator. It was shiny and looked out of place so he knew it did not belong there. As he pulled it out he noticed it was more of a treasure chest and wondered what this could be doing here. Of course his curiosity took over and he had to open it. Inside he found a piece of a pottery. "What the heck could this be," Larry thought.

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Larry Fodder and the Chalice of Power: Box Chart 1

Facts: *What we know from the scenario; data; observations?*	**Hypotheses:** *What we think is going on; possible diagnoses; predictions?*
Questions: *What we want to ask to gather more information? Research questions we want to look up? Vocabulary or content questions we can look up on our own?*	**Action Plan:** *What do we need to do to acquire this information? What specific steps need to be taken to figure the problem out and who is responsible for them?*

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Larry Fodder and the Chalice of Power: Scene 2

As Larry looked inside the treasure chest for clues, he noticed there was a recess in the bottom of the chest that something must have set into. It looked like a chalice of some sort, but the cup itself was not there. All that remained of it was a piece of what looked to be an ancient artifact. But on this piece of ceramic he noticed a white, crusty substance that baffled him. He thought it might hold some importance to the mystery of the chalice. Larry realized he stumbled onto something important and it was meant to be so he quickly tucked it into his book bag to investigate later.

It was getting late and he needed to get home. Once home, Larry took another look at the chest and realized there was an inscription on the bottom that read "This chalice shall import the power of Helios to those who imbibe its contents, but be warned…it must not leave it's resting place or thou shalt be doomed." "Hmm…intriguing" thought Larry. "Wonder if that could help me in my current predicament?"

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Larry Fodder and the Chalice of Power: Box Chart 2

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Questions: *What we want to ask to gather more information? Research questions we want to look up? Vocabulary or content questions we can look up on our own?*	**Action Plan:** *What do we need to do to acquire this information? What specific steps need to be taken to figure the problem out and who is responsible for them?*

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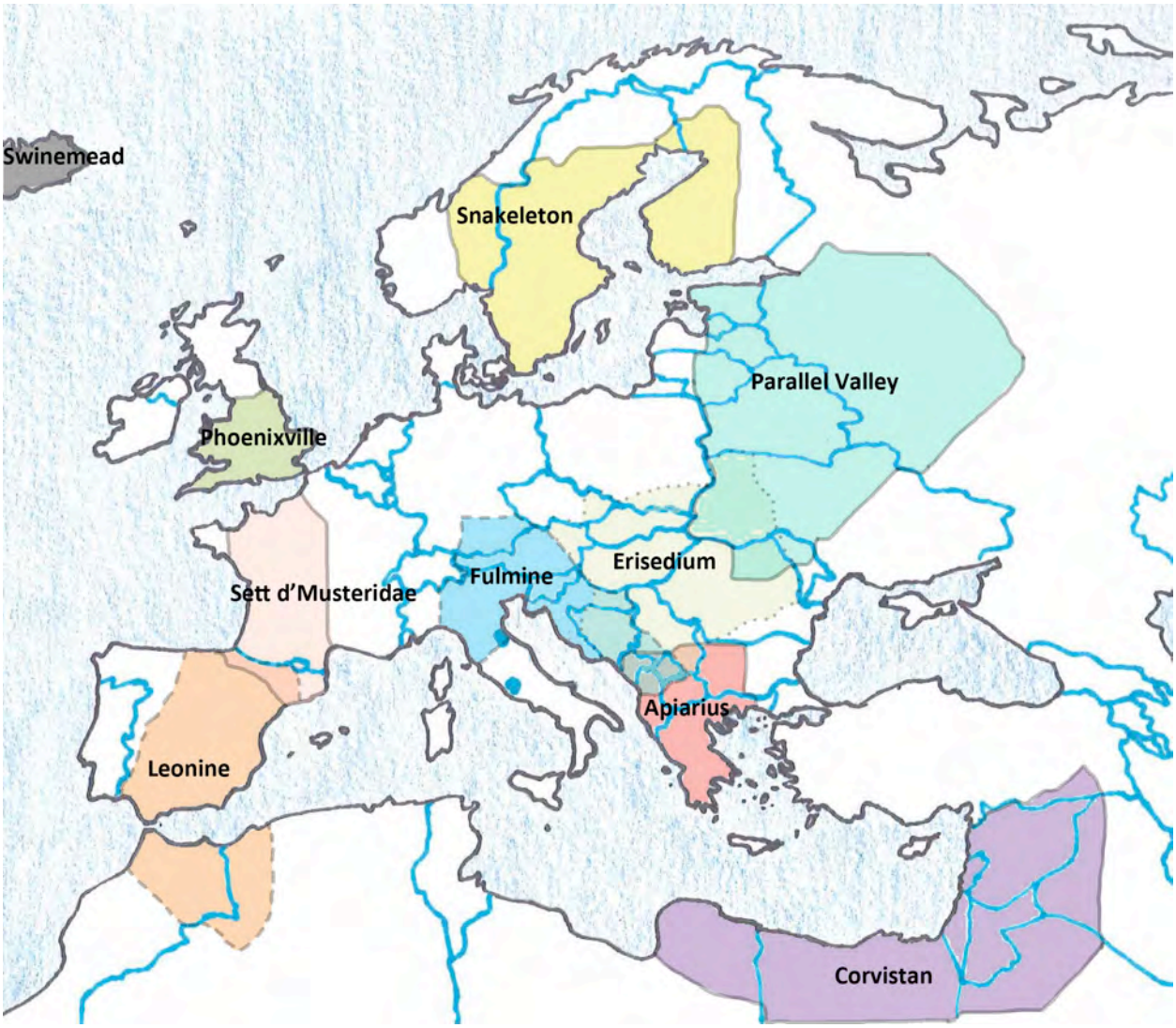

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"We Are Surrounded By Chemical Compounds": Household Labels / Daily Life – Chemical Nomenclature

Each student will be responsible for finding and bringing in labels from household products or items found in daily life whose ingredient lists contain specific types of chemical compounds then researching important uses of these types of compounds in the real world. Try to find at least one household item, which contains the ion(s) discovered in the fragment of the Chalice of Power.

Task: Each person will make a packet (8 ½" x 11" sheets of paper) containing these labels and the specific types of chemical formulas that accompany them. If you have trouble finding items in ingredient lists specifically, or if the item/label is difficult to bring in, you may instead draw the item **OR** edit a digital photograph of the label.

Examples: You might bring in the label from a bottle of Gatorade, draw or take a digital photograph of your shampoo bottle and list of its ingredients, and then ***IDENTIFY*** a chemical compound you know how to write the chemical formula for. Another example is to draw a rusty nail and then listing the rust as "Iron III oxide."

→ Be creative! Don't forget that lots of these compounds are found in daily life, even if they are not in specific products that you buy. People breathe out CO_2 (carbon dioxide), for example; you could draw a person's lungs expelling the gas! **Please use other example than the ones I mentioned so that I know you found them on your own**.

→ This Project Is Broken Down Into 3 Parts: ←

Part 1- Find It: You will bring in labels, drawings, or digital photograph of the following:

- A product containing a Type 1 Binary Ionic Compound
  - → One metal that forms one type of cation + one nonmetal (no polyatomic ion)
- A product containing a Type 2 Binary Ionic Compound
  - → One transition metal (needs cation charge specified) + one nonmetal (no Polyatomic ion)
- A product containing a Binary Covalent Compound
  - → Only two elements, both of which are nonmetals
- A product containing a Polyatomic Ionic Compound
  - → Contains two polyatomic ions ***OR*** one metal + one polyatomic ion ***OR*** One polyatomic ion + one nonmetal
- A product containing a salt
  - → This will say "salt" in an ingredients list.

**** NOTE: your product may use slightly different naming rules. If unsure, check with me! Make sure you use the standard naming system that we have learned in class when you name you compound.**

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Part 2- Label It: For each label or drawing/photograph, you will:

- Identify the type of compound and rules used for naming
- Write the chemical formula and IUPAC nomenclature name and decorate the page for how it is used.
* Note: Be creative and make it look neat and pretty.

Part 3- Research It: Pick an industry that interests you personally (maybe something you want to do as a career or hobby) and research how some ionic or covalent compound or a salt is used in that field. You could find something in medicine, technology, sports, textile, manufacturing new products, etc. Write a one-page paper explaining how it is prepared, where it is found, how it is used in the industry, and how it has impacted society.

You will be graded on the following criteria:

- Ability to correctly categorize the compounds
- Write their names and formulas properly
- Proper explanation of real-world uses of chemicals
- Neatness, organization, and overall presentation of packet

Grading Rubric

Project Part	Items Completed	Points
Part 1	2 pts for each label found	_____ / 10
Part 2	10 pts for accurate chemical formulas 10 pts for accurate IUPAC name 10 pts for accurate rules for each type of compound 10 pts for neatness/creativity	_____/ 10 _____/ 10 _____/ 10 _____/ 10 _____/ 40 Total for Part 2
Part 3	10 pts for Where it is found? 10 pts for How it is prepared? 10 pts for How it is used? 10 pts for Importance in industry and society 10 pts for proper writing skills	_____/ 10 _____/ 10 _____/ 10 _____/ 10 _____/ 10 _____/ 50 Total for Part 3

Total Project Grade _____/ 100

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