Lesson Plan Template

Grade: Secondary (High school)

Subject: Algebra II

Materials: Whiteboard, pen, paper

Technology Needed: Promethean or smartboard

Instructional Strategies:

- ☐ Direct instruction
- ☐ Guided practice
- ☐ Socratic Seminar
- ☐ Learning Centers
- ☐ Lecture
- ☐ Technology integration
- ☐ Other (list)
- ☐ Peer teaching/collaboration/ cooperative learning
- ☐ Visuals/Graphic organizers
- ☐ PBL
- ☐ Discussion/Debate
- ☐ Modeling

Guided Practices and Concrete Application:

- ☐ Large group activity
- ☐ Independent activity
- ☐ Pairing/collaboration
- ☐ Simulations/Scenarios
- ☐ Other (list)
- ☐ Hands-on
- ☐ Technology integration
- ☐ Imitation/Repeat/Mimic

Explain:

Beginning of class will have lecture/ direct instruction. Then we will break apart into table groups where students will discuss the problems collaboratively. In addition, they will often repeat the actions I do on problems to learn them further.

Standard(s) HS. N-CN.1

Objective(s)

The learner will be able to write a real number as a complex number.
The learner will understand the concept of an imaginary and complex number

Bloom's Taxonomy Cognitive Level: Apply, analyze, evaluation, knowledge

Differentiation

Below Proficiency: Students below proficiency know basic terms and phrases involved in doing the problems. However, applying what they know in the physical context of doing a problem is difficult. To achieve equity in the class, these students will be placed with students above proficiency who may be able to guide them in the right direction. Thus, if they have questions there is a stronger chance it will get answered as students above proficiency will most certainly be able to help. I will also check in with these students often. Give them more hints and provide modified homework assignments if necessary.

Above Proficiency:
Students who are above proficiency know all the basic terms and phrases. In addition, they are excellent at solving problems using these terms and phrases. Students who are above proficiency will be paired up with those students who otherwise struggle. This unique opportunity gives them the chance to truly show what they know and gain a deeper understanding. They will also be often called upon to present in front of the class and explain their reasoning.

Approaching/Emerging Proficiency:
These students are fully capable and have shown the ability to do everything in our lessons. However, they commonly make minor errors and sometimes mix up terms with one another. These students will be all paired together. This way they can engage in productive conversation with one another. Additionally, they will be able to pass on ideas to one another. Thus, if someone does not know something their partners may and vice versa. These students will also be called upon to present in front of the class, and may also at times be provided modified homework assignments and be given more hints.

Modalities/Learning Preferences:

Because we are doing math, this lesson leans towards being best suited for kinesthetic and auditory learners. However, there are other elements of the lesson that make it accessible and understandable to others.

Lesson Plan Template

Classroom Management- (grouping(s), movement/transitions, etc.)	**Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)**
Students will be paired up with their table partners. We will move from one activity to the next by me posing the question "Is there any questions at this point." In addition, I will verbalize that we are moving on to the next thing.	Students are expected to follow rules and guidelines as outlined in my classroom rules. The number one rule is to show respect and allow for everyone's thoughts to be heard

Minutes	**Procedures**
5	**Set-up/Prep:** Before class begins, I will have the previous units test set on each student's assigned seat. Once the bell rings, we will be going over any and all questions on the previous exam. If there are any additional questions outside the five minutes I have allotted for this portion I will answer them outside of class, and post my conclusion on the LMS.
12	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** For this portion, I will pose the question:" What is an imaginary number, and what is a complex number?" "Are they any different?" I will allow them to discuss this question with their table partners. If they cannot conclude on a definitive answer, I will allow them to Google the question. From there, once they find an answer we will engage in a deeper discussion. I will then give them the formal definitions for each. A complex number is a number z=a+bi where a,b are real numbers. An imaginary number is a number that can be expressed as the square root of a negative number. Usually the square root of negative 1. I will then go on to explain that a complex number and an imaginary number are not the same thing. However, an imaginary number is one part of a complex number. To further engage the students, I will also give some uses for imaginary and complex numbers, such as electrical engineering. In addition, they can be used to help design airplane wings.
15	**Explain: (concepts, procedures, vocabulary, etc.)** **Example 1:** Write (8)^1/2 as a complex number. 1.) "We know that a complex number has two parts as we discussed." What are those two parts?" 2.) That's right, "The two parts are the real and imaginary part." With the real parts being the integers being a and b. 3.) "Knowing this, how do we write (8)^1/2 as a complex number?" Offer students the chance to give their own ideas for the answer. If they come across the correct answer I will allow them to explain their findings. If not I will answer the question as follows. 4.) We can write it as a complex number like so; (8)^1/2= (8)^1/2+(0)i. 5.) Why can we write it as such?" 6.) We can write it like that because, the rules of multiplying by zero still apply to imaginary numbers. Thus, (8)^1/2+(0)i=(8)^1/2+8=(8)^1/2. 7.) "Is there any questions at this point." **Example 2:** Write -7i as a complex number 1.) "This problem is very similar to the last one. However, the part of the complex number we are given is imaginary." "Knowing this, how do you think we should proceed writing -7i as a complex number?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 2.) "Because we are given the imaginary part, we must have an imaginary part in our answer. Therefore, we have; -7i=0+-7i. " 3.) "We can write it this way, because including any integer for our "a" would result in having -7i+ or - some other integer. This would make our answers unequal " 4.) " is there any questions at this point." **Example 3:** Write 6+(-4)^1/2 as a complex number 1.) "We have 6+(-4)^1/2. Therefore, finding our first term, in our complex number should be simple. What is that number/term?' As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 2.) The number or term for the first part is 6. "However, what do we do with the (-4)^1/2?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 3.) "So, from our definition of an imaginary number, we know (-1)^1/2=i. Thus, how do we write (-4)^1/2 as an imaginary number?' As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 4.) "We can write the (-4)^1/2 as ((-1)(4))^1/2. This can be rewritten as (-1)^1/2(4)^1/2" 5.) "We know that i=(-1)^1/2. This we have i(4)^1/2." 6.) "However, (4)^1/2=2. Thus, we have i2" 7.) "Putting everything together we have 6+2i."

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	8.) "Are there any questions at this point." Now, let's get together with our table partners and work on some questions together.
10	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)** Have the table partners answer two questions. These questions will count as participation points for the day, provided no one misbehaves. The two questions are write the following numbers as complex numbers. 3.4 and -3-(-18)^1/2. Note that the responses to these questions will be used to evaluate the overall effectiveness of a lesson
3	**Review (wrap up and transition to next activity):** **"**Nice work today class." "Let's come to class tomorrow with our assignments done." "Over the night, consider how we would add two separate complex numbers together."

Formative Assessment: (linked to objectives) **Progress monitoring throughout lesson- clarifying questions, check-** Throughout the lesson, many clarifying questions are asked. For instance, I ask "how do we?" on many occasions. Other times, I ask "why can we write it as such?" **in strategies, etc.** **Consideration for Back-up Plan:** In the event that the table group work makes it apparent that the students were struggling. I would redo the lesson changing the examples, and emphasizing the definitions even more.	**Summative Assessment (linked back to objectives)** **End of lesson:** At the end of the lesson, I assign several questions for table groups to go over. The results of them answering those questions serves as a good assessment. In addition, the homework assigned and the unit test and quiz serve as a summative assessment. **If applicable- overall unit, chapter, concept, etc.:** Use the properties and definition of complex numbers and imaginary numbers to add, subtract, multiply and divide complex numbers.

Reflection (What went well? What did the students learn? How do you know? What changes would you make?): NA

Grade: High school	**Subject: Algebra II**
Materials: Pen paper pencil smartboard and whiteboard	**Technology Needed: calculator**
Instructional Strategies: ☐ Direct instruction ☐ Guided practice ☐ Socratic Seminar ☐ Learning Centers ☐ Lecture ☐ Technology integration ☐ Other (list) ☐ Peer teaching/collaboration/ cooperative learning ☐ Visuals/Graphic organizers ☐ PBL ☐ Discussion/Debate ☐ Modeling	**Guided Practices and Concrete Application:** ☐ Large group activity ☐ Independent activity ☐ Pairing/collaboration ☐ Simulations/Scenarios ☐ Other (list) ☐ Hands-on ☐ Technology integration ☐ Imitation/Repeat/Mimic Explain: Beginning of class will have lecture/ direct instruction. Then we will break apart into table groups where students will discuss the problems collaboratively. In addition, they will often repeat the actions I do on problems to learn them further.
Standard(s) HS.N-CN.2	**Differentiation** **Below Proficiency:** Students below proficiency know basic terms and phrases involved in doing the problems. However, applying what they know in the physical context of doing a problem is difficult. To achieve equity in the class, these students will be placed with students above proficiency who may be able to guide

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Objective(s)
The learner will be able to apply properties of complex numbers to add and subtract complex numbers.
The learner will apply previous knowledge learned to a new concept.

Bloom's Taxonomy Cognitive Level: Apply, analyze, evaluation, knowledge

them in the right direction. Thus, if they have questions there is a stronger chance it will get answered as students above proficiency will most certainly be able to help. I will also check in with these students often. Give them more hints and provide modified homework assignments if necessary.

Above Proficiency:
Students who are above proficiency know all the basic terms and phrases. In addition, they are excellent at solving problems using these terms and phrases. Students who are above proficiency will be paired up with those students who otherwise struggle. This unique opportunity gives them the chance to truly show what they know and gain a deeper understanding. They will also be often called upon to present in front of the class and explain their reasoning.

Approaching/Emerging Proficiency:
These students are fully capable and have shown the ability to do everything in our lessons. However, they commonly make minor errors and sometimes mix up terms with one another. These students will be all paired together. This way they can engage in productive conversation with one another. Additionally, they will be able to pass on ideas to one another. Thus, if someone does not know something their partners may and vice versa. These students will also be called upon to present in front of the class, and may also at times be provided modified homework assignments and be given more hints.

Modalities/Learning Preferences:
Because we are doing math, this lesson leans towards being best suited for kinesthetic and auditory learners. However, there are other elements of the lesson that make it accessible and understandable to others.

Classroom Management- (grouping(s), movement/transitions, etc.)
Students will be paired up with their table partners. We will move from one activity to the next by me posing the question "Is there any questions at this point." In addition, I will verbalize that we are moving on to the next thing.

Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)

Students are expected to follow rules and guidelines as outlined in my classroom rules. The number one rule is to show respect and allow for everyone's thoughts to be heard. When moving from lecture to table work they are expected to be quiet and contribute to their table.

Minutes	Procedures
5	**Set-up/Prep:** Here, I will post previous days questions on the projector, if there are any questions at this time, I will address them. Any additional questions outside this time will be addressed and answered on the LMS.
7	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** **"**Yesterday before class finished, I asked you how you thought we would add complex numbers." "Does anyone have any ideas how we would do that?" Say we had add z+w when z=12+8i and w=9+7i If someone has an idea of how to solve the problem I will give them a chance to answer it on the whiteboard. If they get it right, we will move on to example 1. However, if they do not I will go through and do it. Showing them we just add our like terms together.

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Explain: (concepts, procedures, vocabulary, etc.)

Example 1: Add z+w when z=2+i7 and w=4+i9.

1.) "First, we add our real parts together. These are our like terms. Very similar to when we add like terms together when adding and subtracting equations."
2.) Thus, we can add our 2 and 4 together to get 6. Next, we add our i9 and i7 together to get 16i.
3.) Combining everything together we get z+w=6+16i.
4.) "Are there any questions at this time?"

Example 2: Find z-w when z=4-8i and w=9+3i

5.) "As before, we need to combine our like terms." "Thus, what should we combine for the real parts?"
As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further.
6.) "That is correct, we must combine 4 and 9. Because our operation is subtraction we have 4-9 to get -5."
7.) "Now, what should we combine in terms of our imaginary part?"
As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further.
8.) "We must combine -8i and 3i. Because we are subtracting we have -8i-3i we have -11i."
9.) "Combining everything together, we have -5-11i=z-w."
10.) "Are there any questions at this time?"

Example 3: Now let's add something a little harder. (z+w)-(z-w) when z=2+3i and w=4+4i

1.) "We must follow pemdas, therefore we must do what is in parentheses first. For us we will start (z+w)."
2.) "Combining like terms of both our real and imaginary parts as above, we have 2+4 and 3i+4i."
3.) "This gives us 6+7i."
4.) "Now we must do z-w."
5.) "Combining like terms of both our real and imaginary parts as above, we have 2-4 and 3i-4i."
6.) "This yields (z-w)=-2-1i.
7.) "Now we must subtract the two parts."
8.) "We have 6+7i—2-i."
9.) "Combining like terms as above, we have -4+8i."
10.) "Are there any questions at this time?"

"Ok, class lets break apart into our table groups now."

10

Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)

Here, I will post three problems on the board. One each of z+w, z-w and (z+w)+(w-z). Where z=2-4i and w=8-3i.

Groups will answer these questions individually, and if they have any questions they will ask me. Once they have answered the problems, they will place them in the hw tray, to get participation points for the day.
The remaining time before our wrap up will be homework time for the students. They are able to come up to my desk with any and all questions they may have. I expect hw time to be a collaborative time, without people simply giving away answers.

3

Review (wrap up and transition to next activity):

"Ok class, today we worked on adding and subtracting complex numbers. We used the same properties we used to add and subtract equalities. We simply combine like terms and put everything together."

Formative Assessment: (linked to objectives)

Progress monitoring throughout lesson- clarifying questions, check- Throughout the lesson, many clarifying questions are asked. For instance, I ask "how do we?" on many occasions. Other times, I ask "why can we write it as such?"

in strategies, etc.

Consideration for Back-up Plan: If the end of the lesson group work/ table groups show it, I will reteach the lesson. Instead, I will use more examples to equalities. In addition, I will revisit the previous days lesson. I will show how complex numbers have two parts, just like equalities have two parts (a variable and a constant).

Summative Assessment (linked back to objectives)

End of lesson:
At the end of the lesson, I assign several questions for table groups to go over. The results of them answering those questions serves as a good assessment. In addition, the homework assigned and the unit test and quiz serve as a summative assessment.

If applicable- overall unit, chapter, concept, etc.: Use the properties and definition of complex numbers and imaginary numbers to add, subtract, multiply and divide complex numbers.

Reflection (What went well? What did the students learn? How do you know? What changes would you make?):

Lesson Plan Template

Grade: High school	**Subject: Algebra II**
Materials: Pen, paper pencil whiteboard smartboard	**Technology Needed: smartboard**
Instructional Strategies: ☒ Direct instruction ☐ Guided practice ☐ Socratic Seminar ☐ Learning Centers ☒ Lecture ☐ Technology integration ☐ Other (list) ☒ Peer teaching/collaboration/ cooperative learning ☐ Visuals/Graphic organizers ☐ PBL ☒ Discussion/Debate ☐ Modeling	**Guided Practices and Concrete Application:** ☐ Large group activity ☒ Independent activity ☐ Pairing/collaboration ☐ Simulations/Scenarios ☐ Other (list) ☐ Hands-on ☐ Technology integration ☐ Imitation/Repeat/Mimic Explain: Beginning of class will have lecture/ direct instruction. Then we will break apart into table groups where students will discuss the problems collaboratively. In addition, they will often repeat the actions I do on problems to learn them further.
Standard(s) HS.N-CN.2	**Differentiation** **Below Proficiency:** Students below proficiency know basic terms and phrases involved in doing the problems. However, applying what they know in the physical context of doing a problem is difficult. To achieve equity in the class, these students will be placed with students above proficiency who may be able to guide them in the right direction. Thus, if they have questions there is a stronger chance it will get answered as students above proficiency will most certainly be able to help. I will also check in with these students often. Give them more hints and provide modified homework assignments if necessary. **Above Proficiency:** Students who are above proficiency know all the basic terms and phrases. In addition, they are excellent at solving problems using these terms and phrases. Students who are above proficiency will be paired up with those students who otherwise struggle. This unique opportunity gives them the chance to truly show what they know and gain a deeper understanding. They will also be often called upon to present in front of the class and explain their reasoning. **Approaching/Emerging Proficiency:** These students are fully capable and have shown the ability to do everything in our lessons. However, they commonly make minor errors and sometimes mix up terms with one another. These students will be all paired together. This way they can engage in productive conversation with one another. Additionally, they will be able to pass on ideas to one another. Thus, if someone does not know something their partners may and vice versa. These students will also be called upon to present in front of the class, and may also at times be provided modified homework assignments and be given more hints. **Modalities/Learning Preferences:** Because we are doing math, this lesson leans towards being best suited for kinesthetic and auditory learners. However,
Objective(s) The learner will be able to use properties of complex numbers to multiply complex numbers together **Bloom's Taxonomy Cognitive Level:** Apply, analyze, evaluation, knowledge	

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	there are other elements of the lesson that make it accessible and understandable to others.
Classroom Management- (grouping(s), movement/transitions, etc.) Students will be paired up with their table partners. We will move from one activity to the next by me posing the question "is there any questions at this point." In addition, I will verbalize that we are moving on to the next thing.	**Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)** Students are expected to follow rules and guidelines as outlined in my classroom rules. The number one rule is to show respect and allow for everyone's thoughts to be heard. When moving from lecture to table work they are expected to be quiet and contribute to their table.

Minutes	Procedures
5	**Set-up/Prep:** Post previous days homework answers and ensure all materials are ready for the lesson. Any questions from the previous days homework will be answered at this time. Any additional questions outside this time will be answered on the LMS.
7	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** "How do we multiply complex numbers together?" "How would we multiply (3-7i)(4-8i)? As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. If the students reach the answer I will have them explain it in front of the class. If not I will solve it getting an answer of 23-52i+56i^2=-33-52i
20	**Explain: (concepts, procedures, vocabulary, etc.)** **Example 1:** Multiply (7+4i)(3-2i) 1.) "As like everything before, multiplying complex numbers is the same as multiplying something like (x+4)(x-4), we simply distribute." 2.) "Therefore, we distribute the 7 to the 3 and -2i and the 4i to the 3 and -2i. 3.) "What do we get as a result?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 4.) "That's right, we get 21-14i+12i-8i^2" 5.) "What do we get as a result?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 6.) "However, we have i^2 and we need to write the result in the form a+bi. Does anyone know what i^2=?" 7.) "Yes, because i=(-1)^1/2. Then i^2=-1. 8.) "As a result, we have 21-2i+8. Which can be rewritten as 29-2i." 9.) "Are there any questions at this point." **Example 2:** Multiply (2-8i)(3+4i) 10.) "We start by foiling." "What do we get as a result?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 11.) "foiling we get 6+8i-24i-32i^2. 12.) "Applying i^2=-1. We get 6-16i+32." 13.) "This gets us 38-16i." 14.) "Are there any questions at this point?" **Example 3:** First, add 7+8i and -3-4i. Then take that answer and multiply it by the complex number 5+2i. 15.) Using the skills from the previous says, we will add 7+8i and -3-4i." 16.) "This gets us 4+4i. Now we need to multiply this number by 5+2i. So we have (5+2i)(4+4i) 17.) "We now do this the same as the previous examples." "How do we start this part of the problem?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 18.) "That's right, we foil. After foiling we get 20+20i+8i+8i^2." 19.) "Now what do we do?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 20.) "We combine our like terms and rewrite 8i^2 as -8. Then, we have 12+28i." 21.) "Are there any questions at this point?" "Let's break apart into our groups right now and work on two problems."
13	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)**

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	Solve (4-3i)(1-9i) and (8+7i)(2-4i) Groups will answer these questions individually, and if they have any questions they will ask me. Once they have answered the problems, they will place them in the hw tray, to get participation points for the day. The remaining time before our wrap up will be homework time for the students. They are able to come up to my desk with any and all questions they may have. I expect hw time to be a collaborative time, without people simply giving away answers.
5	**Review (wrap up and transition to next activity):** "Ok class, today we multiplied complex numbers with one another. We noticed how multiplying complex numbers is very similar to multiplying (x+8)(x-9). We start by foiling and then we combine like terms in addition we write i^2 as-1."

Formative Assessment: (linked to objectives) **Progress monitoring throughout lesson- clarifying questions, check-in strategies, etc.** Throughout the lesson, many clarifying questions are asked. For instance, I ask "how do we?" on many occasions. **Consideration for Back-up Plan:** In the event this lesson is not understood, we could reform table groups so each table has one student that has a grasp on the lesson. Then, we can have peer teaching occur for several more examples. Hopefully, this allows for there to be more "teachers" in the class to address any and all questions anyone may have.	**Summative Assessment (linked back to objectives)** **End of lesson:** At the end of the lesson, I assign several questions for table groups to go over. The results of them answering those questions serves as a good assessment. In addition, the homework assigned and the unit test and quiz serve as a summative assessment. **If applicable- overall unit, chapter, concept, etc.:** Use the properties and definition of complex numbers and imaginary numbers to add, subtract, multiply and divide complex numbers.

Reflection (What went well? What did the students learn? How do you know? What changes would you make?):

Grade: High school	**Subject: Algebra II**
Materials: Pen, paper pencil	**Technology Needed: Smart Board/ promethean board**
Instructional Strategies: ☐ Direct instruction ☐ Guided practice ☐ Socratic Seminar ☐ Learning Centers ☐ Lecture ☐ Technology integration ☐ Other (list) ☐ Peer teaching/collaboration/ cooperative learning ☐ Visuals/Graphic organizers ☐ PBL ☐ Discussion/Debate ☐ Modeling	**Guided Practices and Concrete Application:** ☐ Large group activity ☐ Independent activity ☐ Pairing/collaboration ☐ Simulations/Scenarios ☐ Other (list) ☐ Hands-on ☐ Technology integration ☐ Imitation/Repeat/Mimic Explain: Beginning of class will have lecture/ direct instruction. Then we will break apart into table groups where students will discuss the problems collaboratively. In addition, they will often repeat the actions I do on problems to learn them further.
Standard(s) HS. N-CN.2 **Objective(s)**	**Differentiation** **Below Proficiency:** Students below proficiency know basic terms and phrases involved in doing the problems. However, applying what they know in the physical context of doing a problem is difficult. To achieve equity in the class, these students will be placed with students above proficiency who may be able to guide them in the right direction. Thus, if they have questions there is a stronger

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The learner will be able to use properties of complex numbers to multiply complex numbers together **Bloom's Taxonomy Cognitive Level:** Apply, analyze, evaluation, knowledge	chance it will get answered as students above proficiency will most certainly be able to help. I will also check in with these students often. Give them more hints and provide modified homework assignments if necessary. **Above Proficiency:** Students who are above proficiency know all the basic terms and phrases. In addition, they are excellent at solving problems using these terms and phrases. Students who are above proficiency will be paired up with those students who otherwise struggle. This unique opportunity gives them the chance to truly show what they know and gain a deeper understanding. They will also be often called upon to present in front of the class and explain their reasoning. **Approaching/Emerging Proficiency:** These students are fully capable and have shown the ability to do everything in our lessons. However, they commonly make minor errors and sometimes mix up terms with one another. These students will be all paired together. This way they can engage in productive conversation with one another. Additionally, they will be able to pass on ideas to one another. Thus, if someone does not know something their partners may and vice versa. These students will also be called upon to present in front of the class, and may also at times be provided modified homework assignments and be given more hints. **Modalities/Learning Preferences:** Because we are doing math, this lesson leans towards being best suited for kinesthetic and auditory learners. However, there are other elements of the lesson that make it accessible and understandable to others.
Classroom Management- (grouping(s), movement/transitions, etc.) Students will be paired up with their table partners. We will move from one activity to the next by me posing the question " is there any questions at this point." In addition, I will verbalize that we are moving on to the next thing.	**Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)** Students are expected to follow rules and guidelines as outlined in my classroom rules. The number one rule is to show respect and allow for everyone's thoughts to be heard. When moving from lecture to table work they are expected to be quiet and contribute to their table.

Minutes	Procedures
5	**Set-up/Prep:** Post previous days homework answers and ensure all materials are ready for the lesson. Any questions from the previous days homework will be answered at this time. Any additional questions outside this time will be answered on the LMS.
7	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** "Yesterday we multiplied two complex numbers with one another. As a consequence of multiplying three complex numbers we will have to deal with i^3. What do you think i^3 is?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. "As we know, i^2=-1. However, as a consequence of this, i^3=-i. This will come in handy when we multiply three complex numbers together."
15	**Explain: (concepts, procedures, vocabulary, etc.)** **Example 1:** Multiply (2+3i)(3+3i)(4-2i) 1.) First, we start by multiplying and foiling (2+3i)(3+3i)." 2.) "This gets 6+6i+9i+9i^2. " 3.) "Now we multiply (6+15i+9i^2)(4-2i). 4.) "We foil this the same to get" 5.) 24-12i+60i-30i-18i^3. 6.) "Now, what do we do with the -18i^3?"

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	As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 7.) "As we know from the bell ringer question, i^3=-i. Thus, -18i^3 =18i" 8.) "As a result, combining like terms we get; 24+36i." "Are there any questions at this point?" **Example 2:** 1.) Multiply (3+4i)^2(2-i). 2.) "We will start by squatting (3+4i)." 3.) "We know this is 9+24i+16i^2." 4.) "Now, multiply (9+24i+16i^2)(2-i)." 5.) "Foil as normal. What do you get?" As before I will give some time for the students to arrive at the correct answer. 6.) "That is right, we get (18-9i+48i-24i-16i^3). Using i^3=-I and combining like terms we get. 18+31i. "Are there any questions at this point?"
18	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)** Here I will post two problems on the board. Multiply (2+2i)(3-2i)(4+3i) and (4+i)(3-i)(3+i). They will hand them in when they are done and I will use their responses to assess the effectiveness of the lesson. The responses they hand in will be used as a participation grade for the day. The remainder of the time will be used to allow students time to do their homework and ask any questions we may have.
5	**Review (wrap up and transition to next activity):** "Ok today we worked on multiplying complex numbers again. However, today we learned how to multiply three complex numbers together. We also learned that i^3=-i.

Formative Assessment: (linked to objectives) **Progress monitoring throughout lesson- clarifying questions, check-in strategies, etc.** Throughout the lesson, many clarifying questions are asked. For instance, I ask "how do we?" on many occasions. We also will have students attempt to answer questions on their own throughout the lesson. When they think they have the right answer, they are allowed to attempt it up front on the board. **Consideration for Back-up Plan:** If necessary, we will have them only multiply two complex numbers using a lesson similar to the previous days. In addition, they will be given fewer homework problems than originally assigned.	**Summative Assessment (linked back to objectives)** **End of lesson:** At the end of the lesson, I assign several questions for table groups to go over. The results of them answering those questions serves as a good assessment. In addition, the homework assigned and the unit test and quiz serve as a summative assessment. **If applicable- overall unit, chapter, concept, etc.:** Use the properties and definition of complex numbers and imaginary numbers to add, subtract, multiply and divide complex numbers.
Reflection (What went well? What did the students learn? How do you know? What changes would you make?):	

Grade: High School	**Subject: Algebra II**
Materials: Pen, paper, pencils whiteboard	**Technology Needed: Smartboard**
Instructional Strategies: ☐ Direct instruction ☐ Guided practice ☐ Socratic Seminar ☐ Learning Centers ☐ Lecture ☐ Peer teaching/collaboration/ cooperative learning ☐ Visuals/Graphic organizers ☐ PBL ☐ Discussion/Debate ☐ Modeling	**Guided Practices and Concrete Application:** ☐ Large group activity ☐ Independent activity ☐ Pairing/collaboration ☐ Simulations/Scenarios ☐ Other (list) Explain: ☐ Hands-on ☐ Technology integration ☐ Imitation/Repeat/Mimic

Lesson Plan Template

□ Technology integration □ Other (list)	Beginning of class will have lecture/ direct instruction. Then we will break apart into table groups where students will discuss the problems collaboratively. In addition, they will often repeat the actions I do on problems to learn them further.
Standard(s) HS.N-CN.3 Use conjugates to find quotients of complex numbers.	**Differentiation** **Below Proficiency:** Students below proficiency know basic terms and phrases involved in doing the problems. However, applying what they know in the physical context of doing a problem is difficult. To achieve equity in the class, these students will be placed with students above proficiency who may be able to guide them in the right direction. Thus, if they have questions there is a stronger chance it will get answered as students above proficiency will most certainly be able to help. I will also check in with these students often. Give them more hints and provide modified homework assignments if necessary. **Above Proficiency:** Students who are above proficiency know all the basic terms and phrases. In addition, they are excellent at solving problems using these terms and phrases. Students who are above proficiency will be paired up with those students who otherwise struggle. This unique opportunity gives them the chance to truly show what they know and gain a deeper understanding. They will also be often called upon to present in front of the class and explain their reasoning. **Approaching/Emerging Proficiency:** These students are fully capable and have shown the ability to do everything in our lessons. However, they commonly make minor errors and sometimes mix up terms with one another. These students will be all paired together. This way they can engage in productive conversation with one another. Additionally, they will be able to pass on ideas to one another. Thus, if someone does not know something their partners may and vice versa. These students will also be called upon to present in front of the class, and may also at times be provided modified homework assignments and be given more hints. **Modalities/Learning Preferences:** Because we are doing math, this lesson leans towards being best suited for kinesthetic and auditory learners. However, there are other elements of the lesson that make it accessible and understandable to others.
Objective(s) The learner will be able to use conjugates to divide complex numbers. The learner will be able to multiply complex numbers together. **Bloom's Taxonomy Cognitive Level:** Apply, analyze, evaluation, knowledge	
Classroom Management- (grouping(s), movement/transitions, etc.) Students will be paired up with their table partners. We will move from one activity to the next by me posing the question " is there any questions at this point." In addition, I will verbalize that we are moving on to the next thing.	**Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)** Students are expected to follow rules and guidelines as outlined in my classroom rules. The number one rule is to show respect and allow for everyone's thoughts to be heard. When moving from lecture to table work they are expected to be quiet and contribute to their table.

Minutes	Procedures
5	**Set-up/Prep:** Post previous days homework answers and ensure all materials are ready for the lesson. Any questions from the previous days homework will be answered at this time. Any additional questions outside this time will be answered on the LMS.
7	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** In the past, we have multiplied, added and subtracted complex numbers. However, how do we divide complex numbers?" Remember we have to write it in the form a+bi As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further I do not expect them to know about the conjugate so I will explain it here. "a complex conjugate is the number with an equal real part and an imaginary part equal in magnitude but opposite in sign."

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	"You may be wondering where the complex conjugate comes into play, and I will show you here shortly.**"**
15	**Explain: (concepts, procedures, vocabulary, etc.)** **Example 1: Find 1/z if z=(4-3i)** 1.) "We have 1/(4-3i) However, we cannot multiply by (4-3i) because that keeps the denominator with a complex number." "What do you think we should do then?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 2.) That's right, we can use the complex conjugate. When we multiply the complex conjugate we have; 1/(4-3i) x (4+3i)/(4+3i). 3.) " Here we use skills learned when multiplying complex conjugates. Thus, tell me what we get? Remember to multiply the numerator and denominator." As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 4.) That's right, we have (4+3i)/16+9i^2) However, we know i^2=-1. 5.) "Thus, we have (4+3i)/16+9) Which can be rewritten as (4+3i)/7. 6.) "Now, as you may see, we can rewrite it as (4/7)+(3i/7). "Are there any questions at this point?" Example 2: Find 1/w when w= 9-3i 1.) 1/(9-3i). What is the complex conjugate of (9-3i)?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 2.) "The complex conjugate of (9-3i) is (9+3i). This is because we keep the real part the same, and change the sign of the imaginary part. 3.) "Thus, we have 1/(9-3i) x (9+3i)/(9+3i)." 4.) "Multiplying our complex numbers together we get; (9+3i)/(81-9i^2. However, remember i^2=-1. " 5.) "Therefore, we have (9+3i)/(90). This gets us 1/10+1/30(i) "Are there any questions at this point?" Example 3: find i/w when w=3+2i 1.) Here our complex conjugate is (3-2i). Therefore, we have 1/(3+2i) x (3-2i)/(3-2i) 2.) "Therefore, we have (3+2i)/(9-4i^2) 3.) Remembering that i^2=-1 we have (3+2i)/(13)." 4.) "This leaves us with (3/13)+(2i/13). "Are there any questions at this point?"
18	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)** Here I will post two problems on the board. Find 1/z when z=7-I and 1/w when w=4-2i. They will hand them in when they are done and I will use their responses to assess the effectiveness of the lesson. The responses they hand in will be used as a participation grade for the day. The remainder of the time will be used to allow students time to do their homework and ask any questions we may have.
5	**Review (wrap up and transition to next activity):** **"**Today, we worked on dividing complex numbers. We used complex conjugates to find the answer and to be able to write it in a+bi. In addition, we also used several skills we have been working on for a while. For instance, multiplying complex numbers and combining their like terms."

Formative Assessment: (linked to objectives) **Progress monitoring throughout lesson- clarifying questions, check- in strategies, etc.** Throughout the lesson, many clarifying questions are asked. For instance, I ask "how do we?" on many occasions. We also will have students attempt to answer questions on their own throughout the lesson. When they think they have the right answer, they are allowed to attempt it up front on the board. **Consideration for Back-up Plan:**	**Summative Assessment (linked back to objectives)** **End of lesson:** At the end of the lesson, I assign several questions for table groups to go over. The results of them answering those questions serves as a good assessment. In addition, the homework assigned and the unit test and quiz serve as a summative assessment. In addition, the quiz and test they will take later are also an assessment. **If applicable- overall unit, chapter, concept, etc.:** Use the properties and definition of complex numbers and imaginary numbers to add, subtract, multiply and divide complex numbers.

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If necessary, we will skip the homework part of this assignment and simply continue practicing problems. This way, we can continue to develop the skills necessary to do this. Furthermore, we can have them break apart into table groups with each group having a student who understands the lesson content well.	

Reflection (What went well? What did the students learn? How do you know? What changes would you make?):

Grade: High School	**Subject: Algebra II**
Materials: Pen, paper, pencil whiteboard	**Technology Needed: Smartboard**

Instructional Strategies:

- ☐ Direct instruction
- ☐ Guided practice
- ☐ Socratic Seminar
- ☐ Learning Centers
- ☐ Lecture
- ☐ Technology integration
- ☐ Other (list)
- ☐ Peer teaching/collaboration/ cooperative learning
- ☐ Visuals/Graphic organizers
- ☐ PBL
- ☐ Discussion/Debate
- ☐ Modeling

Guided Practices and Concrete Application:

- ☐ Large group activity
- ☐ Independent activity
- ☐ Pairing/collaboration
- ☐ Simulations/Scenarios
- ☐ Other (list)
- ☐ Hands-on
- ☐ Technology integration
- ☐ Imitation/Repeat/Mimic

Explain:
Beginning of class will have lecture/ direct instruction. Then we will break apart into table groups where students will discuss the problems collaboratively. In addition, they will often repeat the actions I do on problems to learn them further.

Standard(s)

HS.N-CN.3 Use conjugates to find quotients of complex numbers.

Objective(s)

The learner will be able to divide complex numbers. The learner will be able to use properties of multiplying complex numbers to divide complex numbers.

Bloom's Taxonomy Cognitive Level: Apply, analyze, evaluation, knowledge

Differentiation

Below Proficiency: Students below proficiency know basic terms and phrases involved in doing the problems. However, applying what they know in the physical context of doing a problem is difficult. To achieve equity in the class, these students will be placed with students above proficiency who may be able to guide them in the right direction. Thus, if they have questions there is a stronger chance it will get answered as students above proficiency will most certainly be able to help. I will also check in with these students often. Give them more hints and provide modified homework assignments if necessary.

Above Proficiency:
Students who are above proficiency know all the basic terms and phrases. In addition, they are excellent at solving problems using these terms and phrases. Students who are above proficiency will be paired up with those students who otherwise struggle. This unique opportunity gives them the chance to truly show what they know and gain a deeper understanding. They will also be often called upon to present in front of the class and explain their reasoning.

Approaching/Emerging Proficiency:
These students are fully capable and have shown the ability to do everything in our lessons. However, they commonly make minor errors and sometimes mix up terms with one

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	another. These students will be all paired together. This way they can engage in productive conversation with one another. Additionally, they will be able to pass on ideas to one another. Thus, if someone does not know something their partners may and vice versa. These students will also be called upon to present in front of the class, and may also at times be provided modified homework assignments and be given more hints. **Modalities/Learning Preferences:** Because we are doing math, this lesson leans towards being best suited for kinesthetic and auditory learners. However, there are other elements of the lesson that make it accessible and understandable to others.
Classroom Management- (grouping(s), movement/transitions, etc.) Students will be paired up with their table partners. We will move from one activity to the next by me posing the question " is there any questions at this point." In addition, I will verbalize that we are moving on to the next thing.	**Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)** Students are expected to follow rules and guidelines as outlined in my classroom rules. The number one rule is to show respect and allow for everyone's thoughts to be heard. When moving from lecture to table work they are expected to be quiet and contribute to their table.

Minutes	Procedures
5	Post previous days homework answers and ensure all materials are ready for the lesson. Any questions from the previous days homework will be answered at this time. Any additional questions outside this time will be answered on the LMS.
7	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** "How do we divide (8-3i)/(4+2i)? Solve it on your own. We will go over answers., As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. That's correct, our answer is (8-3i)/(4+2i) x (4-2i)/(4-2i) Which gives us (32-16i-12i-4i^2/ (16-4i^2) Therefore, we have (36-28i)/20.
15	**Explain: (concepts, procedures, vocabulary, etc.)** **Example 1: (7-i)/(2-i)** **1.) "**Our complex conjugate in this case is 2+I, because we always use the denominator to find the conjugate. 2.) "Therefore, we have : (7-i)/(2-i) x(2+i)/(2+i) 3.) "Multiplying the same way we have, we get what?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. **4.)** "We get (14+7i-2i-i^2)/(4-i^2)." **5.) "**We can rewrite this as (15+5i)/5. Which equals 3+(5/3)I" "Are there any questions at this time?" **Example 2:** (3+i)/(2+2i) 1.) "What is our complex conjugate for this problem?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further 2.) Our complex conjugate is 2-2i. 3.) "That leaves us with (3+i)/(2+2i) x(2-2i)/(2-2i)." 4.) "Using rules of multiplication, we have (6-6i+2i-8i^2)/(4-4i^2) 5.) "Combining like terms and using i^2=-1 we have what?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. **6.)** "This leaves us with (8-4i)/8. Which can be rewritten as 1-(1/2)i. "Are there any questions at this time?" "Now break apart into your table groups to earn some points."
18	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)** Here I will post two problems on the board. Find(7-i)/(3+i) and (4-3i)/(1+i). They will hand them in when they are done and I will use their responses to assess the effectiveness of the lesson. The responses they hand in will be used as a participation grade for the day.

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	The remainder of the time will be used to allow students time to do their homework and ask any questions we may have.
5	**Review (wrap up and transition to next activity):** Today, we continued to divide complex numbers. We used many of the same skills we used yesterday. However, we also used the fact that our denominator is what we use to find the complex conjugate.

Formative Assessment: (linked to objectives)
Progress monitoring throughout lesson- clarifying questions, check-in strategies, etc.

Throughout the lesson, many clarifying questions are asked. For instance, I ask "how do we?" on many occasions.
We also will have students attempt to answer questions on their own throughout the lesson. When they think they have the right answer, they are allowed to attempt it up front on the board.

Consideration for Back-up Plan:

If necessary, we will skip the homework part of this assignment and simply continue practicing problems. This way, we can continue to develop the skills necessary to do this. Furthermore, we can have them break apart into table groups with each group having a student who understands the lesson content well.

Summative Assessment (linked back to objectives)
End of lesson:

At the end of the lesson, I assign several questions for table groups to go over. The results of them answering those questions serves as a good assessment. In addition, the homework assigned and the unit test and quiz serve as a summative assessment.

If applicable- overall unit, chapter, concept, etc.: Use the properties and definition of complex numbers and imaginary numbers to add, subtract, multiply and divide complex numbers

Reflection (What went well? What did the students learn? How do you know? What changes would you make?):

Grade: High School	**Subject: Algebra II**
Materials: Pen paper pencil and whiteboard	**Technology Needed:** Smartboard and computer
Instructional Strategies: ☐ Direct instruction ☐ Guided practice ☐ Socratic Seminar ☐ Learning Centers ☐ Lecture ☐ Technology integration ☐ Other (list) ☐ Peer teaching/collaboration/ cooperative learning ☐ Visuals/Graphic organizers ☐ PBL ☐ Discussion/Debate ☐ Modeling	**Guided Practices and Concrete Application:** ☐ Large group activity ☐ Independent activity ☐ Pairing/collaboration ☐ Simulations/Scenarios ☐ Other (list) ☐ Hands-on ☐ Technology integration ☐ Imitation/Repeat/Mimic Explain: Beginning of class will have lecture/ direct instruction. Then we will break apart into table groups where students will discuss the problems collaboratively. In addition, they will often repeat the actions I do on problems to learn them further.
Standard(s) HS.N-CN.2 Use the definition $i2 = –1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.	**Differentiation** **Below Proficiency:** Students below proficiency know basic terms and phrases involved in doing the problems. However, applying what they know in the physical context of doing a problem is difficult. To achieve equity in the class, these students will be placed with students above proficiency who may be able to guide them in the right direction. Thus, if they have questions there is a stronger chance it will get answered as students above proficiency will most certainly be able to help. I will also check in with these students often. Give them more hints and provide modified homework assignments if necessary.

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Objective(s) The learner will use properties of i to multiply complex numbers together. **Bloom's Taxonomy Cognitive Level:** Apply, analyze, evaluation, knowledge	**Above Proficiency:** Students who are above proficiency know all the basic terms and phrases. In addition, they are excellent at solving problems using these terms and phrases. Students who are above proficiency will be paired up with those students who otherwise struggle. This unique opportunity gives them the chance to truly show what they know and gain a deeper understanding. They will also be often called upon to present in front of the class and explain their reasoning. **Approaching/Emerging Proficiency:** These students are fully capable and have shown the ability to do everything in our lessons. However, they commonly make minor errors and sometimes mix up terms with one another. These students will be all paired together. This way they can engage in productive conversation with one another. Additionally, they will be able to pass on ideas to one another. Thus, if someone does not know something their partners may and vice versa. These students will also be called upon to present in front of the class, and may also at times be provided modified homework assignments and be given more hints. **Modalities/Learning Preferences:** Because we are doing math, this lesson leans towards being best suited for kinesthetic and auditory learners. However, there are other elements of the lesson that make it accessible and understandable to others.
Classroom Management- (grouping(s), movement/transitions, etc.) Students will be paired up with their table partners. We will move from one activity to the next by me posing the question "is there any questions at this point." In addition, I will verbalize that we are moving on to the next thing.	**Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)** Students are expected to follow rules and guidelines as outlined in my classroom rules. The number one rule is to show respect and allow for everyone's thoughts to be heard. When moving from lecture to table work they are expected to be quiet and contribute to their table.

Minutes	Procedures
5	**Set-up/Prep:** Post previous days homework answers and ensure all materials are ready for the lesson. Any questions from the previous days homework will be answered at this time. Any additional questions outside this time will be answered on the LMS.
7	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** Write down what we have learned about complex numbers so far. Including the definition of a complex number As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. So far, we have learned how complex numbers are not so different from things like (x-2) in terms of the properties we use to add, subtract, multiply and divide them. We learned how important the conjugate is in division and we learned that i^2=-1 and i^3=-i
10	**Explain: (concepts, procedures, vocabulary, etc.)** **This portion will be me posting a question and allowing kids to explain how to do it up at the board.** **Example 1:** Add (z+w) (z-w) (z x w) when z=3+2i and w=5-4i 1.) I will allow them to explain their reasoning. 2.) I will look for phrases like combine like terms and foil **Example 2:** Find 1/z when z=8+3i and (8-i)/(3+2i) 1.) **I** will allow them to explain their reasoning. 2.) Here I will look for proper multiplying and the use of terms like complex conjugate.
23	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)** Here I will allow students the opportunity to complete a review of this quizzes material. It will be select problems not included on any of the homework. They will be given adequate time to address any questions and concerns they may have. The review questions will be nearly identical to those assigned on the test.
5	**Review (wrap up and transition to next activity):**

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	Remember to study for the quiz tomorrow and review any and all notes you have. If you can do the problems I assigned as part of the review you will be adequately prepared.

Formative Assessment: (linked to objectives)
Progress monitoring throughout lesson- clarifying questions, check-in strategies, etc.

By having students come up and try questions, I am monitoring there understanding of the content.

Consideration for Back-up Plan:
If need be, I will readdress any of the lessons that the students are not skilled sufficiently in.

Summative Assessment (linked back to objectives)
End of lesson:
At the end of the lesson, I assign several questions for table groups to go over. The results of them answering those questions serves as a good assessment. In addition, the homework assigned and the unit test and quiz serve as a summative assessment.

The summative assessment for this particular lesson will be revealed in the quiz I give the next day. If the quiz goes well, the students and the lesson were adequate. If not, they will do poorly.

If applicable- overall unit, chapter, concept, etc.:
Use the properties and definition of complex numbers and imaginary numbers to add, subtract, multiply and divide complex numbers

Reflection (What went well? What did the students learn? How do you know? What changes would you make?):

Grade: High School

Subject: Algebra II

Materials: Pen, paper pencil whiteboard/ promethean that can save writing

Technology Needed:

Instructional Strategies:

- ☐ Direct instruction
- ☐ Guided practice
- ☐ Socratic Seminar
- ☐ Learning Centers
- ☐ Lecture
- ☐ Technology integration
- ☐ Other (list)
- ☐ Peer teaching/collaboration/ cooperative learning
- ☐ Visuals/Graphic organizers
- ☐ PBL
- ☐ Discussion/Debate
- ☐ Modeling

Guided Practices and Concrete Application:

- ☐ Large group activity
- ☐ Independent activity
- ☐ Pairing/collaboration
- ☐ Simulations/Scenarios
- ☐ Other (list)
- ☐ Hands-on
- ☐ Technology integration
- ☐ Imitation/Repeat/Mimic

Explain:
Beginning of class will have lecture/ direct instruction. Then we will break apart into table groups where students will discuss the problems collaboratively. In addition, they will often repeat the actions I do on problems to learn them further.

Standard(s)

(+)HS.N-CN.4

Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers).

Explain why the rectangular and polar forms of a given complex number represent the same number.

Objective(s)
The learner will be able to graph an imaginary number in the Cartesian plane

Differentiation

Below Proficiency: Students below proficiency know basic terms and phrases involved in doing the problems. However, applying what they know in the physical context of doing a problem is difficult. To achieve equity in the class, these students will be placed with students above proficiency who may be able to guide them in the right direction. Thus, if they have questions there is a stronger chance it will get answered as students above proficiency will most certainly be able to help. I will also check in with these students often. Give them more hints and provide modified homework assignments if necessary.

Above Proficiency:
Students who are above proficiency know all the basic terms and phrases. In addition, they are excellent at solving problems using these terms and phrases. Students who are

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Bloom's Taxonomy Cognitive Level: Apply, analyze, evaluation, knowledge	above proficiency will be paired up with those students who otherwise struggle. This unique opportunity gives them the chance to truly show what they know and gain a deeper understanding. They will also be often called upon to present in front of the class and explain their reasoning. **Approaching/Emerging Proficiency:** These students are fully capable and have shown the ability to do everything in our lessons. However, they commonly make minor errors and sometimes mix up terms with one another. These students will be all paired together. This way they can engage in productive conversation with one another. Additionally, they will be able to pass on ideas to one another. Thus, if someone does not know something their partners may and vice versa. These students will also be called upon to present in front of the class, and may also at times be provided modified homework assignments and be given more hints. **Modalities/Learning Preferences:** Because we are doing math, this lesson leans towards being best suited for kinesthetic and auditory learners. However, there are other elements of the lesson that make it accessible and understandable to others.
Classroom Management- (grouping(s), movement/transitions, etc.) Students will be paired up with their table partners. We will move from one activity to the next by me posing the question "is there any questions at this point." In addition, I will verbalize that we are moving on to the next thing.	**Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)** Students are expected to follow rules and guidelines as outlined in my classroom rules. The number one rule is to show respect and allow for everyone's thoughts to be heard. When moving from lecture to table work they are expected to be quiet and contribute to their table.

Minutes	Procedures
5	**Set-up/Prep:** Will spend several minutes here covering the quiz, and handing back results.
10	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** Is it possible to graph a complex number in the same way we would a real number? As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. Here I will field responses they have, and then I will give them my explanation. "Because of a complex consequence of algebra called an isomorphism we can write the complex plane as the Cartesian plane. "a" is the real part of z and "b" is the imaginary part of z. The only difference is we have ib when graphing a complex number for our y value and not b.
15	**Explain: (concepts, procedures, vocabulary, etc.)** **Example 1:** **"**For our bell ringer, we did not actually graph a complex number but now we will." "Say we have z=4+3i." 1.) First, we draw our Cartesian plane as we would normally. 2.) Then, we plot our point a by moving horizontally across the x axis. Draw a dashed line vertically at 4 3.) What do we do next? As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 4.) That is correct, we go up to our ib point just as we would if we had an point (a,b) because we have 4+3i, we now have b as 3i. Draw a horizontal line at 3i.

Lesson Plan Template

	5.) Find the intersection, and plot a point there. Then draw a segment from the origin to our intersection point. Thus, we have graphed our complex number z=4+3i Are there any questions at this point? **Example 2:** Graph z x w when z=3+3i and w=2+3i 1.) Foil 2.) We have 6+9i+6i+9i^2 3.) 6+15i-9 4.) This leaves us with -3+15i 5.) Now what do we do? As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 6.) That's right, we just plot our real part first. Therefore, we find -3 on the x axis. And make a dashed line vertically. 7.) Now, we plot our imaginary part. Thus, just find 15i and make a dashed line horizontally. 8.) Find the intersection and make a point at the intersection. Then draw a segment from the origin to our intersection point. We have now graphed our complex number. 9.) Are there any questions at this point?
10	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)** Post two problems on the board. Graph z=2-3i and w=12-i Once the questions have been answered and handed in for daily points. They are allowed to ask any and all questions they may have.
5	**Review (wrap up and transition to next activity):** Today we learned how to graph complex numbers in the Cartesian- plane. We learned that graphing these numbers is really not a complex problem, and we are able as a result of an isomorphism.

Formative Assessment: (linked to objectives) **Progress monitoring throughout lesson- clarifying questions, check-in strategies, etc.** Throughout the lesson, many clarifying questions are asked. For instance, I ask "how do we?" on many occasions. We also will have students attempt to answer questions on their own throughout the lesson. When they think they have the right answer, they are allowed to attempt it up front on the board. **Consideration for Back-up Plan:** In order to fully understand how to do this an understanding of complex numbers is needed. Therefore, I will spend time going back over properties of complex numbers and some of the early workings of them.	**Summative Assessment (linked back to objectives)** **End of lesson:** At the end of the lesson, I assign several questions for table groups to go over. The results of them answering those questions serves as a good assessment. In addition, the homework assigned and the unit test and quiz serve as a summative assessment. **If applicable- overall unit, chapter, concept, etc.:** Use the properties and definition of complex numbers and imaginary numbers to add, subtract, multiply and divide complex numbers

Reflection (What went well? What did the students learn? How do you know? What changes would you make?):

Grade: Algebra	**Subject:** Algebra II
Materials: pen paper pencil whiteboard	**Technology Needed:**
Instructional Strategies: ☐ Direct instruction ☐ Guided practice ☐ Socratic Seminar ☐ Learning Centers ☐ Lecture ☐ Peer teaching/collaboration/ cooperative learning ☐ Visuals/Graphic organizers ☐ PBL	**Guided Practices and Concrete Application:** ☐ Large group activity ☐ Independent activity ☐ Pairing/collaboration ☐ Simulations/Scenarios ☐ Other (list) ☐ Hands-on ☐ Technology integration ☐ Imitation/Repeat/Mimic

Lesson Plan Template

□ Technology integration □ Other (list) □ Discussion/Debate □ Modeling	Explain: Explain: Beginning of class will have lecture/ direct instruction. Then we will break apart into table groups where students will discuss the problems collaboratively. In addition, they will often repeat the actions I do on problems to learn them further.
Standard(s) (+)HS.N-CN.4 Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers). Explain why the rectangular and polar forms of a given complex number represent the same number.	**Differentiation** **Below Proficiency:** Students below proficiency know basic terms and phrases involved in doing the problems. However, applying what they know in the physical context of doing a problem is difficult. To achieve equity in the class, these students will be placed with students above proficiency who may be able to guide them in the right direction. Thus, if they have questions there is a stronger chance it will get answered as students above proficiency will most certainly be able to help. I will also check in with these students often. Give them more hints and provide modified homework assignments if necessary. **Above Proficiency:** Students who are above proficiency know all the basic terms and phrases. In addition, they are excellent at solving problems using these terms and phrases. Students who are above proficiency will be paired up with those students who otherwise struggle. This unique opportunity gives them the chance to truly show what they know and gain a deeper understanding. They will also be often called upon to present in front of the class and explain their reasoning. **Approaching/Emerging Proficiency:** These students are fully capable and have shown the ability to do everything in our lessons. However, they commonly make minor errors and sometimes mix up terms with one another. These students will be all paired together. This way they can engage in productive conversation with one another. Additionally, they will be able to pass on ideas to one another. Thus, if someone does not know something their partners may and vice versa. These students will also be called upon to present in front of the class, and may also at times be provided modified homework assignments and be given more hints. **Modalities/Learning Preferences:** Because we are doing math, this lesson leans towards being best suited for kinesthetic and auditory learners. However, there are other elements of the lesson that make it accessible and understandable to others.
Objective(s) The learner will use properties of complex numbers to find the **Bloom's Taxonomy Cognitive Level:** Apply, analyze, evaluation, knowledge	
Classroom Management- (grouping(s), movement/transitions, etc.) Students will be paired up with their table partners. We will move from one activity to the next by me posing the question "is there any questions at this point." In addition, I will verbalize that we are moving on to the next thing.	**Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)** Students are expected to follow rules and guidelines as outlined in my classroom rules. The number one rule is to show respect and allow for everyone's thoughts to be heard. When moving from lecture to table work they are expected to be quiet and contribute to their table.

Minutes	Procedures

Lesson Plan Template

5	**Set-up/Prep:** Because no homework was assigned from the previous day, the days bell ringer question will be written on the board to begin class.
10	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** How do we find the absolute value or moduli of a complex number? As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. Here I will explain how the moduli of a complex number is simply (a^2+b^2)^1/2.
15	**Explain: (concepts, procedures, vocabulary, etc.)** **Example 1:** Find the moduli of z=4+3i 1.) "We know that the moduli is (a^2+b^2)^1/2." 2.) Therefore, we use a=4 and b= what? As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 3.) "Our b term is the real part of our imaginary term 3i. Thus, our b is 3. 4.) That gives us.. (4^2+3^2)^1/2. 5.) "Which is (25)^1/2=5 "Are there any questions at this point? **Example 2:** Find the moduli of z=3-2i 1.) "what are our a and b terms for this problem?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 2.) "Our a and b terms for this problem are 3 and -2 respectively." 3.) "Thus, we have (3^2+(-2)^2)^1/2 4.) "Which is (13)^1/2 Are there any questions at this point? **Example 3:** Find the moduli of z x w when z=2-3i and w=2+2i 1.) "What is our first step? Any takers?" As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 2.) "Our first step is to multiply z and w." 3.) "Thus, we have 4+4i-6i-6i^2. However, we know this to be 10-2i. " Are there any questions at this time? 4.) "Now we proceed as we have in the previous 2 examples. What do we get? As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. 5.) "Yes, we have (100+4)^1/2. Now we are done." 6.) Break apart into your table groups now.
15	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)** Find the moduli of z and w when z=3-I and =4+2i. Finally find the moduli Once they have finished answering these problems they will hand them in to me for their participation points for the day. Then, they are free to ask me any and all questions they may have and work on their homework.
5	**Review (wrap up and transition to next activity):** Today, we found the moduli of complex numbers. As now know finding the moduli of a complex number simply means squaring each of the coefficients of our complex number, and taking that sum and finding its square root.

Formative Assessment: (linked to objectives) **Progress monitoring throughout lesson- clarifying questions, check-in strategies, etc.** Throughout the lesson, many clarifying questions are asked. For instance, I ask "how do we?" on many occasions.	**Summative Assessment (linked back to objectives)** **End of lesson:** At the end of the lesson, I assign several questions for table groups to go over. The results of them answering those questions serves as a good assessment. In addition, the homework assigned and the unit test and quiz serve as a summative assessment.

Lesson Plan Template

We also will have students attempt to answer questions on their own throughout the lesson. When they think they have the right answer, they are allowed to attempt it up front on the board.

Consideration for Back-up Plan:

In order to fully understand how to do this an understanding of complex numbers is needed. Therefore, I will spend time going back over properties of complex numbers and some of the early workings of them.

If applicable- overall unit, chapter, concept, etc.:
Use the properties and definition of complex numbers and imaginary numbers to add, subtract, multiply and divide complex numbers

Reflection (What went well? What did the students learn? How do you know? What changes would you make?):

Grade: High school

Subject: Algebra II

Materials: Pen paper pencil whiteboard

Technology Needed: Smartboard or promethean to write on

Instructional Strategies:

- ☐ Direct instruction
- ☐ Guided practice
- ☐ Socratic Seminar
- ☐ Learning Centers
- ☐ Lecture
- ☐ Technology integration
- ☐ Other (list)
- ☐ Peer teaching/collaboration/ cooperative learning
- ☐ Visuals/Graphic organizers
- ☐ PBL
- ☐ Discussion/Debate
- ☐ Modeling

Guided Practices and Concrete Application:

- ☐ Large group activity
- ☐ Independent activity
- ☐ Pairing/collaboration
- ☐ Simulations/Scenarios
- ☐ Other (list)
- ☐ Hands-on
- ☐ Technology integration
- ☐ Imitation/Repeat/Mimic

Explain: This lesson will be a review of the previous two days lesson, and will mainly focus on finding moduli. Problems will be posted and one student will volunteer to solve each of them. I will provide guidance as needed.

Standard(s)

(+)HS.N-CN.4

Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers).

Find moduli (absolute value) of a complex number.

Explain why the rectangular and polar forms of a given complex number represent the same number.

Objective(s)

The learner will be able to explain how to graph a complex number. The learner will be able to use the definition of moduli to find a moduli.
Bloom's Taxonomy Cognitive Level: Apply, analyze, evaluation knowledge

Differentiation

Below Proficiency: Students below proficiency know basic terms and phrases involved in doing the problems. However, applying what they know in the physical context of doing a problem is difficult. To achieve equity in the class, these students will be placed with students above proficiency who may be able to guide them in the right direction. Thus, if they have questions there is a stronger chance it will get answered as students above proficiency will most certainly be able to help. I will also check in with these students often. Give them more hints and provide modified homework assignments if necessary.

Above Proficiency:
Students who are above proficiency know all the basic terms and phrases. In addition, they are excellent at solving problems using these terms and phrases. Students who are above proficiency will be paired up with those students who otherwise struggle. This unique opportunity gives them the chance to truly show what they know and gain a deeper understanding. They will also be often called upon to present in front of the class and explain their reasoning.

Lesson Plan Template

	Approaching/Emerging Proficiency: These students are fully capable and have shown the ability to do everything in our lessons. However, they commonly make minor errors and sometimes mix up terms with one another. These students will be all paired together. This way they can engage in productive conversation with one another. Additionally, they will be able to pass on ideas to one another. Thus, if someone does not know something their partners may and vice versa. These students will also be called upon to present in front of the class, and may also at times be provided modified homework assignments and be given more hints. **Modalities/Learning Preferences:** Because we are doing math, this lesson leans towards being best suited for kinesthetic and auditory learners. However, there are other elements of the lesson that make it accessible and understandable to others.
Classroom Management- (grouping(s), movement/transitions, etc.) Students will sit in their table groups. I will ask some questions I have previously formulated. One person from each group will go up and solve the problems on the board.	**Behavior Expectations- (systems, strategies, procedures specific to the lesson, rules and expectations, etc.)** Students are expected to follow rules and guidelines as outlined in my classroom rules. The number one rule is to show respect and allow for everyone's thoughts to be heard. When moving from lecture to table work they are expected to be quiet and contribute to their table.

Minutes	Procedures
5	**Set-up/Prep:** Post pervious days homework and answer any questions on the homework.
5	**Engage: (opening activity/ anticipatory Set – access prior learning / stimulate interest /generate questions, etc.)** How do we graph complex numbers? Explain in words As before I will give some time for the students to arrive at the correct answer. If they cannot find it, then I will go about explaining the concept further. If someone gets the answer I am looking for I will roll with it. If not I will say something along the lines of.. When graphing a complex number z=a+ib we simply move horizontally along the x axis to a number equal to our integer a. Then we extend a dotted line vertically at a. From there, we find our ib value along the y axis and extend a dotted line horizontally. After that, we find the intersection of our dotted lines, plot a point at the intersection, and draw a segment from the origin to the point.
10	**Explain: (concepts, procedures, vocabulary, etc.)** The above definition I gave you is sufficient for all you need to know for the exam **Example 1:** Find the moduli (absolute value) of the complex number z=3-i2 (3^2+(-2)^2)^1/2=(13)^1/2 For this problem, I will call up a student to solve and explain it as part of the review. My goal is talking about the problems will make them understand it more, and maybe a student will have a trick that resonates with them. If no students get the right answer, I will do the problem on my own similar to how I did examples the previous day. Are there any questions at this time? **Example 2:** Find the moduli of w=5+2i (5^2+2^2)^1/2=(29)^1/2 For this problem, I will call up a student to solve and explain it as part of the review. My goal is talking about the problems will make them understand it more, and maybe a student will have a trick that resonates with them. If no students get the right answer, I will do the problem on my own similar to how I did examples the previous day. Are there any questions at this time?

Lesson Plan Template

	Example 3: Find (z x w) and the moduli of (z x w) when w=1+2i and z=2+2i For this problem, I will call up a student to solve and explain it as part of the review. My goal is talking about the problems will make them understand it more, and maybe a student will have a trick that resonates with them. If no students get the right answer, I will do the problem on my own similar to how I did examples the previous day. (z x w)= 2+4i+4i^2 =-2+4i Moduli of (z x w)=((-2)^2+(4)^2)^1/2=(20)^1/2 Are there any questions at this time? "Make sure you guys review the quiz we took over this material involving adding subtracting and multiplying complex numbers. In addition, be sure you are proficient at dividing complex numbers.
15	**Explore: (independent, concreate practice/application with relevant learning task -connections from content to real-life experiences, reflective questions- probing or clarifying questions)** **Note for this lesson there will be no table groups as the whole lesson had them.** Here they will solve review problems from the book. They are free to work in table groups and ask each other any questions they wish. Furthermore, they are free to ask me any clarifying questions they need at this time
5	**Review (wrap up and transition to next activity):** Remember to review for the test tomorrow. If you can do all the problems from the quiz you will be well prepared. If you can do all the problems from the quiz and the problems we did today you will be very well prepared. Remember you are not required to graph a complex number. Instead, please just have a stout way of explaining the process.

Formative Assessment: (linked to objectives) **Progress monitoring throughout lesson- clarifying questions, check-in strategies, etc.** Periodically students will come up and attempt to solve questions and problems I have posed. The whole purpose of my review is to engage students in conversation and get a gauge of whether or not they know what they are doing. **Consideration for Back-up Plan:** If I notice students are particularly bad at one thing, we will simply regress to that topic they struggle with. So, if they struggle with finding the moduli, we will go back to that lesson and find the root of their struggles.	**Summative Assessment (linked back to objectives)** **End of lesson:** The summative assessment of this lesson is the actual test they will be given the next day. Ideally, the students would also hand in the review questions I assigned. However, I will allow them to keep those until the exam is taken. **If applicable- overall unit, chapter, concept, etc.:** Use the properties and definition of complex numbers and imaginary numbers to add, subtract, multiply and divide complex numbers

Reflection (What went well? What did the students learn? How do you know? What changes would you make?):

Note each of these lessons examples will be done on something that can save them. This way all example problems can be sent to the students