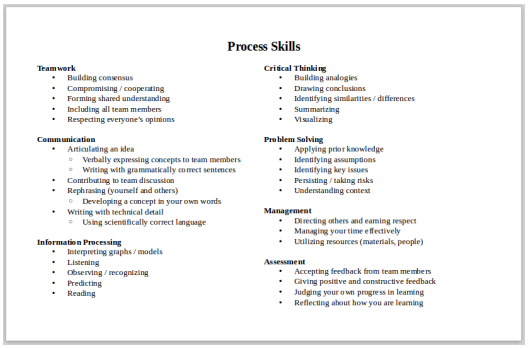
Activity 2: Arithmetic

Now that you've written a few programs, let's take a step back and discuss how to do basic arithmetic. But first, there's something important to know about why you're working in teams.

Model 1 Process Skills



Process Skills

Teamwork
- Building consensus
- Compromising / cooperating
- Forming shared understanding
- Including all team members
- Respecting everyone's opinions

Communication
- Articulating an idea
  - Verbally expressing concepts to team members
  - Writing with grammatically correct sentences
- Contributing to team discussion
- Rephrasing (yourself and others)
  - Developing a concept in your own words
- Writing with technical detail
  - Using scientifically correct language

Information Processing
- Interpreting graphs / models
- Listening
- Observing / recognizing
- Predicting
- Reading

Critical Thinking
- Building analogies
- Drawing conclusions
- Identifying similarities / differences
- Summarizing
- Visualizing

Problem Solving
- Applying prior knowledge
- Identifying assumptions
- Identifying key issues
- Persisting / taking risks
- Understanding context

Management
- Directing others and earning respect
- Managing your time effectively
- Utilizing resources (materials, people)

Assessment
- Accepting feedback from team members
- Giving positive and constructive feedback
- Judging your own progress in learning
- Reflecting about how you are learning

Your learning team has a new card that is not a role. It lists the *process skills* that are essential for your ability to construct knowledge.

Questions (10 min) Start time: _____

1. Manager: have each person take turns reading sections of the Process Skills card out loud. Discuss as a team which skills you would like to focus on today. Write your top three choices:

2. What is a process skill? As a team, come up with a precise definition.

3. What other knowledge and skills do you expect to learn from this course? How are they different from process skills?

4. Who has the responsibility to ensure that your team thinks about process skills during the activity each week? How can the other roles support him/her?

Model 2 Dividing Numbers

9 / 4	*evaluates to*	2
10 / 4	*evaluates to*	2
11 / 4	*evaluates to*	2
12 / 4	*evaluates to*	3
13 / 4	*evaluates to*	3
14 / 4	*evaluates to*	3
15 / 4	*evaluates to*	3
16 / 4	*evaluates to*	4

9 / 4.0	*evaluates to*	2.25
10 / 4.	*evaluates to*	2.5
11. / 4	*evaluates to*	2.75
12 / 4.0	*evaluates to*	3.0
13 / 4.	*evaluates to*	3.25
14.0 / 4	*evaluates to*	3.5
15 / 4.0	*evaluates to*	3.75
16 / 4.	*evaluates to*	4.0

Questions (15 min) **Start time:** _____

5. In the first table, which number(s) divided by 4 evaluate to 3? What is significant about the number of answers you have written down?

6. How do the answers in the first table differ from the second table?

7. To the right of the second table, round each answer to the closest integer. How do those values compare to what you see in the first table?

8. Carefully explain the difference between the number formats in the first and second tables.

9. Complete the table:

14. / 4.	*evaluates to*	
14. / 4	*evaluates to*	
14 / 4.	*evaluates to*	
14 / 4	*evaluates to*	

10. Dividing numbers with fractional parts (known as **floating-point** numbers) gives you different results from dividing two integers. In the previous question:

a) Which rows evaluate to an integer?

b) Which rows evaluate to a floating-point number?

11. Imagine you are writing a Java program that requires division.

a) What must be true about the **operands** (the numbers around the **operators**) for you to get the mathematically correct answer?

b) Does it need to be true for both operands?

12. Consider what you know about addition (+). If you add two integers in a Java expression, will the result always be mathematically correct? Justify your answer.

13. What about subtraction (-) and multiplication (*)? If you subtract or multiply two integers, will the answer always be mathematically correct? Justify your answer.

14. Summarize what you have learned about the difference between integer division and floating-point division.

Model 3 Variable Declarations

In addition to **literal** numbers like 1 or 2.3, most Java programs involve **variables** (named values that can be changed). The following code **declares** and **assigns** three variables:

```
1 int dollars;
2 int cents;
3 double grams;
4
5 dollars = 1;
6 cents = 90;
7 grams = 3;
```

Questions (10 min) Start time: _____

15. Identify the Java **keyword** used in a variable declaration to indicate

    a) an integer:

    b) a floating-point number:

16. Consider numbers of dollar bills, cents, and grams. Which of these units only makes sense as an integer, and why?

17. What would you expect the following statements to print out? (Hint: Refer to Model 2.)

    a) `System.out.println(dollars);`

    b) `System.out.println(cents);`

    c) `System.out.println(grams);`

18. What do you think the purpose of a variable declaration is?

19. Consider the statement: `cents = dollars;`

a) Compare this code to lines 5–7 in Model 3. What value do you think cents and dollars will have after running this statement?

b) Which side of the equals sign (left or right) was assigned a new value?

20. Examples of Java operators include + and -; they describe an operation to be executed (e.g., addition or subtraction).

a) Do you consider the equals sign in Java an operator (an operation to be executed)? If so, explain the operation. If not, explain why not.

b) Do you consider the equals sign in mathematics an operator (an operation to be executed)? If so, explain the operation. If not, explain why not.

21. In your own words, explain how you should read the = sign in Java. For example, the Java statement `x = a + b;` should be read as "x _____ a plus b."

Model 4 Order of Operations

The Java language defines a specific order of execution for math and other operations. For example, multiplication and division take **precedence** over addition and subtraction. Using parentheses, you can override the order of operations. The following table lists some Java operators from highest precedence to lowest precedence.

Parenthesis	`( )`
Unary (positive or negative signs)	`+ -`
Multiplicative	`* /`
Additive	`+ -`
Assignment	`=`

For the following questions, assume you have these two variables:

```
int x;
double y;
```

Questions (10 min) **Start time:** _____

22. What operator has the lowest precedence? Why do you think Java is designed that way?

23. The + and - operators show up twice in the table of operator precedence. For the Java expression `x = 5 * -3;` explain how you know whether the - operator is being used as an unary or binary operator in this expression.

24. Give the order of operations in the Java expression: `x = 5 * -3;`

a) First operator to be evaluated:

b) Second operator:

c) Third operator:

25. Give the order of operations in the Java expression: `y = 9 / 2;`

a) First operator to be evaluated:

b) Second operator:

26. Based on your answer to the previous question, explain why the variable `y` would be assigned 4.0 (as opposed to 4 or 4.5).

27. Rewrite the assignment for `y` so that it would be set correctly to 4.5. (Hint: you'll need to recall what you learned about division in Model 2.)