

SECTION 1: WELCOME NEW ANTARCHITECTS

This activity section introduces students to the storyline of the unit: they are newly hired architects contracted to design a station for scientists working in Antarctica. Their first activities include researching Antarctica and learning about the software.

The table below shows a menu of activities and handouts related to Memo 1. Concept Close-Ups—which serve as opportunities to focus more closely on a given math concept introduced during the project work—are indented and noted (*CCUs*). Activities that specifically assess student progress are also marked (*Assessment*). And finally, activities in which students use computers for some (or all) steps are noted by a computer icon, so that you can better plan your computer needs.

Choose those activities that work best for you and your students:

	ACTIVITIES	HANDOUTS
	Introduce the Project	Memo 1 AntArchiTech Checklist
	Do A Pre-Test (<i>Assessment</i>)	A Short Design Problem
	Learn to Use ArchiTech	ArchiTech Use it Now
	Measure by Metric (<i>CCU</i>)	Metric Mania
	Research Antarctica	Rock and Ice: An Antarctic Casebook
	Compare F & C (<i>CCU</i>)	How Cold is Cold?
	Keep a Math Journal (<i>Assessment</i>)	Math Reflection Guidelines Math Journal Prompts Judging Your Writing
	Check ArchiTech Skills (<i>Assessment</i>)	Tech Check

Overall time frame for Section 1: Approximately 9-12 class periods.

INTRODUCE THE PROJECT

Intent: Give students an overview of what they'll be doing as AntArchiTects.

Students' Product: Understanding of the project scope; the beginnings of new folders or binders; and a completed activity checklist.

Math Concepts and Skills:
Beginning to establish connections between design work and mathematics.

Time Frame: 1 class period

Materials:

- Student Handout: **MEMO 1**
- Student Handout: **ANTARCHITECT CHECKLIST**

What to Do:

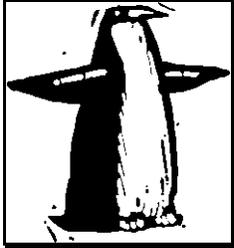
- (1) Pass out **MEMO 1** to each student. Make sure students understand their role in this project: they are architects hired to design a research station in Antarctica.
- (2) Brainstorm (as a class) what kinds of math students think they'll use as architects, and suggest to them how the math builds in the unit. Hand out the **ANTARCHITECT CHECKLIST** and have students note which handouts you anticipate doing.
- (3) Introduce a paper management system you'll want students to use throughout the unit, such as binders, math journals, etc.
- (4) Finally, divide the class into teams of 2-4 AntArchiTects, for the project duration.

***Teaching Strategies:** Dorene Abrams, a math teacher at Harriet Tubman Middle School in Portland, Oregon, discussed encouraging an interdisciplinary approach to teaching Antarctica: "At a team meeting, I asked my colleagues if they were interested in developing supportive lessons on Antarctica for the 4-6 weeks that my students would be involved in the project. The Language Arts/Social Studies teachers set aside time for research projects on subjects relating to Antarctica. The Science teacher took the opportunity to instruct both about insulation and R-value (using materials developed by the local natural gas company) as well as organized experiments which incorporated the Celsius scale. Our Health teacher discussed survival issues in the Antarctic climate, emphasizing the sociological factors related to isolation."*

Equity Tip: This block exemplifies an important strategy used throughout our series: the Antarctic continent is an equally strange environment to most all middle schoolers. No one is an expert, but everyone can become one. This block is essential in building that expertise.

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MEMO 1



To: ANTARCHITECTS
From: Booker Vega, Principal Designer
Re: Welcome new hires!

Greetings and welcome to ANTARCHITECTS, an architecture firm specializing in designs for cold climates. We hope you'll feel right "AAT" home in your new job.

We also hope you're ready to get right to work because we've got a hot (or rather, cold) new client: **The Frozen Scientific Group**. Our client needs us to design a scientific research station for a site in Antarctica where scientists will live year-round. Here are some important facts to know right away:

<p>The site is on the Antarctic coast. The site is a small, flat field of dry rock, 17m x 30m. The station will be open for at least 20 years. Four scientists will live there for two years at a time.</p>

Those are the basics, but the more you research and understand about your clients and Antarctica, the better your design will be.

Over the course of the project, other ANTARCHITECTS will design research stations, too, and we will give all of the designs to **The Frozen Scientific Group** for them to evaluate. Good luck!

ANTARCHITECT CHECKLIST

In order to start designing layouts, you need to undergo our training in architectural design. This is a great honor.

As you complete an activity:

- (1) Get it checked off (first column)
- (2) Write a few words about what math you learned during that activity.

Cross the activity off if your teacher does not assign it.

After you have successfully completed the first 6 activities, you will receive a certificate showing that you have completed our AntArchiTect training program. In order to keep that license valid and up-to-date, you need to complete all of your assigned activities on this list. Let's get going!

√	ACTIVITY	MATH SKILLS LEARNED
	A Short Design Problem	
	ArchiTech Use It Now	
	Metric Mania	
	Researching Antarctica	
	How Cold is Cold?	
	Tech Check	
<i>Congrats! You have earned your AntArchiTect certificate!</i>		
	Creating a Requirements List	
	Reasoning with Requirements	
	Making the Floor Plan	
	Area & Perimeter	
	From the Classroom to Screen	
	Design Review	
	R-Value Rivalry	
	Making the Best of It	
	Walls, Perimeter, & Heating Cost	
	Re-Designing the Floor Plan	
	Math Map	
	Presentation	
	Final Report	
	A Short Design Problem	

DO A PRE-TEST ASSESSMENT

Intent: To introduce students to the concepts in the unit as well as to assess their math skills going into the unit.

Student Product: A completed sheet highlighting project-specific skills and needs.

Math Concepts and Skills:
Dependent upon student skills.

Time Frame: 1 class period

Materials:

- Student Handout: **A SHORT DESIGN PROBLEM**

What to Do:

(1) To use this activity as a pre/post test, have students do this handout before starting the unit and again at the end of the unit (see Teaching Strategies).

(2) Explain to the students that this activity will help them start thinking about the math in **THE ANTARCTICA PROJECT**. Advise students to use whatever they already know to answer the questions, and that they're not expected to know it all at this point. Make it clear what your grading criteria are; for example, grading on effort and thought shown in the answer (see Possible Solutions).

(3) Give copies to each student or each group. If you plan to use it as a pre/post test, you may want to give it to each student individually.

(4) After students complete the handout, you can debrief in whole-class or small group format to introduce some issues and vocabulary that you'd like students to be aware of going into the unit (see Possible Solutions).

***Teaching Strategies:** This problem is a scaled-down version of this unit's design problem that students can do at their desks in one class period. The idea is that students can solve the problems to some extent before doing Antarctica, but can solve them more successfully — by utilizing more sophisticated mathematics — after doing the unit. Many teachers give students a chance to answer these same questions after the unit, which can be useful in assessing mathematical growth. Furthermore, as you go through the unit, you can periodically remind students of these test problems. By the time students get to the post-test, they should have a very clear idea about how the math in Antarctica relates to the test problems they did (and are about to do again).*

Possible Solutions to A SHORT DESIGN PROBLEM Handout:

As you go over the design problem with the students, the following chart may be a useful reference. Each “Part” of the handout asks students to use different mathematical “Related skills and concepts” which, from the student perspective, may result in “Sample questions that could come up.”

Part #	Related skills and concepts	Sample questions that could come up
1	Division of contiguous spaces in buildings Scale drawings Metric measurement Square units	Do buildings have spaces between rooms? What is the size of the whole bus as it is drawn? How many meters is a bed? How big is a square meter?
2	Designing for real-world use	How much space does a guitar player take up?
3	Using computation in design All topics from problems 1,2	Why is it useful to calculate the area of a room? What are the formal mathematical terms for these ideas?
4	Optimization Functions	How can math help make a better design decision? How does cost per square meter affect total cost?

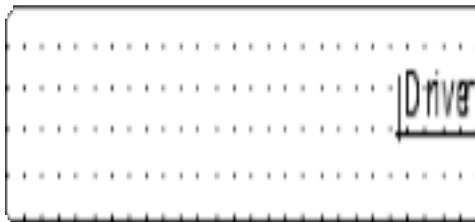
After going over the handout with the students, you will probably want to collect the handouts and score them at some level. We recommend that you grade the pre-test on the effort and thought shown in the answer, not on the particular math skills required.

A SHORT DESIGN PROBLEM

Scary Harry, the mega rock star, needs a new tour bus to carry him around the country on his Mock Rock Tour. You are responsible for designing the interior of this bus. Harry needs a place to sleep, a place to hang out with the band and practice, and a bathroom with a Jacuzzi tub. The band sleeps in another bus, but they all practice together on Harry's bus.

Part 1: Below is a diagram of the empty bus.

(a) Make a rough sketch below of how you would divide the space between the three rooms needed (bedroom, practice room, bathroom).



- = .5 meters

(b) Based on your sketch, estimate the size of each room:

ROOM	SIZE (in square meters)
Bedroom	
Practice Room	
Bathroom	

Part 2: How did you decide how big to make each space?

Part 3: Describe all the math you can think of that might help you make the spaces the right size.

HINT: Rather than just naming math (for example, 'I would use multiplication'), try to describe what you would do with math (for example, 'I would multiply the width of a window by the total number of windows to find out how much fabric is needed to make curtains').

Part 4: Harry wants his bedroom soundproofed so the band won't disturb his beauty sleep when they practice. The walls of the interior rooms are 2 meters tall.

You are considering two kinds of soundproofing:

SOUNDPROOFING TYPES	COST?	HOW LONG DOES IT LAST?
Type 1	\$1.00 per square meter	Two years
Type 2	\$8.00 per square meter	Ten years

(a) Describe how to figure out the total cost of each type of soundproofing for 10 years.

(b) Describe how you would decide which type to use. Explain in detail any math that might help you decide.

LEARN TO USE ARCHITECH



Intent: Provide several options for helping students learn to use ARCHITECH.

Students' Product: Familiarity with ARCHITECH software and completed handouts.

Math Concepts and Skills:
Introduction to scale representations
Metric measurement

Time Frame: 1 class period

Materials:

- Student Handout: ARCHITECH USE IT NOW
- ARCHITECH software

What to Do: Choose *one or more* of the following ways to structure this activity:

- Do an overview demonstration of the features of ARCHITECH with the whole class, using a computer hook-up to a large TV screen or an overhead projector.
- Give the USE IT NOW handouts to each of the students. Have them split into their AntArchiTects groupings and work through the handout at the computer.
- Set up a system of 'cascading training': you, the teacher, trains 2 or 3 students to use the ArchiTech software; each student, in turn, trains someone new, and each new trainee trains someone new, until all students have been personally trained.

Teaching Strategies: Teachers have had great success with cascading training. The whole class can be trained on essential features in about a class period this way, and kids seem to pay more attention when they know they will be explaining the software to someone else. *HINT: Make sure students keep moving—sometimes they get distracted by making furniture or tweaking things; remind them that the point is to learn the software tools and that they'll have the rest of the project to work on a design.*

Concept Close-Up: If you find your students struggling with metric while working on ArchiTech, give them time to do the Concept Close-Up *Metric Mania* that immediately follows this activity. It helps them think practically about metric measurements, as well as sets up a conversion chart for reference.

Equity Tips: For technically savvy kids, being a 'technical expert' is a chance for them to be involved with teaching others. On the other hand, setting up a training system also provides a chance to bring students who have been shying away from technology use into it. Choose some of these students to be 'early' technical trainers.

Assessing Math Learning: You can use the Tech Check activity at the end of Section 1 to assess your students' skills on ArchiTech.

ARCHITECH: USE IT NOW

1. Open ArchiTech on your computer.
2. Use the tools on the left-hand side of the screen to start designing a house. Follow the steps below, checking off each step as you go. Use the “Helpful Hints” column if you get stuck on how to do a step.

<input checked="" type="checkbox"/>	TRY THIS:	HELPFUL HINTS:
<input type="checkbox"/>	Make a house with 4 outside walls.	
<input type="checkbox"/>	Add doors and windows as needed.	
<input type="checkbox"/>	Divide the house into rooms.	
<input type="checkbox"/>	Add 1 piece of furniture per room.	<i>Click & hold on the ‘Bench’ icon to get the furniture menu.</i>
<input type="checkbox"/>	Move a piece of furniture from one side of the room to another (without destroying it).	<i>Click, hold, and drag as ‘the hand’ appears.</i>
<input type="checkbox"/>	Re-size a piece of your furniture (without destroying it).	<i>Click and drag on one of the corner ‘handles’ of the furniture piece.</i>
<input type="checkbox"/>	Rotate your front door so that it swings open to the other direction.	
<input type="checkbox"/>	Save your ArchiTech design before going further.	
<input type="checkbox"/>	Destroy one of your walls. Rebuild it.	<i>Place the destroy tool claw on the wall itself.</i>
<input type="checkbox"/>	Build a second floor to your house. Trace the outer walls and divide up rooms. Don’t worry about adding any furniture yet.	<i>Click on the “2” in the top left corner to get to the 2nd floor.</i>
<input type="checkbox"/>	Change the scale so that 1 unit (between 2 dots) equals 2 meters in the real world.	<i>Click on the scale lock; enter 2; and re-click on the scale lock to finish.</i>
<input type="checkbox"/>	Make a couch that is 2 meters long.	
<input type="checkbox"/>	Make a toilet that is about 1 meter wide.	<i>Go into the ‘Options’ menu and choose ‘No sticking’ so you can place between dots, not just dot to dot.</i>
<input type="checkbox"/>	Find the place on the screen that tells you that toilet’s exact dimensions.	<i>Look in the bottom left corner of the screen.</i>
<input type="checkbox"/>	Save your ArchiTech design again.	

3. You've got a house! Now let's analyze your house design.

a. Press the 'Data Window' button (at the top of the screen).
Press 'Calculate.'

How much is it going to cost to build your house? \$_____

b. There are other things you might want to know about your house:
Press 'Variable Choices.' There are 6 category headings in **bold**.

- Drag the variable 'Heating Cost' up to the Data Window.
Release it next to 'Building Cost' (so it makes its own column heading).
What does it tell you about your house design?

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- Use some of the other variables to fill in the chart below.

YOU NEED TO KNOW:	WHICH VARIABLE WOULD YOU USE?	ANSWER:
The count for how many meters of windows in your house		
The total floor area for your design		
The unit cost of the foundation for your house		
How to label your design with a memo		

4. Press 'Record' to ask the computer to record your current design.
When the 'Memo' box comes up, type in 'Design 1 - basic' to describe it.
Row 2 now shows a record of this design.

5. Push the button for 'Sliders' in the top left-hand corner of the screen.
Sliders reflect the *temperature* (the top 2 sliders) on which you would base *insulation* (the bottom 4 sliders) for your house.

a. Design 2: Change outside insulation from 20R to 30R.

How did that affect:

- your building cost?
- your heating cost?

Press 'Record' to keep a record of this most recent design.

Type 'Design 2 - changed outside insulation' in the memo box.

This design record will show up in Row 2 now.

b. Design 3: Decrease outside temperature by 10 degrees.

How did that affect:

- your building cost?
- your heating cost?

Press 'Record,' again, to keep track of this particular design.

Type 'Design 3 - decreased outside temperature' in the memo box.

This design record will show up in Row 2 now.

6. Which of your design(s) is cheapest to build? _____

Which of your designs is cheapest to heat? _____

MEASURE BY METRIC

A CONCEPT CLOSE-UP

Intent: To familiarize students with the metric system of measurement.

Students' Product: A completed conversion chart for continued reference.

Math Concepts and Skills:

Metric System
Measurement

Time Frame: 1 class session

Materials:

- Student Handout: METRIC MANIA
- Meter Sticks
- Rulers (with metric units on them)

What to Do:

(1) You may have seen students struggle with the metric units in ArchiTech. Start a general discussion about the metric system. Brainstorm different units of the metric system and ask your students if they can order the units of measurement. Is a centimeter smaller or larger than a meter?

(2) Give out the student activity METRIC MANIA. Give them time to complete the benchmarks section. When they get to the conversion part, you may want to do the first row with them. Afterwards, have groups of students discuss with each other the method they used to complete their chart.

Teaching Strategies: Students should find that converting within the metric system is easier than converting within the standard system. After students have completed this activity, ask them which one is easier and why. Some may still think the standard system is easier because of their familiarity with it. Others may say that the metric system is easier because everything deals with powers of ten. A big poster with the conversion table could be made by some of the students and then posted in the room for future reference. If you feel like your students could use more experience converting within the standard system, do the activity Standard Measurement (one of the activities from the **Measurement Systems** extension).

Assessing Math Learning (Post-Activity):

- Have your students write a letter to a friend explaining the metric system.
- Put the following on the board and ask your students to show how this is true: "To go from a smaller unit to a larger unit, divide. To go from a larger unit to a smaller unit, multiply."

Possible Solutions to METRIC MANIA Handout:

1. This chart gives students a chance to relate the metric system to objects with which they are familiar — either to objects in the world or to the standard units of measurement. Most students will have less intuition when it comes to how big the different units of metric measurement are.

metric unit	about the same size as ...
millimeter	the tip of a dull pencil
centimeter	half an inch
meter	a little longer than a yard
kilometer	a little more than half a mile

2.

1 kilometer = 1000 meters	1 kilometer = 100,000 centimeters	1 kilometer = 10,000,000 millimeters
1 meter = 100 centimeters	1 meter = 1000 millimeters	1 meter = .001 kilometers
1 centimeter = 10 millimeters	1 centimeter = .01 meters	1 centimeter = .00001 kilometers

3. Using the chart, you can see that there are 100,000 centimeters in 1 kilometer. Multiply this by 2 to calculate how many centimeters there are in 2 kilometers. The answer is 200,000 centimeters.

METRIC MANIA

1. Fill in the chart:

metric unit	about the same size as ...
millimeter	
centimeter	
meter	
kilometer	

2. Complete the following conversion chart for the metric system:

1 kilometer = 1000 meters	1 kilometer = _____centimeters	1 kilometer = _____millimeters
1 meter = 100 centimeters	1 meter = _____millimeters	1 meter = _____kilometers
1 centimeter = 10 millimeters	1 centimeter = _____meters	1 centimeter = _____kilometers

3. How many centimeters are there in 2 kilometers?
Explain how you got your answer.

RESEARCH ANTARCTICA



Intent: Provide ways for students to learn about the environment for their design.

Students' Product: Notes and lists about Antarctica.

Math Concepts and Skills: Organizing data

Time Frame: 2-3 class periods

Materials:

- Research Casebook: ROCK AND ICE
- Internet access

What to Do: Hand out ROCK AND ICE. It contains facts and figures on Antarctica, relevant Internet addresses, and a bibliography. Then choose *one or more* of these ways for students to begin researching Antarctica:

- Assign each group of AntArchiTects be responsible for collecting information on a certain Antarctic topic: climate, wind, history, etc.
- Give students the opportunity to show their expertise in a particular research topic. Either have groups make presentations to the class or ask them to prepare a handout on their topic—and then bind these handouts together as a class book.

Teaching Strategies: Research works most efficiently if the responsibility for different topics is distributed around the classroom. Students get a chance to be experts on a certain topic as well as be dependent upon sharing information and resources with each other. It sometimes helps students to organize their notes with two columns labeled — such as 'essential info' and 'fun info'— so that they can include interesting facts even if those facts are not directly relevant to their research topic. Encourage students, though, to keep their overall project — designing a research station — in mind as the context for their research.

Concept Close-Up: If you find your students confused by the Celsius temperatures they see in some of the Antarctica literature, give them time to do the Concept Close-Up *How Cold is Cold?* that follows soon after this activity. It helps them understand the basis for Celsius and suggests ways to make a conversion guide.

Teacher Quotation: “Unless the students know as much about Antarctica as possible, the station design become more of a house with a laboratory instead of a laboratory with living quarters.” - Jim Brohman, Buchanan, Michigan

COMPARE °F AND °C

A CONCEPT CLOSE-UP

Intent: To give students a sense of how C and F are related to each other by designing their own guides for conversion between the two measurements.

Students' Product: A guide for converting between Celsius and Fahrenheit.

Math Concepts and Skills:
Functions
Multiple representations

Time Frame: 2-3 class sessions

Materials:

- Student Handout: **HOW COLD IS IT?**

What to Do:

(1) Discuss temperatures in Antarctica with your students. They may have noticed during their research that most of the measurements are given in Celsius; how do those temperatures compare to Fahrenheit temperatures? Do they think there is a way to convert any Celsius temperature to Fahrenheit and vice versa?

(2) Give students the **HOW COLD IS IT?** handout to guide them through designing their own conversion guides.

(3) After students have created their conversion guides, have several groups explain their work to the class. Or you could ask students to make posters of their conversion guides, which could be displayed for students to browse.

Teaching Strategies: *If students are struggling with getting started, it's a good idea fill some of the chart in together. If you notice that one group has a good start, send a student from that group over to explain what they've done so far. Encourage students to make a graph of the relationship between Celsius and Fahrenheit. Ask them to describe the advantages and disadvantages of this kind of representation compared to a chart or equation. Depending on the experience of your students, you may challenge them to write an equation that describes the conversion between Celsius and Fahrenheit. First have them write out the steps for conversion in words, and then guide them towards simplifying this into an equation.*

Assessing Math Learning:

- Ask students questions about their guides as their designing them, such as "Can you convert any temperature between freezing and boiling using the guides?"
- Give students a few temperatures to convert. Allow them to use any of the conversion guides that are around the room.

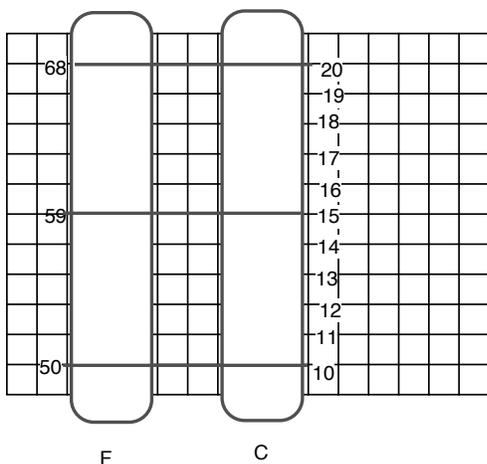
Technology Tips: Students could use a spreadsheet to generate a chart showing the conversions between Celsius and Fahrenheit.

Possible Solutions for *How Cold Is It* handout:

1. The relationship between a temp in °C and a temp in °F is a linear function. In creating a conversion guide, students are creating their own representation of a function. Some possible solutions:

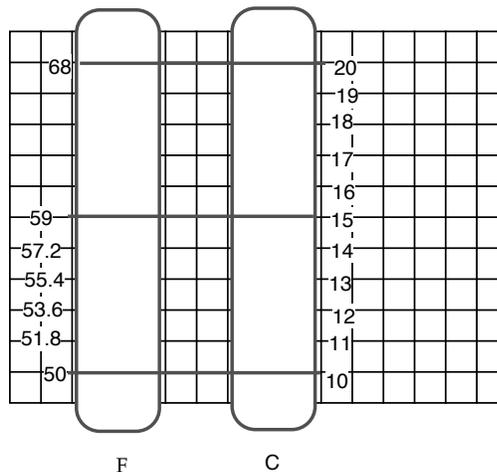
Solution 1:

Using the thermometer picture and making more pictures. Just using the picture gives a partial solution. Some students may be satisfied with this. But, we need more to answer questions such as: What's the °F temp for 85 or 86 °C? One approach is to "blow up" part of the picture to get a closer look, as in the picture here.



Since 59 is half way between 50 and 68 on the °F side, it maps onto 15 °C, which is half way between 10 and 20 on the °C side. To get all the other temps on the °F side from this little piece, we'll need decimal fractions.

From 50 to 59 is 9 degrees.
Divide this among five squares on the graph paper: $9/5$ of a degree for each square OR 1.8 per square. You will get this picture:



This still only solves the conversion problem for a few temperatures.

But the idea that there are 1.8 F degrees for every 1 C degree can be used to make a more general conversion solution. Using that reasoning could produce the following conversion guide:

When converting from Celsius to Fahrenheit,

1. Multiply the Celsius degrees by 1.8
2. Add 32 to the result.
3. This is the Fahrenheit temperature.

When converting from Fahrenheit to Celsius,

1. Subtract 32 from the Fahrenheit temperature.
2. Divide the result by 1.8.
3. This is the Celsius temperature.

Solution 2:

The standard equations for converting:

$$F = \frac{9}{5}C + 32 \quad \text{and} \quad C = \frac{5}{9}(F - 32)$$

Unless students have already seen these equations, they are unlikely to be the method of choice! But, you can introduce them after students have presented their methods, and show connections between their methods and the equations.

The thermometer picture is another way to make sense of the equations. You can point out connections between representations of this function.

For example:

Connecting equation to picture: The thermometer picture shows why we add 32 to go from C to F as well as multiply by 9/5. The spacing on the graph paper and how many degrees each square represents for F and C (18 and 10) shows where 9/5 comes from.

Connecting equation to words: Show how the equation gives the same “instructions” as the words.

2. $48^\circ \text{ Celsius} = 48(1.8) + 32 = 118.4^\circ \text{ Fahrenheit (pretty hot!)}$

3. Some students may choose to use only words in their guides, and their guides may be based on a set of instructions. Other students may use the pictures with a few words to go along with them. Still others may use the equation as the focus of their conversion guide.

HOW COLD IS IT?

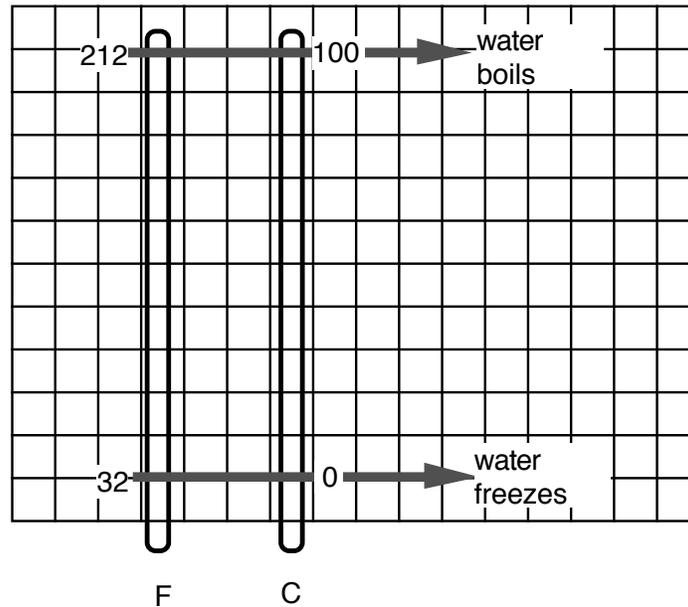
Temperature measurements come in different “flavors.”
You need to be able to use either and sometimes go between both.

Because Antarctica is an international reserve, temperatures in Antarctica are expressed in Celsius ($^{\circ}\text{C}$), which is part of the worldwide metric system. Celsius (or Centigrade) measurements are based on two temperatures for water.

	WATER BOILS	WATER FREEZES
CELSIUS $^{\circ}\text{C}$	100	0
FAHRENHEIT $^{\circ}\text{F}$	212	32

We can use these facts to convert any temperature in $^{\circ}\text{F}$ to $^{\circ}\text{C}$ or any temperature in $^{\circ}\text{C}$ to $^{\circ}\text{F}$.

1. Make a step by step conversion guide for converting between Fahrenheit (F) and Celsius (C). You can use the chart below, or any other charts, graphs, or pictures of your own.



2. Use your conversion guide to convert 48°C to F. Now use another group’s conversion guide to do the same.

3. In your logbook, write a paragraph comparing the two conversion guides. How are they different? How are they the same?

KEEP A MATH JOURNAL

ASSESSMENT

Intent: To set up a structure for student writing about the mathematical breakthroughs they encounter in *Antarctica*.

Students' Product: Entries in a math journal.

Time Frame: On-going.

Materials:

- Blank notebooks or binders
- Student Handout: *Math Journal Prompts / Math Reflection Guidelines*
- Student Handout: *Judging Your Writing*

What to Do: Many teachers use writing as a standard part of their math teaching. Whatever format you like — journals, 'problem-of-the-week' write-ups, etc. — can likely be adapted to work with this unit.

- Some teachers like to institute one general writing prompt that students use frequently. The *Math Journal Prompts* can help students organize their writing. OR you could, on the other hand, create personalized prompts based on your interactions with students that day. For example, if everyone seems confused about how big a meter is, you can ask them to write an entry that describes the sizes of objects in their rooms at home in meters.
- As students work on their projects, they will come upon new problems that require math to solve. Use the *Math Reflection Guidelines* to help students capture their thinking about these problems. Some teachers ask each group to do a certain number of math reflections (e.g. 3) during the unit, in addition to regular writing.

Teaching Strategies: In a project-based unit, writing is a tool for making the bridge between the experiences students have in the unit and the mathematical progress you want them to make. Writing is a great way to show progress because it is easy to compare early writing with later writing.

- **Grading:** Many teachers feel that it is important to grade student writing in order to communicate that it is an important part of their work in math class. Other teachers feel that written comments and a non-judgmental approach encourage more writing. You should decide what works best with your students. If you decide to use numerical scoring, try the *Judging Your Writing* rubric. It was constructed based on teacher recommendations — specifically that rubrics be simple. The 5-3-1 scoring was adopted because it saves time (you don't spend precious minutes deciding between a 2 and a 3). This rubric is reproduced on a handout, *Judging Your Writing*, in case you want to share it with students and have them judge their own work.
- **Sharing:** Seeing frequent examples of good writing is a sure-fire way to improve the quality of student writing. Try writing a journal entry as a class, sharing exemplary entries, and making up an entry for the class to score. Be as specific as you can about what qualities make an entry work.

Management Tips:

- Notebooks: Management is easier when all of a student's work is in one place. If you use spiral notebooks or composition books, you can have students glue handouts (such as Concept Close-Ups) into their notebooks. Binders also work well as math notebooks.
- Group Notebooks or Folders: Students will produce some writing collaboratively in small-group settings. A separate notebook or folder for the group guarantees that the group will have the writing no matter who is absent.
- Collect notebooks one class at a time so the pile doesn't seem overwhelming.
- Have students produce a lot of entries, but read each one quickly to get an overall sense, rather than deeply for detail, mechanics, and the like. You are looking for evidence of an upward trend, but not necessarily looking closely at each data point.

NAME: _____

MATH JOURNAL PROMPTS

Use these prompts to help organize your journal writing.

1. What did I do? Describe what your group worked through. . .

We worked on. . .

2. What math did I use? Describe the math you used. . .

We used. . .

3. What did I learn? Describe NEW math ideas you ran into.

I learned how to. . .

I also learned about. . .

4. Examples? Give examples of the math concepts you have described in questions #2 and #3 above. . .

For example, if you . . .

This is an example of how I used this math idea. . .

5. Troubles? Describe one math area or problem that you are having trouble with or don't understand or need help with. . .

We can't figure out . . .

It was really hard to. . .

I wish I understood. . .

I need help with. . .

MATH REFLECTION GUIDELINES

Use these guidelines to write a report about a math problem you have been working through with your group or by yourself.

1. Problem Statement

Write down the problem, question or issue in your own words so that another student could understand what the problem is.

2. Solution Process

How did you get started in solving the problem? What did you do? What worked, what didn't? What specific math ideas or methods did you use in exploring and solving this problem?

3. Justification

Write a clear written justification for your solution. What makes you think your solution is right or good enough? Is there more than one way to prove you are right? If so, explain both ways.

4. Extension

What's the most important idea from solving this problem that you'd want to share with others? Were you surprised by anything?

NAME: _____

JUDGING YOUR WRITING

Use this chart to get an idea about the quality of your math writing. What score would *you* give yourself?

SCORE	MEANING
5	<p>Shows evidence of thinking through the problem thoroughly.</p> <p>Shows accuracy and rigor in mathematical reasoning and problem solving.</p> <p>Uses math vocabulary appropriately.</p> <p>Uses diagrams and/or charts where appropriate.</p>
3	<p>Shows evidence of thinking through the problem.</p> <p>Includes some mathematically justified description, solution, or analysis.</p> <p>Makes some errors in math vocabulary, reasoning, or computation—or stops short of a complete solution or analysis.</p>
1	<p>Makes an attempt to think through the problem using mathematical vocabulary, reasoning, and/or computation.</p>

TECH CHECK ASSESSMENT



Intent: Assess students' skills at using the software for specific tasks.

Students' Product: Checklist of computer tasks completed

Math Concepts and Skills: Scale and measurement

Time Frame: 1 class period

Materials:

- ArchiTech software
- Student Handout: **TECH CHECK FOR ARCHITECH**

What to Do: Organize the class in one of several ways:

- Students work with a partner and evaluate each other's skills.
- Students work independently and you evaluate each one by one.
- You evaluate one student per group who becomes the assessor for her group.
- Any student who has been evaluated can check any other student who is ready.

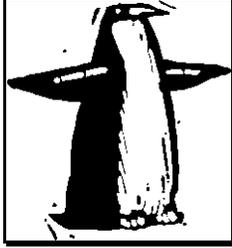
***Teaching Strategies:** If the peer assessment system is used, remind students that they can help each other with the tasks in the tech check, but should not do the assignment for them.*

AntArchiTect Certificate: After students complete the tech check, they have completed the training program laid out in the AntArchiTect checklist. Their certificate is on the back side of the tech check, and you just need to fill in each student's name. With Section 1 ending, it's a good time to bring each student's checklist up to date, as well as congratulate your class for good work so far.

TECH CHECK FOR ARCHITECH



Open ArchiTech.
Draw a building.
Find the building cost.
Find the heating cost per month.
Record the costs for this design in the data window.
Destroy one wall of the building.
Redraw the wall in a different way.
Update the building cost.
Update the heating cost.
Record the new costs for this version of the building design.
Draw a bench that is as close to 1.5 m x 3.5 m as possible.
Change the scale to 1 unit = 2 meters in the real world.
How big is that same bench now?
Name, save, and print your file.



It is with great honor
that we grant the license of

ANTARCHITECT

to our very own

You have shown strong mathematical skills,
research abilities, and design talent
during our AntArchiTect training program.

In order to keep this certificate up-to-
date, you must successfully complete the
rest of the assigned project activities.

KEEP UP THE GOOD WORK!

