Oregon Wood Magic™
Traveling Show
Unit Plans

This binder contains your Oregon Wood Magic™ Traveling Show Unit Plans that you may wish to use with your students. The Science unit (which focuses on life science) begins with an introduction to the plant kingdom; and, focusing on trees, covers topics in plant anatomy and physiology (vessels, photosynthesis, water transport, etc.), the importance of trees as resources, and how we manage forests for both our benefit and that of the entire ecosystem. Oregon Wood Magic is one lesson of the fourteen-lesson unit. The mathematics unit is project based and covers the geometric concepts of shape, perimeter and area, as well as measurement, algebraic reasoning, and calculations and estimations. You may want to use as many or as few of these plans as meet your curricular needs. Feel free to modify the lessons as you see fit to match your needs and the needs of your students.

We do request that, to maximize the educational experience of your class’s participation in Wood Magic, you do “prep” them for the program by highlighting what kinds of activities they should expect and by debriefing with them about what they learned after participating in the program.

You will be receiving a package of tree cookies (cross-sectional slices of branches). These correspond to life science lesson number 9. As part of that lesson, the students make name tags out of tree cookies. If you decide not to use the Unit or do lessons in a different sequence, please do have them make the nametags and wear them at Wood Magic. This will facilitate communication between your students and the presenter.

We look forward to interacting with you and your students at Oregon Wood Magic, Traveling Show!
Lesson One

Teacher notes: This lesson sets the stage for the unit. It begins by having students realize why plants are important and therefore are worthy of studying. To get students thinking about plants, they list plants and animals with which they are familiar, and compare and contrast these two kingdoms. A few things that students often have misconceptions about that you should pay particular attention to are:

**Plants can’t move.** Actually plants can and do move—think of rustling leaves, or plants tilting toward the sun on a windowsill. They just don’t have the freedom of movement that most animals have (for animal exceptions think of coral or sponges that tend to remain stationary for most of their lives).

**Plants don’t need oxygen.** Plants need oxygen, just like animals do! They breathe in oxygen and release carbon dioxide when they respire. During photosynthesis, they take in carbon dioxide and release oxygen. More oxygen is produced by plants than used in respiration, but plants do need oxygen!!

CIM Science Content Standard: Life Science: SC.03.LS.01, SC.03.LS.02, SC.05.LS.01, SC.04.LS.01.01

Goal: Set the stage for unit by going over the importance of plants. Introduce the plant kingdom by having students compare plants and animals.

Objectives: The student will be able to:
1. Explain why plants are important;
2. State several ways plants are similar to animals;
3. State several ways plants are different from animals.

Materials: Chart paper (4 pieces that can be posted) or white board divided into 4 sections for writing (you will need the list of plant examples that students generate for use in tomorrow’s lesson—if you can’t commit the board space for that long, you will need to copy this list for reference in Lesson Two)
Lesson:

Motivation/Preassessment

1. Tell students we will be starting a unit on plants. Ask students why they think plants are important. You may want to list their suggestions as they brainstorm. Some responses may be:
   - Provide oxygen
   - Provide shade
   - Pleasing (makes the neighborhood/home look nicer)
   - Share the earth with us
   - Start food chains
   - Provide materials (wood, medicines, paper, food, etc.)
   If they don’t mention oxygen, food, and other materials, you may want to hint at these to get them to mention them or mention them yourselves.

2. Ask students if they know the difference between plants and animals. (They will probably all say “yes.”) Tell them you want them to prove it.

3. Using a piece of chart paper or board section, label it “Animals” and have students provide examples (e.g. dog, cat, hamster, horse, etc.)
   Post the chart paper so students can easily view it throughout the lesson.

4. Label another piece/section “Plants” and get examples of plants. Try to get a variety to include trees (oaks, pines), flowers (tulips, dandelions), and non-flowering plants (fern, moss). Post this chart paper.

Body

5. Referring to the two lists of examples, tell students we will be generating lists of how plants and animals are alike and different.

6. Label another piece/section “Similarities” and record what students brainstorm belong on this list (living, breathe, need oxygen, need energy). Post.

7. On the final sheet of chart paper or board section, label “Differences” and repeat the process (Plants move in place while animals can move from place to place, Animals cannot make oxygen, Plants can make their own food, Plants have seeds or spores). Post.
Closure

8. Make some generalizations from the students’ lists. (Your comments will obviously need to be tailored to your class’s list, but they may include: Our list of animals is longer than plants—It looks like animals share a lot of characteristics with plants—and the like.) Comment to students on the fine job they did with the lists. Tell them we’ll be using them in tomorrow’s lesson.

9. Review by asking students to provide
   a) a few reasons plants are important
   b) two ways we are like plants
   c) two ways plants are different from us

10. Have students notice plants they might see on the school grounds, around their neighborhoods and homes to lengthen the list of plant examples tomorrow.

Extensions/Connections:
You might have students go through old magazines to find pictures of different kinds of plants and make collages or a class bulletin board.

You can take your students on a nature walk around the neighborhood or school grounds and bring back sample leaves, cones, etc. they find on the ground for a classroom display. (Take along some bags for students to use in gathering their “treasures.”)
Lesson Two

**Teacher notes:** Students will look at their list of plant examples and begin to classify them. They should find that there are many ways this can be done, and be told botanists actually use a variety of schemes. Students will then do an activity to classify trees. Possible sources of confusion are:

**Trees can have flowers.** While we tend to think of flowers as a separate group from trees, it is important for students to realize that some trees are flowering trees—for instance, magnolias, dogwood, even maples, though the flowers aren’t as showy!

**Size and color are often poor choices for classification characteristics.** Tall trees start out as tiny plants. In addition, sizes of plant parts, for instance, leaf size, can vary on any individual plant. Think about tree leaves and autumn to explain the problem color may pose.

**Fungi (mushrooms) are generally not classified as plants.** In most classification systems, fungi have their own kingdom. They are similar to plants, but they don’t make their own food (carry on photosynthesis).

**CIM Science Content Standard:** Life Science: SC.03.LS.01, SC.05.LS.01, SC.05.LS.01.01; Physical Science: SC.03.PS.01

**Goal:** Students will generate ways to classify plants, particularly trees.

**Objectives:**
The student will be able to:
1. Define classification as a system of grouping.
2. Classify plants in at least two ways.
3. State several ways trees can be classified.

**Materials:**
Student generated list of plant examples from Lesson One
Classification Handout
Optional: scissors

**Lesson:**
*Motivation/Preassessment*
1. Refer students to the list of plant examples they generated yesterday. Ask if anyone has any other plants to add to the list, and extend the list if possible.

2. Tell students the list has quite a variety. Ask them if they remember what classification means (a system of grouping things). Why is classification useful? (It helps to organize things.)

3. Have students tell you things they might classify (notebook sections, toys, Pokemon) and suggest ways they typically classify things (color, type, alphabetically, numerically, etc.)
   If students haven’t worked with classification before, you may have them do a quick classification activity using their shoes. How can you group them? (laces vs non-laces, colors, sport shoes vs dress shoes, etc.) Or use games students are familiar with (Pokemon can be water, rock, etc. In Monopoly, property is grouped by color. In chess, pieces are grouped by shape, i.e. pawns look different than bishops. With
playing cards, there are four suits and/or different face values.) Or talk about the school library: fiction vs non-fiction, alphabetical vs. numeric.

Body
4. Looking at the list of plant examples, have students suggest ways to classify plants. They may come up with size, color, flowering vs non-flowering, trees vs bushes vs flowers. Accept all reasonable ways.

5. Tell students that botanists have various ways of grouping plants as well. It’s not very easy to come up with just a few categories. You might mention the problems listed in the teacher notes. If you look just at “typical” flowers for an example, you can distinguish between single plants with one flower and bushes (daisy vs. rose) or annuals vs. perennial (plants that live for only one growing season and plants that flower year after year). You also have some plants that have both male and female parts in one flower, while other plants have separate sexes. They can also be characterized by the type of “fruit” they produce—dry dandelion fruits (the yellow flowers turn into the fluffy white balls that children often pick to blow) look very different from rose hips. Botanists also use the pattern of leaf venation (parallel as in corn which just shows parallel lines or netted as in maple leaves which has lots of branching), what the seed looks like (one cotyledon like corn or two cotyledons like peanuts), as well as other characteristics!

6. Inform students that for the remainder of the unit on plants, we’ll be focusing on trees—the different types, how they grow, their place in the ecosystem and our lives. Most of what we learn about trees will hold true for all types of plants, and some of it will even hold true for us!

7. Tell students they’ll be doing a small group classification activity to try and group different types of trees.

8. Explain that each group will be given a handout with pictures of different trees. The group should try and come up with at least two different ways they can classify the trees. Each group must choose a recorder to write down the groups’ classification ideas and a spokesperson who will share the group’s ideas. If you have scissors, the students may find it easier to cut out the individual pictures and manipulate them when deciding on classification schemes.

9. If students are done early, challenge them to continue to subdivide the groups and subgroups and make a chart showing how they divided the trees.
For an example to follow, you can use writing instruments:

```
writing utensils
  /   \
/pens  pencils
  /     /   \
/markers  ballpoint  colored
        /     /   \
       Red  blue  yellow
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10. Check for students’ understanding of the assignment. Form groups and pass out activity sheets.

11. Monitor students as they work. Be sure each group has assigned a recorder and spokesperson.

12. When students have had ample time to work, regroup as a class and have a spokesperson share one of the group’s ideas.

12. Record these so students will know what has already been proposed.

13. Once all groups have reported, see if there are any additional grouping strategies.

14. Commend students for their suggestions. Taxonomists (scientists who specialize in classifying) tend to make two broad groupings for trees: hardwood or deciduous (trees that lose their leaves each fall) and softwood or evergreens/conifers (trees with needle-like leaves). There are also many other characteristics they use, as well—such as whether the trees flower, the type of seeds they produce, what the leaves look like. So classifying is not a simple task!

Closure
15. If any students did the challenge and continued to subdivide the pictures, have them share their results with the class.

17. Review the lesson by asking students to define classification
give 2 ways plants can be classified
give 2 ways trees can be classified

18. Collect the students’ written group reports.
**Extensions/Connections:**
Students can cut out the pictures and paste them on poster paper to show various classification schemes. Students will need additional copies of the handout to have sufficient numbers of pictures.

Because patterns/relationships is a math standard, connections can be made to this activity in math class (e.g. we classify numbers as whole, fractions, decimals; we classify operations such as add, subtract, multiply, divide; you can show overlapping by grouping multiples of 2 then 3 and showing how some numbers can be classified in more than one category—just as with our plant classification scheme.)

Interpretation of data is a part of the Statistics and Probability CCGs. Having the students construct charts of their classification schemes will help reinforce this goal.
Lesson Three

**Teacher notes:** Today we move into life cycles and growth requirements. Some concerns you may run into:

**Cones don’t have seeds?** Not all cones that you find will still seeds in them. Generally they fall out of the cones and get blown away—that’s how the seeds are dispersed. So, students may often find “empty” cones. If you look at the individual scales of the cones, however, you can usually see the imprint of where the winged seeds were.

**Do conifers “shed” their leaves (needles)?** Unlike deciduous trees which shed their leaves on an annual cycle, conifers continually lose and replace their leaves (needles) so the tree is never “naked.” (Larch is a local exception of a conifer that does shed all its needles simultaneously.)

**Why do covered leaves lose their color?** If you choose to do the optional plant activity described below, the leaf that was covered will be paler in color. Green plants produce chlorophyll in the sun. In the absence of light, the green pigment cannot be replenished, so the leaf becomes lighter in color. Because chlorophyll is necessary for photosynthesis, the leaf will eventually die without sunlight.

**Do conifers shed their leaves (needles)?** Unlike deciduous trees which shed their leaves on an annual cycle, conifers continually lose and replace their leaves so the tree is never “naked.” (Larch is a local exception of a conifer that does shed all its needles simultaneously.)

(Note: The transparency with the various seeds really shows fruits (ripened ovaries). Obviously, not all fruits are fleshy like apples and peaches. Some are dry like maples and ash. This unit is not designed to get into specific reproductive structures, however. The distinction you choose to make between seeds and seed-bearing structures is left to your discretion based on your comfort level and the level of your students.)

**CIM Science Content Standard:** Life Science: SC.03.LS.02, SC.05.LS.01, SC.05.LS.01.01, SC.05.LS.04, SC.04.LS.04.01, SC.05.LS.04.02; Scientific Inquiry: SC.03.SI.01, SC.05.SI.01

**Goal:** Examine the life cycle of deciduous trees and conifers. Determine what seeds need to germinate and seedlings need to grow.

**Objectives:**
The student will be able to:
1. Define life cycle (series of stages living things go through throughout their life beginning with when they are formed until they can reproduce);
2. Explain the basics of the life cycle of a tree;
3. List the growth/development requirements of seeds and seedlings;
4. Compare and contrast deciduous trees and conifers.

**Materials:**
Overheads of life cycles of trees (deciduous and conifer)
Overhead of “seeds”
Overhead of cone with scales
Seed packet
Optional: Samples of maple “wings” and cones with scales
Lesson:

**Motivation/Preassessment**

1. Review yesterday’s activity. What were some of the ways we came up with to classify trees?

2. Today we will be looking at the life cycles of trees. Who can tell me what a life cycle is? (a series of stages a living thing goes through during its life)

**Body**

3. If we were to outline the life cycle of a tree, where would we start? How do all trees start their lives? (As seeds)

4. Seeds and the structures that hold the seeds look different depending on the tree. Show overhead of different “seeds” and have students say how they are different. (You can show the maple wing and cone if you have them.) (Students should respond that some are in cones, one is a fruit, some have “wings.” etc.)

5. Ask if students remember what a deciduous tree is (a tree that loses all its leaves in the fall).

6. Show the overhead of a deciduous tree life cycle. Go through the stages on the transparency.

7. Tell students deciduous trees are also called hardwoods. Ask why they think that is. (Because the wood from deciduous trees is hard!)

8. Have someone refresh everyone’s memory of what a conifer is (a tree with needles or needle-like leaves). Ask—do you think the life cycle of a conifer is different from that of a deciduous tree? (Answers may vary, but the cycles are basically the same.)

9. Do you think they start from seeds? (Yes) Put up the overhead of the cone with scales to show that seeds are inside cones. (You can refer to an actual pinecone, as well, if you have one with scales.) You can add that “conifer” means cone-bearing.

10. Put up the transparency of the conifer life cycle. Go through the stages.

11. Have students tell you the similarities and differences between the two life cycles. (Deciduous trees lose their leaves all at once during autumn and conifers don’t—otherwise, they are very similar.)

12. Ask, if a deciduous tree is called a hardwood, what do you think conifers are called. (Softwoods). Why? (Because the wood from conifers is softer than wood from deciduous trees.)

13. Use the overhead of “seeds” again. See if students can distinguish whether the seeds are from conifers or deciduous trees.

14. Hold up a seed packet. Ask if the seeds are living. (Yes, they’re dormant not growing.)

15. Ask how they know the seeds are living. (If they plant them they will probably grow.)
16. Ask what the seeds need to develop into plants. (*You’ll probably get sun, soil, water.)

17. Continue to prod: Can seeds develop without sun? Where do you plant seeds to grow them? (under soil) Does sunlight reach them? (no). So…(see if students can conclude that seeds do not need the sun to germinate.)

18. Ask: Do seeds need water? Think of the seed packet. What do you need to do to the seeds to get them to grow? (plant them…) Has anyone ever planted seeds and then forgotten to water them? What happens? (They don’t sprout!) So…(get students to conclude that seeds do need water to grow.)

19. Now move on to soil. Do seeds need soil? Has anyone ever tried growing a seed in just water (avocados or seeds on moist cotton balls)? Do plants begin to grow without soil? (Yes)

20. What about seedlings? When the seed germinates and a little plant—a seedling—begins to grow, what does it need to continue growing (again, you’ll probably get sun, water, and soil).

21. Go through all these again like you did with the seeds. Challenge the students. Do seedlings need sun? (What happens if a plant is grown in the dark? It dies.)

There are two activities you can do to show this, but both require time. You can actually place a small seedling in the dark (put it in a closet or place a box over the plant to prevent it from getting light and see what happens to it in a week. You will need to remember to water it!) Another activity is to use a mature plant and sandwich one of the leaves between aluminum foil or black construction paper, using a paper clip or a piece of tape to secure the covering around the leaf. In about a week, remove the covering from the leaf. The leaf should be much paler in color than the other leaves.

22. Do seedlings need soil? (Generally. Some plants can continue to grow in water, but they need to have nutrients added to the water.) (Some of your students may know something about hydroponics—where plants are grown in water and not soil; however, here, again, the water contains a nutrient solution.)

23. Do seedlings need water? (Yes) What would happen to a plant if you stopped watering it? (It would wilt and die.)

Closure
24. Tell students that a little later in the unit they’ll learn about how plants get water and work with the sun. For now, let’s review
   Which trees are hardwoods? Which are softwoods?
   What do seeds need to grow?
   What do seedlings need to grow?
   Have some one tell you the general scheme of a tree’s life cycle.
Extensions/Connections

As an optional activity, students can make a greenhouse bulletin board or grow seeds in cups or film containers. To make the bulletin board, you'll need soil, self-sealing plastic sandwich bags, and seeds (radish, lima bean, and corn all sprout quickly.) After putting their names on their bags, have students fill about ¼ of the bag with potting soil. Sprinkle a few seeds onto the soil and moisten the soil (don’t over-water or the seeds will rot). Seal the bags and hang on the bulletin board. Because the bags are sealed, they shouldn’t need to be watered. You can work in the water cycle to the activity! For the cup or film container alternative, students can do the same only using a different “pot.” They'll need to remember to keep these seeds moist.

Students may want to experiment and see if seeds really can grow without soil—some may use just moistened paper toweling or cotton and others can use soil. Skeptics may want to see if water is necessary! Some may want to see if seeds can germinate in the dark! Encourage them to investigate! (Moistened paper toweling or cotton balls may also be used in the greenhouse activity in lieu of soil.)

For math, students can examine their seeds each day and record when they sprout. They can then make graphs and/or determine the average number of days it takes for a particular type of seed to germinate. Once the seeds have germinated, they can make and record daily measurements of shoot and/or root growth. Again, results can be used as the basis for statistics or graphing. You can even double bar graph by comparing the growth rate of roots to shoots!

For geography, students may be asked to determine what types of trees are most common in the local area. They may look up growth requirements in library references and explain why certain trees are present while others are not.

To extend this geography lesson beyond the local area and to combine it with art, have groups of students looking at different climatic regions of the country and see which trees are most common to their region. (In Oregon, we could even look at the different types of trees as one moves from West to East!) The students could draw pictures or find pictures of these trees and place them on a US (or State) map to who the locations and the variety.

As an add-on science activity, you can also show geotropism with the seeds. Geotropism is a plant’s response to gravity. Roots grow towards gravity (down). Use a clear cup filled with cotton balls. Place seeds in various angles about halfway down the cup, between the outer wall of the cup and the cotton balls. There should be enough cotton to hold the seeds in their positions. Moisten the cotton. As the seeds germinate, you should be able to see that regardless of the angle of the seed, all the roots eventually grow down toward the bottom of the cup!

To show phototropism (the plant’s reaction to light), use a mature plant (or the students' seedlings!) and place them on a windowsill. If they aren’t moved, the stems will all eventually grow toward the source of the light. You can then turn them around and again the plant will reorient itself!
Lesson Four

**Teacher notes:** This lesson connects to the previous one by expanding on the concept of plants needing water. It involves an activity where students will see that water moves up the plants in special tube-like vessels. The lesson includes the names of the two main types of vessels in trees: xylem (ZY-lum) and phloem (FLOH-em). If you feel these words are beyond most of your students, just knowing that special tubes exist is sufficient for a basic understanding. A few points about the activity: use fresh celery and cut off the bottom of the stalks as close to the time you’ll be using them as possible (if possible, cut them while the students are preparing their water cups). This activity will be started today but won’t be completed until the next lesson. Think of a place where they can place the cups for a day (Window ledge? Counter top? Table?) (Depending on when during the day you start this activity, the students may see some changes in the celery before the end of the school day.) If you have a local florist, you may see if they would be willing to donate some carnations for your class to use in lieu of celery—even a few as class demos would be a nice touch!

**CIM Science Content Standard:** Life Science: SC.03.LS.02, SC.05.LS.03, SC.05.LS.03.01; Scientific Inquiry: SC.03.SI.01, SC.05.SI.02

**Goal:** Discuss how water moves up plant stems. Learn the names of the two main vessels in plant stems.

**Objectives:**
The student will be able to:
1. Identify the function of xylem and phloem;
2. Describe how water moves through a plant.

**Materials:**
Celery stalks (with leaves!)
Cups
Food coloring (dark colors only—red, blue, green—yellow and orange are more difficult to see. Ink works also.)
Water
A knife for the teacher’s use

**Lesson:**

**Motivation/Preassessment**
1. What were the three requirements for a tree to grow? (sun, soil, water)

2. Today we are going to focus on water. Do we need water? (Yes.) Which part of our body needs water? (All parts!) Which part of the tree needs water? (All parts!)

**Body**
3. How do we get water into our bodies? (We drink it!)

4. How does a tree get its water? (Through the roots)

5. Why? (It’s in the soil, and the roots branch out to soak up the water from the ground.)
6. What part of the plant does the water move to once it leaves the roots? (Students will probably say it moves through the stem)

7. Have students tell you what part of the tree is a stem. (The trunk)

8. Then where does the water go? (Through branches and leaves)

9. Ask students how we get water to all parts of our body (Hint: what runs throughout our body?) (Hopefully, students will be able to think of blood).

10. How do you think the tree gets water to all of its parts? (Probably won’t know)

11. Tell students trees have special tubes or vessels they use to move water and food throughout their structures. These two vessels are xylem (ZY-lum) and phloem (FLOH-em) (You should write these—they are strange-looking words!)

12. Explain to students that xylem are generally dead cells that water moves through in plants. Think of them as empty tubes, like straws.

13. Phloem are living cells that food moves through in plants.
   (A way that you may find useful to remember the difference between xylem and phloem is that “w” for water is close in the alphabet to “x” and “y.” And Phloem starts with an “F” sound, as does “food.”)

14. So water goes into the roots to xylem cells then passes through the xylem in the stems and branches to all of the tree parts.

15. Tell students they will do an activity to see how water can move up xylem. Demonstrate as you tell students what they will be doing. (Students can work individually or in small groups depending on the number of celery stalks you have.) Students will take a cup and fill it ¾ full with water. They then need to add 6 or 7 drops of food coloring to the water (or enough to darken the water). Remind them to be careful with the food coloring and not get any on their clothing. They should put their stalk of celery (stem with leaves) into the cup and place the cup in a designated area. (They need to be left undisturbed for a day.) Some students may have already done this activity or have seen it. These students probably won’t mind doing it again—but ask them not to tell other students what will happen.

16. Check for understanding, then let students begin their set-ups.
Closure
17. Once all students have placed their celery cups in the designated area, check for their understanding of today’s lesson:
   - Which way does water move in a plant? (Up—this wasn’t explicitly stated, so it’s an extension of the movement of water from roots to leaves. As a note, it also moves sideways in special cells called rays!)
   - What part of the plant takes in water? (root)
   - Where does it go from there? (through xylem or special tubes)
   - What is the name of the other type of tube-like structure in trees? (phloem)
   - What is moved through the tree in phloem? (food)

18. Ask students what they think is going to happen to their celery stalks? (Remind students who already know not to “give away” the answer.) Accept all reasonable guesses.

19. Tell students we’ll look at the stems tomorrow (or later in the day, if possible, as well) to see what happens!

Extensions/Connections
As a class demo, you might want to slit the bottom portion of the stem of a stalk vertically so each end can go in a different cup. (Cut the stem so the bottom portions can easily clear the tops of the cups. Leave the stalk connected the rest of the way!) If you make each cup of water a different color, half of the celery will have one color running up the stalk and settling into the leaves, and the other half will show the second color! This works with carnations, as well.
Lesson Five

**Teacher notes:** Today’s lesson wraps up yesterday’s activity with the colored water moving through the celery stalk. It gets the students thinking about what makes the water move through the plant and gives them a visual to relate to when the process is explained (pressure from below, evaporation from above, causes a “chain” of water molecules to move up the xylem). Students then do an activity to see if that holds true for trees. Because of the height of trees, that simple explanation doesn’t hold—but even scientists have just recently come to accept an explanation of how water conduction occurs in trees! This exposes students to some of the nature of science—that it is a human endeavor and we’re constantly learning new things and re-evaluating our ideas.

**CIM Science Content Standard:** Life Science: SC.05.LS.03, SC.05.LS.03.01; Scientific Inquiry: SC.03.SI.01, SC.03.SI.03, SC.03.SI.04; SC.05.SI.01, SC.04.SI.03, SC.05.SI.05

**Goal:** Follow up on the activity from the previous lesson and talk about how water moves through a plant. Do another activity to show the difficulties of water moving through a tree vs. a celery stalk!

**Objectives:**
The student will be able to:
1. Hypothesize ways water can move up a plant;
2. Demonstrate problems with water conduction in trees.

**Materials:**  
Straws (enough for about 6-12 for each student) McDonald’s straws work well if you can get them to donate some!)  
Cups  
Duct Tape  
Scissors  
Celery cups from Lesson 4  
Paper toweling  
Knife for the teacher  
Water

**Lesson:**

**Motivation/Preassessment**
1. Have students review what was set up yesterday (celery in cups of colored water to see how water moves up the plant).

2. Solicit ideas (a review from yesterday) of what they think will happen.

3. Dismiss students to get their cups and bring them to their desks. Have them get some paper toweling so they can place the celery stalk on their desks without getting everything wet!

**Body**
4. Give students time to examine their stalks. Ask for observations. (Should be able to see colored “dots” on the bottom of the stalk, streaks in stem and color in leaves).
5. Ask what they think the colored “dots” are? (They’re the colored water in the xylem.) If you cross section a stem, you can show them that the color does run all the way up! (Do this as a demo rather than going around and cutting each individual student’s stem.) Students may want to “snap” their stalks to check their own.

6. Ask students how water moves in a plant based on what they have seen with their stalks. (Students should be able to say water moves up by going through tubes.)

7. Review for students that the xylem are generally composed of dead cells; that is, they’re empty tubes. Have them think about how water can travel up these tubes? Have students tell you whether the water is moving with gravity or against gravity and how they know (against gravity because the water is moving up, away from the ground).

8. Solicit ideas on how this might work.

9. Have students think about straws. How does a liquid move up a straw? (It gets sucked up.) What might be doing that in the plant? (Evaporation from the top of the plant helps draw water off.)

10. After exploring students’ suggestions, tell them the water gets “pushed” into the plant with pressure (just like if you put a straw in a glass of water, some water will enter the straw). So, water is getting pushed into the bottom and drawn off the top by evaporation, which gets a kind of pump going. Also, because water molecules are attracted to each other, they tend to stick together—and that helps in this process, too! (You may want to sketch a picture of a tube with arrows to help show this process as you explain it.)

11. Look at the celery stalk. How big are xylem cells? (Not very).

12. Compare the size of the celery stalk with a tree. What differences are there (wider and taller).

13. Do the students think wider would be a problem? (Tree would have more xylem than the celery)

14. Do the students think height would be a problem? (Maybe?)

15. Show students a straw. Ask them about how many straws tall is a typical tree. (100’s)

16. Tell students they are going to pretend to be xylem in trees. They will get a bunch of straws and a cup to fill with water. Have them try to suck up a little water with one straw—then connect two straws together and try it—then three, etc. See how many straws they can connect and still be successful in getting in. Ask them what their sucking of the water represents (evaporation).
17. Have students clean up celery activity and pass out new supplies. Caution students not to exchange straws that they are sucking through with other students.

18. After students have completed the activity, see what the average and maximum number of straws were that students were successful with at drawing up water. (It shouldn’t be many!)

19. Ask how they think trees do it then?

20. After entertaining their ideas, tell them that even botanists (scientists who study plants) weren’t sure until just recently (and some botanists still have doubts) how water transport worked. It does involve root pressure, but only in certain plants. And it can occur even when transpiration (water loss by plants) doesn’t! In all plants, evaporation and the tendency for water molecules to stick together (cohesion) are definite factors. Tests have proven that once a string of water molecules is formed, it takes a great deal of pressure to break the stream. Also, the walls of the xylem cells are harder and the width is wider than the straws, which aids in the molecules “sticking” together. Stress the nature of science—that scientists are people just like us. They use observation, logic, and prior knowledge to help explain things. Sometimes it works, and sometimes it doesn’t! So scientific knowledge is tentative, subject to change, as we continue to experiment and make observations.

**Closure**

21. Summarize the activities.

   Water enters a plant through its roots; it moves throughout the plant through xylem.
   Ask what we did that can show that? (colored water in celery). Ask how water continues to move into and up the plant (pressure at the bottom and evaporation from the top).
   Ask about special problems with water movement in trees (height!)
   You may want to mention that trees—because they are wide-- also have special tubes to help move water sideways!

22. Tell students that now that they have some notion about how plants “drink,” in the next lesson we’ll start looking at how trees make their own food!

**Extensions/Connections**

There are a number of math ideas that can be incorporated into this lesson (averaging, range, relative sizes, estimation).

For language arts/drama, students can write and perform a play that depicts the parts of a tree, water and the air (maybe sun and wind) and shows how water is transported from the ground through the tree.
Lesson Six

**Teacher notes:** Today you will be explaining some chemistry to the students! By having them recall the differences between plants and animals, specifically that plants can make their own food, you lead them into a presentation on photosynthesis. You can modify this to use just words or you can expose students to the chemical symbols. Most will already know the symbol for water and some may know oxygen and carbon dioxide. It is doubtful anyone would know what kind of sugar is made in photosynthesis (it’s glucose), and more doubtful anyone would be able to recognize the formula! However, unless you think it would totally confuse students and make their attention wander, I would show them the symbolic representation for photosynthesis! The word “sunlight” is written on the arrow (“yields” symbol) to show that photosynthesis occurs only in the presence of light. Two *misconceptions* that may need to be addressed are:

**Plants don’t breathe.** This was also addressed in the first lesson. Plants do take in oxygen and release carbon dioxide during respiration, just like animals!

**Plants are always engaged in photosynthesis.** In order for photosynthesis to occur, sunlight is needed. Plants cannot carry on photosynthesis in the dark.

**CIM Science Content Standard:** Life Science: SC.03.LS.02, SC.05.LS.05.03

**Goal:** Get an understanding of what occurs in photosynthesis.

**Objectives:**
The student will be able to:
1. define photosynthesis as the process by which plants make food;
2. state that during photosynthesis, plants take in carbon dioxide and water and, in the presence of sunlight, produce a sugar and release oxygen.

**Materials:**
None

**Lesson:**

**Motivation/Preassessment**
1. Ask students for some of the differences between plants and animals.

2. If “plants can make their own food” is not offered, ask, “What’s different about how plants and animals ‘get’ food?”

3. Ask if anyone knows the name of the process by which green plants make their own food. (Supply “photosynthesis” if no one can or does.)
4. Write photosynthesis on the board then draw a slash between photo and synthesis.

5. Ask students what they think “photo” means. (Can prod with other words they’re familiar with that use that prefix—photography, photograph—can you take a picture in the dark? No. What do you need? A flash or light!)

6. Write “light” under photo.

7. Ask students if they have any guesses about what synthesis might mean. (Again, you may be able to prod with synthetic or synthesizer from music).

8. Write “to make” under synthesis.

9. Tell students that photosynthesis comes from words meaning to make with light.

10. Give a preliminary definition of photosynthesis as the process by which green plants, in the presence of light, make food.

11. Have students recall that all living things need food for energy to stay alive and grow.

12. Ask students what happens to a plant kept in the dark? (It dies, wilts, etc.)

13. Ask, what is the light that plants need for photosynthesis? (Generally, it’s the sun—although artificial lights work also, e.g. grow lights, fluorescent lights, etc.)

14. Remind students that plants give us oxygen. Ask why that is important. (We need it to breathe.)

15. Ask students what we breathe out. (Carbon dioxide)

16. Ask students if plants breathe, too. (Students probably won’t know, but plants also breathe—and they also take in oxygen and release carbon dioxide when they breathe! Clarify confusions that might arise by telling students that plants produce more oxygen during photosynthesis than they consume – use up during respiration, which is why plants can be such an important source of oxygen.)

17. Refocusing on plant needs and photosynthesis, ask what else plants needed to grow besides light. (water)

18. Tell students that during photosynthesis plants use carbon dioxide from the air and water from the soil, and in the presence of sunlight, make a sugar and give off oxygen. The sugar is the “food.”
19. You may want to write the equation for photosynthesis on the board, using words and possibly symbols, depending on the level of your students:

\[
\text{Sunlight} \quad \text{CO}_2 \quad + \quad \text{H}_2\text{O} \quad \longrightarrow \quad \text{C}_6\text{H}_{12}\text{O}_6 \quad + \quad \text{O}_2
\]

You will need to tell them that \(\text{C}_6\text{H}_{12}\text{O}_6\) is the chemical formula for glucose, a sugar.

And/or

Plants use carbon dioxide and water (in sunlight) to make sugar and oxygen.

20. Ask students where in a tree they think photosynthesis happens? (The leaves or needles—you may need to let them know that needles are modified leaves.)

21. See if they remember the name of the vessels (tubes) the plants use to transport food made from the leaf throughout the tree. (Phloem)

22. Unlike the xylem, phloem cells are alive. The tree can actively move “food” from cell to cell.

Closure

23. Tell students that in order to make food, leaves use pigments or colors to absorb the sun. Let them know they’ll be doing an activity with leaf pigments tomorrow.

22. Review the day’s presentation by checking for student’s comprehension/recollection:
   a) What is photosynthesis? (process by which green plants make food)
   b) What does a plant take in during photosynthesis? (carbon dioxide and water)
   c) What does a plant release/give out? (oxygen)
   d) What does a plant make? (sugar or glucose)
   e) Can a plant carry on photosynthesis in the dark? (No. Sunlight is needed.)

Extensions/Connections

For an extension that would expose the students to more about the nature and history of science and importance of recording procedures of experiments carefully, can have students read about the “discovery” of the process of photosynthesis. The work of van Helmont, Priestly, and Ingenhouz make for fascinating reading! (van Helmont showed water and not soil was responsible for an increase in plant mass. Priestly showed plants produced oxygen – or “restored air” since he didn’t know it was oxygen! - by placing a mouse and mint shoots under a glass bell jar. The mouse lived! Unfortunately, other scientists at the time (1772) and Priestly, himself, couldn’t replicate his experiment! In 1779, Ingenhouz showed the mint had to be in light for the air to be “restored.” Priestly had rearranged his lab, and the bell jar was no longer in the light, so the mint was unable to photosynthesize!) Interesting stuff, and it shows that scientists are not infallible!
Lesson Seven

Teacher notes: Building on the previous lesson on photosynthesis, this lesson focuses on the leaf pigments that are necessary to absorb the sunlight. The students do a paper chromatography activity to see the different pigments in leaves. Chromatography is a process used to separate different chemicals. This activity will lead into a discussion about fall leaf coloration in lesson eight.

CIM Science Content Standard: Life Science: SC.03.LS.02, SC.05.LS.02, SC.05.LS.03, SC.05.LS.03.01; Physical Science: SC.03.PS.02; Scientific Inquiry: SC.03.SI.01, SC.03.SI.03, SC.03.SI.04, SC.05.SI.01, SC.05.SI.03, SC.05.SI.04

Goal: Discover different pigments found in leaves by doing two paper chromatography activities—one with a marker pen and one with leaves.

Objectives:
The student will be able to:
1. Describe pigments found in leaves;
2. Carry out a paper chromatography activity.

Materials:
A jar with pebbles, sand and water (to use as a class demo)
For each student or group of students:
Fresh leaf
Pencil
Rubbing alcohol (about an inch for each cup)
2 cups
Two strips of a white coffee filter (The filter should be cut into strips that are narrow enough to fit into the cup and be longer than the cup. If available, chromatography paper can certainly be used!)
A dark water soluble marker (blacks usually work best)
Water
Safety glasses (if available)

Lesson:

Motivation/Preassessment
1. Ask students who remembers what photosynthesis is? Solicit a definition (process by which green plants make food)

2. Have students tell you where in the tree photosynthesis occurs. (leaves)

3. Ask what color are most leaves (green). Ask if the leaves always stay green (No) What happens? (they change color in the fall)

4. Note: If you did the optional activity in Lesson 3 where you covered a leaf, this would be a good time to complete that activity. Remove the foil and see what color the covered leaf is (it should be pale and yellowish). Ask the students why they think the leaf changed color.
5. Remind students that plants need sunshine to carry out photosynthesis. Tell them plants also need sunlight to help the leaves make their green pigment.

6. Ask students what a pigment is (It’s something that gives an object its color). Ask students what pigment they see in green leaves. (green) You may want to tell them that the green pigment is called chlorophyll.

**Body**

7. Tell students that the green pigment is what helps the leaves absorb the sunlight during photosynthesis. Make an analogy to wearing dark colors in the sun—you feel warmer because darker colors absorb more of the sunlight than lighter colors.

8. Ask students where they think the colors you see in leaves in the fall comes from (some may guess other pigments—if not ask if other pigments might be present in leaves)

9. Tell students they will be carrying out an experiment to see if there are different pigments in leaves.

10. Explain and demonstrate to the students what they will be doing during this activity.

   a) Place a fresh green leaf top side down on the strip of coffee filter, leaving about 2 inches from the leaf to the end of the strip.
   b) Using a pencil, rub the point back and forth over the lower portion of the leaf about 15 times. (Hold the pencil at an angle so as not to cut through the leaf with the pencil point!)
   c) Move the leaf so an unrubbed portion is placed over the rubbing. Repeat the pencil rub.
   d) Continue moving and rubbing the leaf until a dark green spot is visible on the coffee filter. Tell them that this spot is the leaf’s pigments.
   e) Place the strip into the cup so the spot is inside the cup. Fold the other edge over the end of the cup.
   f) Pour alcohol into the bottom of the cup so the bottom of the filter strip is in the alcohol, but the spot is not! Provide safety directions for working with alcohol (don't drink it, get it on their skin, in their eyes, wear safety glasses, it's flammable, etc.).
   g) Leave undisturbed for about a half an hour.

11. Check for students’ understanding of the procedure, then have them prepare the cups.

12. After the students have set up their “chromatography chambers” have the students perform a chromatography activity with a marker pen while they are waiting. This is similar to the leaf activity, but much quicker.
13. Instead of demonstrating first, you may have students do this along with you. Sharing pens won’t be a time problem. Have students take another strip of coffee filter and make a dark small dot with the marker pen about an inch from the bottom (they should make the dot by using a circular motion with the pen so they have a small, filled-in circle). Place the strip in a cup, as before. This time add water. IT IS IMPORTANT THAT THE DOT NOT GET WET. The students might get their strip positioned, then remove it to add water to the cup. They only need enough water in the cup so the bottom of the filter strip will get wet. After the students place a small amount of water in their cup, have them replace the strip and then watch what happens.

14. As the water moves up the filter strip and hits the dot, the ink should start streaking color bands up the paper. (Most black markers are made up of a number of colors mixed together. The water separates the colors. Colors generally seen are blues, yellows, purples, depending on the marker brand.)

15. Have the students remove their marker strips and share their findings.

16. Ask students if all those colors were visible in the original dot. (No)

17. Explain to students that the procedure they are using in these class activities is called paper chromatography.

18. Write chromatography on the board and break into parts, similar to what was done with photosynthesis. "Chrom" means color and "graph" means to write. Tell them that chromatography is a way to chemically separate materials—in this case water was used to separate pigments. Alcohol was used with the leaves.

19. To explain how it works, take the jar with pebbles, sand and water. Ask students what would happen if you shake the jar. (The materials will get mixed.) Do it.

20. Ask students what will happen if you let it sit on the desk. (The materials will settle out). What will be the order? (pebbles, sand, water). Why? (the heavier materials settle on the bottom and the lighter ones on top) The same thing happens with chromatography. The heavier pigments settle out first!

21. Ask students what they think is happening with their leaf colors? Go look. (Students should see two colors on their strips—green and yellow. Some may have different shades of green, as well.)

22. Have students report their findings. Ask students what pigment in the leaves are the heaviest (green). How do they know (it’s on the bottom)
Closure
23. Have students clean up from the activities (dispose of strips, empty cups, etc.)

24. Hold up a different colored marker. Ask students what color it is. Ask them what they think would happen if you made a dot with that marker and put it in water (Might get different colors). Is there any way of knowing just by looking what colors will streak out? (No)

25. Ask students to tell you what they learned today from these activities.

26. Tell students to think about why they might have seen shades of green and yellow on their chromatography strips, but not in the leaf itself. Have them think about why they see different colored leaves in autumn. These will be the topics of the next lesson!

Extensions/Connections
As an art activity, students can use water-soluble markers to make designs on whole coffee filters. (Don’t color the filter completely.) The students then can fold the filter continually in halves until they have a tight triangle. Place the folded filter into a cup with just a bit on water on the bottom, so the tip of the triangle (which would be the center of the filter paper) would just be touching the water. As the water is drawn up the coffee filter, the colors will run and pigments will separate, etc., making tie-dye like designs on the filters. After they dry, you can hang these on the windows or bulletin boards and decorate the classroom!
Lesson Eight

Teacher notes: After seeing that green leaves are made up of at least two colors in the chromatography activity, students will be led into a discussion of fall coloration. This is another opportunity to discuss the nature of science. Botanists do not have all the answers to why leaves change colors, but there is much that is known! Weather patterns, as well as the chemicals present in the sap of trees, affect the colors that will be seen. Seasonal changes will be tied into the growth cycle of trees, which will then progress to how trees grow. A misconception that may need to be addressed is: Trees grow from the bottom up. Actually trees grow from the top! This is easy to see if you think about attaching bird houses or where people have (in bad judgment) carved initials into trees or if students have seen clothesline pulleys attached to trees. All those things remain in a constant position over time. If trees grew from the bottom up, each year these items would be found higher and higher from the ground!

CIM Science Content Standard: Life Science: SC.05.LS.06, SC.05.LS.05.05

Goal: Discuss fall coloration of leaves, as well as the yearly growth cycles of trees and how they grow.

Objectives:
The student will be able to:
1. Provide an explanation for fall color changes in leaves;
2. Explain what happens to deciduous trees throughout the year in terms of growth.

Materials:
Overheads of tree life cycles and cross section of tree stem
For class demo:
Cup
Water
Food coloring (green, yellow and red)
Optional: Balloon

Lesson:
Motivation/Preassessment
1. Ask students what we discovered about leaf pigments yesterday (there are more than just green in the leaves)

2. Ask students why they think they see different colors on leaves in the fall. (Accept any reasonable explanation).

Body
3. Tell students that if we used a different chemical yesterday, they would have been able to separate more pigments from the leaves than just the greens and yellow. Have students give other pigments that might be present in leaves (brown, red, orange). You can tell students that there are a number of different green pigments, as well, which is why some saw different shades of green in their strips.

4. Ask students if they remember what the purpose of the pigments are. Have a student supply the answer (They absorb sunlight to help in photosynthesis)
5. Help students try to figure out why leaves change color in the fall. Use a cup of water and put in a few drops of yellow food coloring. What happens to the water (it turns yellow because of the yellow coloring.) Have students think of the food coloring as pigments.

6. Ask students what would happen if you put in a lot of green coloring into the cup. (It will turn green. Some may think the two colors would blend.)

7. Put in enough green coloring so the yellow is no longer visible and future drops of food coloring can also be masked.

8. Ask what would happen if you put in a few drops of red? (May get various responses). Do it. (The red should not be visible if you have enough green in the cup.)

9. See if students can equate this to leaves. Why do leaves usually appear green if they contain many pigments? (Green is present in the greatest amounts so they “overpower” the other pigments.)

10. Ask students what would happen if you could remove the green pigment from the leaves—or from the cup. (Other colors would be visible)

11. Equate this to the fall leaf color changes. What was needed to make the green pigment, chlorophyll? Sun What happens to the amount of sunlight as the seasons change? (less sunlight, cooler, wetter weather in the fall) Tell students that in cooler temperatures, the green pigment begins to break down. What would that do? (allow other colors to show) Eventually other pigments break down, too. The leaves no longer can absorb enough sunlight to produce pigments or carry on photosynthesis. What happens next? (the leaf dies and falls off the tree)

12. Return to the life cycle of deciduous trees. Place the transparency on the overhead. Have students lead you through the annual cycle.

13. Ask what happens to the tree after it loses it leaves. Does it die? (No because it is still alive in the spring!)

14. Explain that in the winter since the temperature is cooler, the trees go dormant. Ask if someone can explain this. Equate it to hibernation. (The tree is still alive, but it is not growing.) Why? (There is less sunlight, so less energy to make food, so the tree conserves the energy it has! As spring arrives, the days get longer and warmer. The nutrients in the roots are drawn up into the tree and help make new leaves.

15. Ask students if the same thing happens with conifers? (Show the life cycle diagram of a conifer.) (Students should know that the needles stay on all year.)
16. Tell students that the needles drop (are shed) and are replaced year-round.)
Remind students that needles are a specialized leaf. Because of the decreased
sunlight available in the autumn and winter, photosynthesis declines. The results
are the same as with deciduous trees. Conifers do not add new growth in the winter!

17. Summarize (or have a student summarize) that trees grow more quickly in the
spring, slow in the summer, and taper to no growth in autumn and winter.

18. Ask students how does a tree grow? In what directions? (you are looking for up
and out)

19. Explore the change in tree height first. Ask students if the tree grows from the top
up or from its roots up. (You may get students voting for both options. Don’t give
them the correct choice or indicate what it is!) Ask students if they have ever seen
initials carved into a tree. (yes) If they haven’t seen initials, see if they have seen
other things attached to trees (pulleys, bird houses, etc.). Ask if these things have to
be reset every year or if they remain at the same height. (Students should realize
they remain at the same height). Ask the question again—does a tree grow from the
top up or from its roots up. (From the top!)

20. Ask students how else a tree grows besides taller. (Wider). Have students show
you with their hands about how wide a sapling is. What about a mature tree? Ask
how a tree grows wider? (Accept all ideas.)

21. Show the transparency of a cross section of a tree.

22. Ask how old the tree is? How do they know? (Some may know you can count the
tree rings to age a tree.)
   Point out the xylem on the diagram. (It’s number 4) Ask for someone to recall
   the function of the xylem for the class (transports water)
   Point out the phloem. (It's number 2). Again, ask for its function (transports
   food).
   Ask students what they think number 1 is (bark)

23. Help students deduce why you can count the rings of a tree to determine its age.
Ask why you can count tree rings to determine the age of a tree. (Students
probably won’t know.)
Ask if conditions for tree growth is more favorable in the spring or summer.
Remind students that trees need sun and water to grow. (Spring)
Ask what happens to tree growth in the spring and summer vs. fall and winter
(faster when its warmer and wetter, and no growth in cooler, drier months)
Tell students the xylem vessels appear narrower when it grows slowly and wider
when it grows quickly. When it grows more slowly, the band is dark and when it
grows more quickly, the band is light. Ask why? (Make an analogy to a balloon.
When there’s no air in it, and it’s smaller, the color is dark. When you blow into it
and stretch it, and it’s larger, the color is lighter. If you have a balloon,
demonstrate this.)
How much growth do we see in trees during cold months? (none)
Help students conclude that a pattern of light and dark rings will be made each year. That’s the reason you can determine the age of a tree by counting its rings!
Looking at the overhead, ask for students to point out springwood or earlywood (it’s lighter in color—cells are wider) and summerwood or latewood (it's darker in color—cells are narrow).
Ask where the wood from the rest of the year is found? (no growth, so no rings)

24. You may want to point out the cambium layer on the transparency. (label 3) Tell students this is the layer were cells divide to make new cells. The xylem forms to the inside and the phloem form to the outside of the cambium. Remind students that the xylem are generally not living. The only part of the stem that’s alive is the phloem and cambium.

25. Ask students why they shouldn’t cut initials or other marks into trees. (opens them to infection.) Ask if they can see another reason it’s not good for the tree. (You would cut into the cambium and the tree couldn’t grow there.)

26. Tell students there are others things we can learn from looking at cross-sections of trees besides the age of a tree and we’ll be exploring that in a future lesson.

Closure
26. Have students review what was presented in this lesson
   Why do leaves change colors in the fall? (as pigments are broken down, different colors are seen)
   How do the seasons affect tree growth? (Trees grow more quickly during some seasons and more slowly to not at all during others)
   What can we tell from looking at a cross section of a tree? (How old it is)
   In what directions do trees grow? (from the top up and wider!)

Extensions/Connections
For reading you may want the students to read The Tree by Judy Hindley or The Giving Tree by Shel Silverstein (depending on their reading levels). You can have a discussion on either/both books after the students have read them.

For art, students can make leaf rubbings. Place a piece of paper over the vein side of a leaf. Using the side of a crayon (remove its paper wrapping), rub over the paper. You can also make fruit prints by using fruit as “rubber stamps”—cut a fruit in half crosswise, dip into paint, and press on paper. A little practice here makes perfect. Different fruits and different angles of cutting have different designs!
Lesson Nine

**Teacher notes:** Tomorrow is Wood Magic day! Prep the students by telling them what they can expect to do and see (without giving away too much!) and reviewing assembly behavior. Students will also be looking at tree cookies (cross sections of trees) and making them into name tags to wear on the field trip. (A class set of tree cookies will be mailed to you as the field trip approaches.)

**CIM Science Content Standard:** Life Science: SC.05.LS.03, SC.05.LS.03.01

**Goal:** Look at tree cookies to see the growth rings. Apply what was presented about the cross section of a tree from a overhead to the real thing. Prepare for the Road Show Presentation.

**Objectives:**
The students will be able to:
1. Identify the xylem and phloem on a tree cookie;
2. Tell their parents/guardians/others what they will be doing and seeing at Oregon Wood Magic Road Show;
3. Make a name tag out of their tree cookie.

**Materials:**
Tree cookies
Markers
String
Overhead of cross-section of a tree stem
Optional: Hand-lenses

**Lesson:**

**Motivation/Preassessment**
1. Ask students to volunteer to come up to the overhead and identify the bark, phloem, xylem, and cambium on the transparency.

2. Have students tell what the functions of those three parts of a tree are (xylem transports water, phloem transports food, cambium is the growing area)

**Body**
3. Tell students they will be receiving their own cross section of a tree branch a little later in the lesson to see if they can identify these parts on the “real thing.”
4. Remind students that tomorrow they will be having a guest speaker come to the school and they will be participating in the Oregon Wood Magic Road Show Program. Give them an overview of what to expect:

They will be listening, viewing a series of demonstrations, and participating in a variety of activities. They will learn something about trees, their biology, ecology, our use of them, and how to optimize our use of these resources. They determine how strong a piece of wood is, see if they can blow bubble through a piece of wood, learn what products (besides furniture, paper, and pencils) that we get from trees, and more.

5. Review what you expect from them. Go over class assembly rules.

6. Tell students you will be passing out the tree cookies. They are to see if, using the overhead as a guide, they are able to locate the annual rings, xylem, phloem on their tree sections. (It is sometimes difficult to distinguish between the phloem and cambium.) They can also find the bark!

9. If hand lenses are available, have students use them to examine their cookies.

10. Tell students that after they have found the parts of their stem, they are to convert the tree cookie into a name tag that will be used at the Oregon Wood Magic Show tomorrow. They should use markers (or whatever classroom supplies they/you chose) to decorate their cookies. They should write their names across the diameter so the presenter at Oregon Wood Magic can identify them!

10. Show them how to attach a string to the cookie so they will be able to wear the tags tomorrow.

11. Pass out the cookies, string, hand lenses, art supplies, etc. As they work, walk around and see if the students are remembering to identify the different areas of the stem before decorating them! (You can always have them turn them to the undecorated sides to point to a particular part as you circulate around the room.)

Closure
12. Collect the wood cookies. Review whatever you feel you need to highlight for the field trip.

Extensions/Connections
Encourage the students to talk to their families/guardians about what they expect to see at Oregon Wood Magic road Show.
Lesson Ten

**Teacher notes:** This is field trip day! Be sure to bring the students’ name tags so they can wear them during the visit.

**CIM Science Content Standard:** Life Science: SC.03.LS.02, SC.03.LS.04, SC.05.LS.03, SC.05.LS.05, SC.05.LS.05.05, SC.05.LS.06; a variety of common curriculum goals from History and Nature of Science, Science in Personal and Social Perspectives, and Science and Technology

**Goal:** To give the students first hand experiences with forest products and concerns.

**Objectives:**
The student will be able to:
1. Extend their knowledge about the biology and ecology of trees and forest products; the products we make from trees, and forest-related careers;
2. Gain a deeper appreciation of forests and our reliance on this resource.

**Materials:**
Name tags

**Lesson:**
This will be handled by the presenters!

Collect the name tags after the trip for use in tomorrow’s lesson!

**Extensions/Connections**
Depending on your schedule, if you have time when you return to school you may want to have the students write about what they learned at the presentation; perhaps something about their favorite part. You can work this into a language arts lesson and have them write a particular form of poetry or an art lesson and have them draw something new they learned.
Lesson Eleven

Teacher notes: This lesson will begin with a debriefing of the visit to Oregon Wood Magic and extend into a discussion on the importance of trees, concentrating on ecology, information providers, and special role in cities.

CIM Science Content Standard: Life Science: SC.03.LS.04, SC.03.LS.05, SC.05.LS.04; SC.05.LS.05, SC.05.LS.05.03, SC.05.LS.05.05

Goal: For students to understand the roles trees play in the environment.

Objectives:
The student will be able to:
1. Discuss the main points from the Oregon Wood Magic presentations;
2. List reasons trees are important.

Materials:
Post tests
Advanced organizer transparency
Tree cookie name tags
Handout of tree cross sections
Transparency of tree cross sections handout

Lesson:

Motivation/Preassessment
1. Review the highlights of the field trip:
   What did you learn from the Wood Magic trip?
   What was your favorite station?
   Did you learn anything that was surprising?

2. Tell students that many of the presentations from Oregon Wood Magic dealt with the uses of trees. See if students can recall some of these so they can be discussed in greater detail.

3. You may want to use a concept map as an organizer to help in this presentation. One is provided as an overhead should you care to use it!
Body
4. The presentation will be centered around 4 main categories of the importance of trees. What’s listed are ideas you can include if students don’t generate these themselves.

5. Ecology
Think of the trees that are growing in the forests and parks and on our street. What purposes do they serve in the environment? (List the students’ suggestions and discuss briefly as they are mentioned. These may include
   a) homes for animals (squirrels, birds, insects)
   b) food for animals (fruits/seeds such as acorns, apples, etc.)
   c) dead trees and logs serve as homes for animals as well as food sources for insects and fungi
   d) base for mosses and lichen to attach and grow
   e) part of the water cycle (takes water from the soil and returns in transpiration)
   f) part of the carbon dioxide/oxygen cycle (takes in carbon dioxide during photosynthesis and releases oxygen)
   g) part of the nitrogen cycle (takes nitrogen from the soil and returns it when it decomposes)
   h) erosion control (helps hold soil in place)
   i) provides nesting materials for animals
   j) helps with stream life (offers shade so cools water; downed logs make ponds for spawning)
   k) provides food supply and homes for insects, as well (termites, ants, etc.)

6. Special Uses in Cities
   a) shade
   b) filters the air (traps dust, ash, smoke) and absorbs pollutants (sulfur dioxide and others). Twenty pounds of carbon dioxide are produced for each gallon of gasoline burned by an automobile. A young tree can remove 25 pounds of carbon dioxide in a year! Think of the number of trees that are needed to help keep our air breathable!
   c) windbreak
   d) muffles traffic noise
   e) pleasing to look at
   f) place for wildlife in the city (provides home and food)
7. Clues to the past
   a) Clues to the past, including species present and climatic conditions –
      fossilized seeds and other tree parts give us information about past climates.
      For example, if we found fossils of a palm tree, what would that tell us about
      the climate at that time? (It was hot)
   b) Clues to recent climatic conditions – by looking at tree rings, we can
      determine the richness of the soil, occurrence of droughts or floods, if and
      when fires might have occurred, the abundance of rainfall, amount of insect
      damage. How? What might you see if these different conditions occurred?
      (Good growth, so wide rings, occur if growing conditions are favorable, such
      as rich soil, abundant rainfall, etc. If drought or insect damage occurred,
      there is slow or little growth—the rings are close together. If a fire occurs, a
      darkened spot will be noticeable on the cross section.)

8. Pass back the students’ tree cookies. Have them
   a) age their tree
   b) determine which years in their tree’s life were best and why
   c) have them share their findings in small groups so the other students can
      provide feedback on their perceptions.

9. For early finishers or as an additional class activity, pass out the handout showing
   cross sections of trees. Have students determine the ages of these trees and
   whether they think there is any sign of drought, fire, etc. Again, students can share
   their findings with others doing the activity, work in groups, or the whole class can
   debrief the activity. (An overhead of the handout is provided.)

Closure
10. Review. Ask the students for reasons why trees are important.

11. As a homework activity, ask the students to look around their home for uses of
    wood. This is the last category on the concept map and will be discussed in the next
    lesson.

Extensions/Connections
As a math activity, students can take temperature readings for several days in the
shade of a tree and in open areas in direct sun. Have them graph and analyze their
findings to see whether/how much of a difference trees make in the local temperature.

You can also make up math problems dealing with carbon dioxide production and tree
purification. For example, you might post that they are taking a trip. Suppose they drive
150 miles and get 30 miles to a gallon of gas, and that young trees are planted at a rate
of 400 trees/acre. Have them calculate the amount of acreage of young trees needed
to remove the carbon dioxide produced from that single trip.

As an additional extension, students can come up with ways to reduce the amount of
carbon dioxide we produce!
Annual Growth Rings “Answer Sheet”

a) The tree is 12 years old. The best year of growth was during the 7th year; the worst during the 10th year.

b) The tree is 14 years old. The best year of growth was during its 6th year; the worst during the 11th year.

c) Note the fire scars (black marks)
Lesson Twelve

**Teacher notes:** This lesson continues the discussion on the importance of trees, concentrating on forest products.

**CIM Science Content Standard:** Life Science: SC.05.LS.05.03; Common curriculum goals from Science in Personal and Social Perspectives and Science and Technology

**Goal:** For students to understand the role trees play in our everyday lives.

**Objectives:**
The student will be able to:
1. List products we use daily that come from trees.

**Materials:**
Advanced organizer transparency
Handouts from the GP or OFRI publication OR materials listed for paper making on the appended plan. (See step 4.)

**Lesson:**

*Motivation/Preassessment*
1. Put up the transparency from Lesson 11. Review what was discussed yesterday (trees importance in ecology, providing clues to past and current conditions, in cities).
2. Tell students that today you'll be talking about the fourth category—how we use trees!

*Body*
3. Have students provide examples of how forest products are used in their daily lives. Refer to the previous assignment (looking around their house for how wood is used) to get them started. A partial list follows:

- furniture
- lumber
- writing paper
- tissues
- holiday decorations
- mulch
- turpentine
- maple syrup
- charcoal
- rayon
- medicines (aspirin, quinine for malaria, taxol for cancer)
- spices (cinnamon, cloves, bay leaves, allspice)
- sports equipment (hockey sticks, baseball bats, etc.)

(You may also mention, though not used by us daily, wood products are also used as an additive to cement so it can be poured under water such as when building bridges; and wood products are also used in the solid stage of the booster rockets in the
Space Shuttle!

Students need to be made aware that this is NOT an exhaustive list! Many other products come from trees!

4. As an activity, you can either have students make their own paper, or if you prefer something less messy, you can make copies of either the “Yikes! There’s a Forest in My House!” activity from the Georgia Pacific The Tree Trunk publication OR “How Many Wood Products Can You Identify in this House?” from the OFRI Oregon’s Forests Take a Closer Look publication. Directions for making paper are appended to the end of this plan.

Closure

5. Review. Have students provide several ways that they use products from trees in their everyday lives.

6. Tell students that since trees are so important, not only to us but to other living things, as well as non-living things, that we need to take care of this resource.

7. Have students think of concerns they might have with forest practices (cutting down too many trees, etc.) How forests are managed will be discussed in the next lesson.

Extensions/Connections
For a language arts activity, students can write an essay or a poem about the role trees play in their own personal lives. (Students can write about playing hockey, baseball, reading, writing poetry, etc.)
Paper Making Directions

**Materials** (per group of 3 students)
large pan (square or rectangular) about 3 inches deep
3 cups of water for each student
1-1/2 sheets of newspaper to pulp to each student
newspaper sheets to use to soak up excess water (several sections)
piece of window screen that will fit in the pan (available at a hardware store)
rolling pin
blender

1. Tear newspaper into tiny pieces.

2. Place paper and water into blender. Blend on medium speed for about 5 seconds. You now have pulp!

3. Place the screen in the pan and cover with about an inch of water.

4. Pour about one cup of the pulp over the screen and spread it around with your fingers. This will become your sheet of paper.

5. Carefully lift the screen and let the water drain into the pan.

6. Place the screen with pulp onto half of an open section of newspaper.

7. Close the section and flip it so the screen is on the top.

8. Roll over the top of the folded newspaper with a rolling pin to help remove the excess water from the pulp.

9. Open the section of newspaper and carefully remove the screen.

10. Leave the newly made sheet of paper on the newspaper and place in an undisturbed area overnight so it can dry.

11. Once it’s dry, you can use it like any other piece of paper!

Notes:

If you want to "speed" up the process, after removing the screen, an adult can use a clothes iron to help dry the paper.

Also, if you want to decorate the paper, you can add glitter, place on dried flowers, etc. after the rolling pin step. To scent the paper, add some vanilla extract to the blender!
Lesson Thirteen

Teacher notes: Today students will be exposed to an overview of forest practices and laws governing the harvesting of this natural resource.

CIM Science Content Standard: Various common curriculum goals from Unifying Concepts and Processes, Science in Personal and Social Perspectives and Science and Technology

Goal: To get an understanding of different methods used to harvest trees and realize that there are laws governing harvesting.

Objectives:
The student will be able to:
1. Explain why there are different methods used in harvesting trees;
2. State that laws exist to protect the environment and keep the forests healthy.

Materials:
Transparency of advanced organizer from previous lessons

Lesson:

Motivation/Preassessment
1. As a review, place the transparency of concept map of tree importance on the overhead. Get some examples from the students for each of the categories.

2. Ask students how we can balance cutting trees for all the products we use with the need to have trees standing for other uses. Accept all reasonable suggestions.

Body
3. Tell students that it is important for us, the environment and the timber companies to be sure and have a steady supply of trees in our forests!

4. If students haven’t mentioned these in number 2, ask for some of the ways trees are needed for the environment (prevent soil erosion, provide animal habitats and food, etc.)

5. Tell students one of the ways we balance economics (our use of products) with ecology (the need to have trees in the environment) is by using a variety of practices to cutting down trees. See if students know any (some may suggest clear cutting and thinning).
6. Tell students that the method of tree cutting used depends on a variety of things including:
   a) what the site is like (hilly, flat, near a stream, etc.);
   b) effects on fish, wildlife, and other natural resources;
   c) tree species present on the site;
   d) laws affecting the area.

7. Explain to the students that there are two general methods of forest management: even-aged management and uneven-aged management. (Write these categories on the board.)

8. Ask students if they can offer possible explanations of what these might mean. (They can probably come up with good guesses based on the names!)

9. Clarify: Even-aged management means all the trees in the forest stand are about the same age. See if students can suggest ways that could be accomplished. (Clearcutting and replanting the entire site at the same time.)

10. Ask students for a definition of clearcutting. (All the trees in a certain area are cut down at the same time.)

11. See if students can think of any reason why this might be done. (They probably don’t know. Some may suggest it’s cheaper to cut all the trees down at once.)

12. Explain that foresters clearcut only certain stands of trees. If the stand is made of just Douglas fir (which is one of the most common trees in Western Oregon), clearcutting is commonly used. This is because Douglas fir seedlings grow best if they get a lot of sunlight.

13. See if students can reason why you would want to clear cut if the new trees you plant require a lot of light. (If you left other trees standing, the older trees would block the light from reaching down to the seedlings. You may want to demonstrate this with a quick sketch so students can see that large trees prevent light from reaching the seedlings growing in the shade of their branches OR asking students what it’s like walking in a forest—cool, shady—and using that experience to help them see that larger trees keep sun from reaching the forest floor.)

14. Get students to offer a definition of uneven-aged management. (Trees are of different ages.)

15. Clarify: Uneven-aged management means the trees in the forest stand range in age. Some are old, others young, and other in-between.

16. Ask students how this can be done? (Students should be able to reason that only particular trees are cut at one time.)

17. Explain to students that this method of management works best for stands of mixed species. Trees are cut either singly or in groups as they mature. This is the type of harvesting that more often occurs in Eastern Oregon.
18. Ask students if they think uneven-aged management would work for Douglas fir seedlings. Have them defend their answers. (It wouldn’t work very well because, as noted before, these seedlings require full sunlight. Older trees in the canopy would very likely prevent the seedlings from getting the amount of light they need for best growth.)

19. See if students can give you a definition of thinning. (Thinning means to remove selected trees in a particular area.)

20. Ask why they think a stand might be thinned. (To remove competition and allow healthier growth of the remaining trees. Like most living things, trees grow better if they aren’t crowded and competing (“fighting”) for limited resources such as space, nutrients, and sunlight.)

21. Ask if anyone has seen a clearcut. Have a few students describe it. (Probably say it’s ugly—there’s nothing but empty space, etc.)

22. Ask if this appears to be in the best interest of the environment or the forester? (the forester)

23. Tell students that foresters can be thought of as tree farmers. Ask what farmers do to their fields after they harvest their crops—for example, if the farmer grows grass for seed, what does the farmer do after the seed is harvested? (The farmer prepares the field so s/he can replant the area!)

24. Explain to students that that is what foresters do. After they remove trees, they need to replace them. They do this because it is in their best interest and in the best interest of the environment. In fact, there are government regulations that make sure all foresters take care of the environment! The Oregon Forest Practices Act makes sure that logging operations occur only if other forest resources such as water, soil, fish and wildlife are protected. All harvesting must follow a pre-approved plan!

25. Review some of the regulations that exist to balance our economic use of forests with the ecological roles they fill:
   a) Reforestation – After trees are cut, landowners have to begin replanting the area within 12 months. They must also make sure the seedlings “take” and will grow, which means they tend them for six years, removing weeds, etc. that might make it difficult for the trees to reach maturity.
   b) Protecting water sources – Trees provide shade for fish and keep soil from eroding into the rivers, streams, and other water bodies in the forests. To protect these water sources, landowners cannot harvest trees close to the edges of these waterways. There are also restrictions on the use of chemicals (herbicides and pesticides) in these areas.
   c) Size of clearcuts – Restrictions are in place for how large an area of forest may be clearcutted. Generally, clearcuts are limited to 120 acres. Other regulations concerning clearcutting also are in place.
d) Wildlife habitat – See if students know anything about the Spotted Owl.  
(Certain stands cannot be cut if spotted owls are found nesting in them.)  
Harvesting cannot occur or is strictly regulated if the trees are in or near the  
nesting sites of specific species.  
In addition, landowners must leave a certain number of downed trees and 
snags or green trees in a forested area.  These provide homes, nesting sites, 
and other habitats for forest animals.  
e) Roadways – When foresters are cutting trees, roads are built to transport the 
logs from the forests.  There are laws that govern the building of these roads 
to minimize any negative effects to the environment.

26. Tell students that although it seems as though we are using more forest products 
now than ever before, the number of acres of forests in Oregon has remained about 
the same for the last 300 years!  As scientists learn more about forests, and the 
ecology of forests, management practices change to maximize our use of these 
natural resources.

Closure

27. Ask students to give two main categories of forest management techniques 
(uneven-aged management and even-aged management)

28. Have students provide things that are considered in determining how many and 
which trees to cut down (what the site looks like, the tree species present, the 
wildlife in the area, if it's near a stream, laws).

29. Ask students if foresters can just cut down whatever trees they want, wherever they 
want, as long as they own the land.  (No.  There are strict government regulations 
that need to be followed.)

30. Have students tell why it is important to have rules governing forestry practices.  
(To make sure the ecology of the area is protected—the wildlife, streams, soils, etc. 
are not permanently impacted in a negative way.)

Extensions/Connections

As an extension of the science aspect, and inclusion of math and civics (plus a myriad 
of skills), students may be assigned a research project.  A handful of years ago, fast 
food places switched from serving their food in Styrofoam boxes to cardboard boxes. 
Students can research this issue to determine (a) what factors influenced this change; 
(b) what the financial implications of this were; and (c) was the change in the best 
interest of both the food chain and the public.

Along a similar vein, students may wish to determine whether it is better 
environmentally to build new buildings out of steel or wood.  (The Forest Fact Book by 
OFRI provides a good starting point of things to consider!)
Lesson Fourteen

**Teacher notes:** This is the last lesson in the unit. Students will be asked to think about what careers they see associated with trees, and be exposed to some cultural folklore about trees.

**CIM Science Content Standard:** Various common curriculum goals in History and nature of Science, Science in Personal and Social Perspectives, and Science and Technology

**Goal:** Students will think about the various careers associated with trees and the forest products industry and get a different perspective about trees by looking at some folklore surrounding trees.

**Objectives:**
The student will be able to:
1. List 6 different careers that are associated with forests and forest products;
2. Get a sense of appreciation for the role trees have played in various cultures through time.

**Materials:**
None

**Lesson:**

*Motivation/Preassessment*
1. Ask students to think back over the unit and tell you some of the important facts they learned about trees. (You may want to make a list of these as students provide them.)

*Body*
2. Have students brainstorm a list of possible careers they could choose if they wanted to work with trees or forest products. The list could include:
   - Foresters – road builder, engineer, logger, feller, lumberjack, scaler, trucker, helicopter pilot, grader, etc.
   - Mill worker
   - Carpenter
   - Tree nursery workers
   - Scientists – specializing in wood anatomy, preservation, entomology, pulp and paper, ways to use the wood and wood scraps more efficiently, etc.
   - Artist – graphic design, illustrator, carver
   - Toy Maker
   - Equipment Designers
   - Public Relations
   - Forest Ranger
   - Wildlife Conservation Officer
   - Fire fighter
   - Engineer
   - Architect
   - And obviously a multitude of others. Be sure to try and have the students offer a
variety of careers so they don’t just think of someone who cuts the trees as one involved in forestry! Also, as with any business, forest product companies employ secretaries, accountants, etc.

3. Ask students if they know of any folk tales that involve trees. Have them share these. (Maybe someone will share that Robin Hood always met the Merrymen by his oak tree. Native Americans also have many tales involving trees. Remind students of “Grandmother Willow” in the film *Pocahantas*!)
   Some folk tales you can share are:
   a) some believe that if you place an acorn on your windowsill, your house won’t be hit by lightning
   b) if someone owes you money, and you place a twig from a honey locust tree on that person’s door, without any additional prodding, that person will repay you

4. You can also share some of the medicinal findings about plants that some cultures’ “healers” are aware of that are proving accurate for modern medicine!
   a) aspirin was “discovered” because some natives chewed on the bark of willow trees to relieve headaches. (Willow bark contains the main ingredient in aspirin, though now we make it synthetically!)
   b) A Samoan healer made tea from the wood of a particular tree to treat yellow fever. Scientists examining the tea found it contains a virus-fighting chemical which may also prove useful in combating AIDS!
   c) Taxol is a chemical from the bark of certain trees used in fighting cancer.
   d) Although not a tree, students may be familiar with Aloe vera. Some students may have used the juice of this plant for burns or cuts. Point out how many modern lotions and ointments contain aloe!

5. As an assignment, you can have the students choose to do one of the following:
   a) research how some cultures have depicted trees in their heritage
   b) research how “ancient” treatments are informing Western medicine
   c) write their own tale about trees or the use of trees
   d) create a wordfind or crossword puzzle to review some of the main points explored in this unit of study
Closure
6. Have students share their findings, stories or puzzles with the class.

7. Remind students that when they use things in their daily lives they should think about the source of those materials—and probably they need to thank a tree for providing it for them!

Extensions/Connections
Students can make a hallway project to share their knowledge from this unit with the others in the school. For instance, they can design a bulletin board or some other type of display to show the importance of trees in our lives and world and how we manage the use of this resource!
Oregon Wood Magic  
Mathematics Unit

This unit revolves around a student task. The students design and construct a paper mosaic of geometric shapes, simulating marquetry—the art of using different woods to create pictures or patterns. The math concepts most heavily employed are geometric shapes, perimeter, and area; however, this unit of instruction touches on a number of third and fourth grade mathematics benchmarks in the areas of Calculations and Estimations, Measurement, Algebraic Relationships, Geometry. Note that the measurement standards in the Oregon Standards recommends using metric units with third graders and US customary units with fourth graders. Please make adjustments to the lessons as necessary to meet the need of your students' levels.

Detailed Description of the Task

Students will be using pattern blocks to design their marquetry. Construction paper will act as the wood veneers. To simulate wood, the following colors will be used to represent different trees. As in real-life, the different woods will have different costs associated with them. A listing of the colors, the woods they represent, and a possible cost per square foot is provided:

<table>
<thead>
<tr>
<th>Color</th>
<th>Tree Represented</th>
<th>Cost/square foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark brown</td>
<td>Walnut</td>
<td>$0.40</td>
</tr>
<tr>
<td>Black</td>
<td>Ebony</td>
<td>$0.35</td>
</tr>
<tr>
<td>Purple</td>
<td>Purpleheart</td>
<td>$0.35</td>
</tr>
<tr>
<td>White</td>
<td>Maple</td>
<td>$0.30</td>
</tr>
<tr>
<td>Yellow</td>
<td>Pine</td>
<td>$0.25</td>
</tr>
</tbody>
</table>

Students will do the following:
1. review the shapes of the pattern blocks
2. learn/review the formulas for computing the area and perimeter of rectangles
3. measure the side of a pattern block square (to the nearest whole inch)
4. compute the area of the square
5. use the area of the square and manipulation of the pattern blocks to determine the areas of each of the remaining pattern block shapes
6. use pattern blocks to construct and trace their design onto a piece of paper
7. determine which “wood veneer” (color construction paper) will be used for each piece
8. cut out the pieces of the design from the appropriate colors of construction paper
9. paste the cut out pieces on a base piece of construction paper to create their marquetry
10. determine the perimeter of the creation to make a frame out of strips of “veneer” to finish the piece
11. calculate the cost of their marquetry using the areas of the pieces and the costs per square foot
12. as a challenge, they can determine the choice of “woods” that would create the least expensive design and/or the most expensive design.
Lesson One

**Teacher notes:** This lesson sets the stage for the unit. It introduces wood as an art medium and provides some background into the history of marquetry. Some useful websites for both information and links to examples of marquetry and other forms of wooden art are:

http://www.artmarquetry.com/history.html
http://www.inlay.com/marquetry/marquetry/what%20is%20marquetry.html
http://www.gcreationslcom/history.html

Some words that are introduced here that may be new or in need of review are:

Inlaying – the process of setting one medium onto another so the resulting surface is flat.

Intarsia – a mosaic made by placing stones, tiles, gems, etc. in wood. Some books define intarsia as pictures made by using different woods.

Marquetry – a mosaic made by inlaying a variety of wood veneers onto a wooden background. Those with a repetitive pattern are often referred to as parquetry (as in parquet flooring). Some books will classify pictures made with different woods as marquetry rather than intarsia.

CIM Mathematics Content Standard/Benchmark: Geometry: MA.03.GM.01, MA.03.GM.03, MA.03.GM.05; Problem Solving: MA.03.PS.01, MA.03.PS.02, MA.04.PS.01, MA.04.PS.02

**Goal:** Set the state for the unit by having students think of wood as an art medium, introducing them to marquetry, and outlining the basics of their task.

**Objectives:**
The student will be able to:
1. Define marquetry;
2. List connections between math and the real world.

**Materials:**
Series of overhead transparencies of wooden art figure, intarsia, marquetry, sample design (plain), variations of the design, and a possible task product (marquetry simulation).

**Lesson:**

*Motivation/Preassessment*
1. Ask students to make a list of things in their houses that are made of wood. (You might want to use think-pair-share in small groups for this and then have each group report.)
2. After a few minutes, have the students (or groups) share their lists. You may want to write their responses down. Possible responses may be:
   Various forms of furniture (chairs, tables, desks, etc.)
   Pencils
   Crates
   Decking
   Stairs
   Floors

3. If students don’t mention any type of artwork, ask if any of them have any wooden statues in their homes. If students do mention some form of art, after completing the class’s list, bring their attention back to that idea. Show the overhead of the wooden statue.

4. Ask if anyone has any other form of wooden art work either in their homes or that they’ve seen. You may get or mention carved boxes, bowls, totem poles, etc.

5. Tell students that wood has been used in art for thousands of years, at least since the days of the ancient Egyptians. The kings’ furniture, chests, thrones and sometimes even tombs were made of wood and decorated with gold, gems, ivory, and various other materials.

6. Ask if anyone has ever seen pictures made completely made of wood. Show the overhead of the intarsia. (You can decide if you want them to learn this vocabulary word.) Explain that the pieces of wood need to fit together like pieces of a jigsaw puzzle.

7. Tell them another form of art has to do with making designs (instead of pictures) using different woods. Show the overhead of the marquetry. Do familiarize them with this vocabulary word so you can refer to it throughout the unit.

8. Stress that the different pieces of wood are inlaid into the base. Ask if anyone can provide a definition of “inlaid.” The base wood is carved so when the other pieces of wood are glued in, the finished product is flat (rather than having raised pieces on the base).

9. Inform students that starting in the 17th Century (you might ask for an example of a year that was in the 17th Century so they realize you’re talking about the 1600’s), rich Europeans popularized marquetry, especially on furniture, and it remains popular today.

Body
10. Ask students if they think using different woods really makes a difference. Why or why not? (Answers may vary.)
11. Show the transparency of the “plain” pattern block design. Then show the overhead with the same design “colored” in different ways. Revisit the questions in 10.

12. Ask students what colors natural woods may come in. List these. Add any “unusual” ones that might be missing from the list:
   - White
   - Yellow
   - Brown
   - Tan
   - Black
   - Purple
   - Red
   - Green

   You might also mention that some woods are streaked because of fungi that may be living in the wood. Additionally, some woodworkers dye the woods to get colors that might not occur in nature.

13. Ask students why they think marquetry was common with the Egyptians and other ancient civilizations. (It was pretty—it didn’t need gems, gold, etc.—it was rich looking…)

14. Have students consider why only wealthy Europeans had marquetry on their boxes, furniture, and as artwork? (Answers may vary.)

15. Have students outline what steps they think are needed to make a piece of marquetry. List them:
   - Create the design
   - Choose the colors
   - Find (and usually import) the wood needed
   - Carve the design in the base
   - Cut the pieces of the design.
   - Fit and glue the pieces onto the base
   - Finishing the piece

16. Refer back to 14. Are the reasons the students gave valid? OR if they couldn’t come up with reasons, can they come up with reasons now OR add to the reasons they came up with before?
   a) Think about the varieties of wood needed. These were generally expensive woods, made even more expensive because most are imported from various parts of the world.
   b) Think about the tools available. Most were hand tools—meaning it was both difficult and time-consuming to carve the base and cut out the pieces.
   c) Does anyone know what veneer is? (Thin pieces of wood) Refer students to veneer furniture. Veneer furniture has a cheaper wood as a base with a very thin layer of expensive wood glued on top. Why? (Saves money)
d) Ask students how thick they think the different colored pieces of wood are. (1/4-1/2" thick). They're veneers.

e) Tie this back into b. If you need to cut thin pieces of wood by hand, how difficult would this be (very) which adds to the labor time which also adds to the cost.

17. Do only wealthy people own marquetry today? No. They're still expensive but not as much as prior to the 19th and 20th Centuries.

18. What do they think might have lowered the cost? Power tools and improved tools and techniques (e.g. Jigsaw blade, technology to both cut strips of veneer and then to be able to cut stacks of veneer simultaneously.)

19. Ask students what math they think woodworkers who create marquetry need to use. List these as students brainstorm. The list will probably include

   - Measuring
   - Geometric shapes
   - Patterns
   - Area
   - Computations/calculations
     (Possibly, relationships between shapes, spatial thinking, turns/rotations, reflections/flips, translations/slides)

20. Relate this to the math class! Tell the students that they will be designing and constructing their own piece of marquetry art—only substituting construction paper for veneer. They will be using pattern blocks as templates for the pieces of veneer.

21. Show students the last transparency of the set which shows a "marquetry construction" made using pattern blocks and construction paper. Tell students their finished product may look something like that picture.

22. Tell students to begin giving some thought to their design.

Closure

23. Review the lesson:
   - have a student provide a definition of marquetry
   - have students state things about marquetry they learned today that they found interesting
   - ask students to give ways math is related to marquetry
Extensions/Connections
For art or an add-on math activity, you may want to have students examine some of the work of Escher to see what geometric shapes and patterns he used in much of his art. You might also direct students to the web-pages listed in the “teacher note” section to view other examples of marquetry and wooden art. Tesselations could also be easily connected to this unit (as is evidenced in some of Escher’s work).

In social studies, you might examine early Egyptian, Oriental or European art work, ceremonial regalia, and/or royal dwellings to see the infusion of marquetry and inlay. For example, King Tut’s tomb has a wide variety of items with inlay.

As a science and/or geography activity, students can research the trees that produce the different colored woods traditionally used for veneers for furniture and marquetry. In what countries or regions are these trees typically grown? Students can locate these countries or regions on a world/US map.
Lesson Two

_Teacher notes:_ In this lesson, students will be given more information on the task. They will need to review geometric shapes and area. They will then deduce the area of each pattern block piece given the measurement of the side of a square. You will need to decide if students should work with fractions or decimals. The area of a square (a pattern block) is one square inch. Based on that, the area of a triangle is ½ square inch or 0.5 square inch. You can either direct students to use fractions or decimals or allow them to choose, depending on your objectives.

Some things that may come up that need reviewing (or, depending on the students’ backgrounds, teaching) are:
1. the difference between a rectangle and a square. Many students do not realize that a square is a special kind of rectangle.
2. the formula for the area of a rectangle
3. why area is measured in square units
4. multiplying fractions and/or decimals by whole numbers
5. adding fractions and/or decimals

**CIM Mathematics Content Standards/Benchmarks:** Calculations and Estimations: MA.03.CE.05, MA.03.CE.06, MA.03.CE.15, MA.04.CE.11, MA.04.CE.12; MA.04.CE.14; Algebraic Relationships: MA.03.AR.01, MA.03.AR.03; Geometry: MA.03.GM.03, MA.03.GM.05; Measurement: MA.03.ME.01, MA.04.ME.01, MA.04.ME.05, MA.04.ME.13

**Goal:** Students will review the mathematics concept they need to succeed at the task: geometric shapes, computing area. Students will also practice using the area of one shape to determine the area of others.

**Objectives:**
The student will be able to:
1. Identify the geometric shapes represented by pattern blocks;
2. Determine the area of a rectangle (in this case, a square);
3. Use the area of the square to deduce the areas of the other pattern blocks;
4. Demonstrate their prior knowledge of using a ruler.

**Materials:**
Pattern blocks
Overhead pattern blocks
Rulers
Overhead transparency of marquetry and simulation from Lesson One
Handout and transparency of pattern block shapes for naming and calculating area
Handout of pattern block design for practicing computing area and perimeter
Challenge handout

**Lesson:**

_Motivation/Preassessment_
1. Place transparency of marquetry on the overhead. Ask students what the type of woodwork on the transparency is called.
2. Remind students that they will be designing their own creations that simulate marquetry.

3. Yesterday students helped write a list of what woodworkers do to create marquetry. You may want to refresh their memory. Then have students create a list of the steps they'll need to go through to create their "marquetry." You can place these side by side for comparison purposes.

<table>
<thead>
<tr>
<th>“Real” marquetry</th>
<th>Simulated (or “Our”) marquetry</th>
</tr>
</thead>
<tbody>
<tr>
<td>create the design</td>
<td>create the design</td>
</tr>
<tr>
<td>choose the colors</td>
<td>choose the colors</td>
</tr>
<tr>
<td>get the wood</td>
<td>get the &quot;wood&quot;</td>
</tr>
<tr>
<td>carve the design in the base</td>
<td>trace the design on the base page, if desired</td>
</tr>
<tr>
<td>fit and glue the pieces</td>
<td>fit and glue the pieces</td>
</tr>
<tr>
<td>finish the piece</td>
<td>frame the piece</td>
</tr>
</tbody>
</table>

4. You may want to show the students the transparency that shows the sample simulation.

5. Tell students that to make this simulation more realistic, they will need to "purchase" the veneers for their creations. In order to do this, they will need to calculate the areas of their pieces and the perimeter to frame the picture.

**Body**

6. Have students get out their rulers (or pass them out) while you pass out the handout sheet for filling in names and areas of pattern blocks.

7. Using the transparency of their sheet, go over the geometric shapes with the students. Have students volunteer names and fill in the correct names on the transparency and their sheets as you go.

8. Pass out pattern blocks to students. At a minimum, each student will need at least 3 triangles, 2 diamonds, and one of each of the other designs.

9. You may need to review the differences and similarities between squares and rectangles. A square is a special kind of rectangle. In a rectangle, opposite sides are equal and parallel and the angles are right angles.

   What does "right angle" mean? (90 degrees—makes a box)
   Does a square meet these requirements? (Yes)
   Is a square a rectangle? (Yes)
   What's special about a square? (All sides are equal.)
   Are all rectangles squares? (No)
   Why not? (All sides don’t have to be equal in a rectangle.)
10. See if students can provide a definition or explanation of area.

11. Ask if a student can give you the formula for finding the area of a rectangle. (Most students learn to compute the area by multiplying the length by the width. You may want to use base by height to keep it consistent with most figures.)

12. Tell students they need to calculate the area of the square pattern block. Have them measure the side of the square to the nearest whole inch. (Typical pattern blocks measure one inch.)

13. What is the area of the square? (One square inch. You may need to show them where “square” comes from—inch times inch.) Record the area on the handout/overhead.

14. Tell them we will be using the area of the square to figure out the area of the other pattern blocks. The easiest way to do that is to figure out the area of a triangle first. Using the blocks, have them try and figure out how many triangles it takes to make a square. There are several ways to do this. One way is to eyeball it. Putting a triangle on the square leaves about half a triangle uncovered on each side. Students may realize it takes two. Another is to see that 2 diamonds equal one triangle and half a diamond on each side of the triangle will equal a square. Or, for more concrete students, cut out two triangles and see that it does take one whole triangle and another triangle cut into two pieces to cover the same area as the square.

15. Again, record the area of the triangle on the handout and transparency.

16. Have the students continue to figure the area of the other pattern blocks using either the square or the triangle. (For example, 3 triangles have the same area as a trapezoid, so the area of the trapezoid is 1-1/2 square inches or 1.5 square inches, depending on whether you want to work with fractions or decimals.)

17. When students are done, have volunteers come to the overhead to show with the blocks how they figured out the area of the shapes and write the areas in the appropriate places.

18. Put several pattern blocks together on the overhead. Ask students for the total area of the design. See if they can figure out they need to add the areas of each piece together. (For example, a square and two triangles = 1 + ½ + ½ = 2 square inches.) Have a student volunteer explain his/her reasoning after everyone has had an opportunity to think about it.

19. Try a more complicated design and again have students calculate the area.

20. Pass out the handout of the pattern block design and direct students to calculate the area of that design.
21. When students are done, have them check their work with a partner. When all
students are done, check collectively as a class to be sure everyone has computed
the area correctly.

22. Students that are done early can make their own design using pattern blocks and
figure out the area. If they trace it on a piece of paper, they can switch designs with
another early finisher and compare their findings. Students who need a challenge
may be given a pattern block design that only shows the perimeter drawn. They'll
need to decide which pattern blocks go together to make that design before they can
compute the area. (A Challenge Handout Master is provided for that purpose.)

23. Have students save the handouts. They will be used in the next lesson. Collect the
pattern blocks.

Closure
24. Ask students when they might use area in “real life” outside of math class. (Areas
might be calculated in designing a skate park, deciding on how much carpeting is
needed for a room, how much paint is needed to paint a room, the amount of contact
paper needed to cover their locker shelves in middle school…)

25. Tell students that there are different formulas available for calculating the area of
triangles, trapezoids, circles, and other shapes. See if students can figure out why
computing area the way they did today might be useful. (If the figure is irregularly
shaped, cutting it into “known” shapes makes finding the area easier—for example,
you can draw a simple “house” outline on the overhead (see sample 1 below). If the
design is broken into two pieces—the square and the triangle—the area is easy to
calculate. If you have time, you can try another “irregular” shape and see if students
can break it into its parts (see sample 2 below).

Sample 1

Sample 2

26. Tell students now that they know how to calculate the area of the wood pieces they
might use in their marquetry design, they are almost ready to begin the project.
There is just one more quick thing that needs to be reviewed before they begin on
their marquetry in the next lesson!
Extensions/Connections:

Students can be asked to look at man-made and natural structures in the neighborhood and see if they can break them down into component parts; and/or have students examine the flooring and tiling in the school and see if they can find geometric patterns.

Students can speak with parents or other adults to see when they need to use the concept of area.

For career education, you can arrange to have a guest speaker come in to speak to the class about how they use math in their workplace (someone from the local grocery, etc.).
<table>
<thead>
<tr>
<th>Shape</th>
<th>Area (square inches)</th>
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<tbody>
<tr>
<td></td>
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</tbody>
</table>
Key

Name_______________________________________

<table>
<thead>
<tr>
<th>Shape</th>
<th>Area (square inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square</td>
<td>1</td>
</tr>
<tr>
<td>Triangle</td>
<td>½ or 0.5</td>
</tr>
<tr>
<td>Rhombus</td>
<td>1</td>
</tr>
<tr>
<td>Trapezoid</td>
<td>1 ½ or 1.5</td>
</tr>
<tr>
<td>Hexagon</td>
<td>3</td>
</tr>
<tr>
<td>Diamond</td>
<td>½ or 0.5</td>
</tr>
</tbody>
</table>
Name

Calculate the area of the figure below. Use the area of known shapes to help you.
Key

12 ½ sq. units

Name

Calculate the area of the figure below. Use the area of known shapes to help you.
Challenge!

Name ______________________________________

Calculate the area of the figure below. Use the area of known shapes to help you.
Key

Challenge!

14 Sq. units
Name______________________________

Calculate the area of the figure below. Use the area of known shapes to help you.
Lesson Three

Teacher notes: After reviewing perimeter, students will be given the final set of directions for their marquetry task and begin to design their artwork. You will need to decide on the following parameters for the task:

1. Is there a minimum number of blocks you want them to use in their design? (I recommend at least one of each.)
2. Is there a minimum or maximum size of the finished design? (A simple maximum is that it fit on the paper you provide, leaving room for the frame. You may want to consider a minimum—e.g., take up at least half the page.)
3. Do all the blocks have to be touching?
4. What color veneers are available? (May be dependent on colors of construction paper available. Refer to the Detailed Description of Task (p. 2) for suggested colors.)
5. Is there a minimum/maximum number of colors they should include in their designs? (As the number of colors increase, the number of computations increase.)

CIM Mathematics Content Standards/Benchmarks: Calculations and Estimations: MA.03.CE.10, MA.04.CE.14, MA.04.CE.17, Algebraic Relationships: MA.03.AR.01; Measurement: MA.03.ME.01, MA.03.ME.07, MA.04.ME.01, MA.04.ME.05

Goal: Students will complete the review of the mathematics concept they need to succeed at the task: perimeter. Students will manipulate pattern blocks to design their marquetry.

Objectives:
The student will be able to:
1. Determine the perimeter of a rectangle;
2. Demonstrate their prior knowledge of using a ruler;
3. Manipulate pattern blocks to design a geometric design;
4. See relationships and patterns among pattern block pieces as they place them in the design.

Materials:
Pattern blocks
Rulers
White paper (about the size of construction paper or copy paper)
Construction paper of various “wood” colors (9"X12")
Overhead transparency of simulated marquetry from Lesson One
Handout of pattern block design for practicing computing area and perimeter from Lesson Two

Lesson:
Motivation/Preassessment
1. Show the overhead of the marquetry simulation from Lesson One. Remind students that in the previous lesson, they computed the areas of the individual pattern blocks and learned how to calculate the area of the total design. Ask students if they can figure out the one other thing they need to review in order to begin their marquetry task. Ask a hint you might point to the frame around the picture.
2. Students will need to calculate the perimeter to make a frame around their design.

3. Ask students for the difference between area and perimeter (area is the amount of space something takes up two dimensionally while perimeter is the distance around something).

**Body**

4. Have students take out the handout from the previous lesson (the pattern block design they used to compute area) and their rulers.

5. Direct students to draw a frame around the design on the hand-out.

6. Ask students how they would compute the perimeter of that frame. (Measure the four sides and add them together.)

7. Have students calculate the perimeter of their frames. (Answers will vary depending on the size of the frames the students drew.)

8. Ask students why their perimeter does not have square units and area does. (Area is inch times inch. Perimeter is just adding inches.)

9. Tell students that for the frames for their marquetry, the strips of “veneer” would be an inch wide. How can they determine the area of their frame?

10. Using the overhead of the marquetry simulation, you can have students explain that they could calculate the area of each strip (length X 1 inch) and add the four sides together. (There may be some discussion about overlap at the corners. You can decide if you want to get into minimizing the area of the veneer needed.)

11. Tell the students they are now ready to begin to design their marquetry design blueprint. Give them the parameters of the task, as noted in the Teacher Notes above (size, number of blocks, design specifications, colors, etc.). Have students place their pattern blocks on the piece of white paper so it will be easier to trace the finished design. Check for understanding of the task.

12. Pass out pattern blocks and paper and have students get started. Once their design is traced, the students need to decide on the colors of the base piece of “wood,” the frame, and the pattern block shapes. Students should write the colors on their design “blueprint.” The frame should be 1” wide. Not all students' frames need to be the same size. Students can decide how to most pleasingly “box” in their creation.

13. You may want students to show you their blueprint for approval as they complete them to be sure they have met the requirements. You can sign off on their blueprints.

14. Early finishers can share their designs and discuss color choices.
**Closure**
15. Students should be reminded to place their names on the blueprints. Collect the pattern blocks (and the blueprints if students tend to misplace things).

16. Tell students they will begin constructing their designs tomorrow.

17. Ask students to differentiate between area and perimeter.

18. Have students relate what they think is the hardest part of designing marquetry so far.

**Extensions/Connections**
Have students examine structures in their homes or neighborhoods to see where mosaics or patterns are used (roofing, tiling, flooring, patio tables, etc.)

Read about Leonardo DaVinci, or other artists, architects or engineers, and discuss the importance of working from a blueprint.

You might see if a copy of the school blueprint is available from District Office and have students examine it to determine the need for one and the relationship between the blueprint and the actual building.
Lesson Four

**Teacher notes:** After reviewing the requirements of the tasks, student should begin to create their designs using the construction paper. Encourage students to minimize waste by strategically placing their pattern blocks on the colored paper. Have students share usable “scraps” of paper.

**CIM Mathematics Content Standards/Benchmarks:** Geometry: MA.03.GM.03, MA.03.GM.05, MA.04.GM.09, MA.04.GM.11; Measurement: MA.03.ME.01, MA.04.ME.01

**Goal:** Students will cut out geometric shapes in different colors to build the design from their blueprint.

**Objectives:**
The student will be able to:
1. Minimize total area of paper needed by strategically tracing pattern blocks on the paper.
2. See relationships and patterns among pattern block pieces as they place them in the design.

**Materials:**
Pattern blocks  
Construction paper  
Scissors  
Rulers  
Student blueprints from the previous lesson  
Paste/glue stick  
Overhead pattern blocks  
Envelopes for students to use to store their cut and not yet pasted pattern pieces

**Lesson:**
*Motivation/Preassessment*
1. Have students get their blueprints from the previous lesson. (If you required it, remind them to have you approve their plans before they begin building their design.)

2. Show students where the supply of “veneers” will be kept. (A front desk, table, etc. that students have easy access to would be useful to minimize disruption of other students or you!)

3. Tell students you have a limited supply of “veneers” and they need to conserve the resources. Ask them how they could do that. You might have a volunteer come to the overhead to show how they would arrange several overhead pattern block pieces to minimize the amount of paper required.

4. Tell students to bring usable scraps of paper back to the supply table. Scraps that are unusable should be placed in the recycling bin (if you have one) or the trash, depending on your school policy. Encourage students to use the scraps, and not always reach for a full sheet!
5. If students don’t have their own scissors and glue sticks/paste, let them know where these supplies can be found. Also remind students not to use too much glue/paste on their pieces to help keep the finished product neat.

6. You might encourage students to cut out all their pieces first and then begin pasting.

7. Check for any questions students may have.

**Body**

8. Have students work on creating their designs. Depending on the complexity of student designs, it will probably take more than one class period to do the cutting and pasting.

9. Monitor students as they work. You might ask them for names of shapes, how they could calculate the area of those pieces, how they decided on the pattern, etc.

**Closure**

10. Stop students before the end of the class period so there is clean-up time. Have students return usable scraps and other materials to their appropriate locations and clean up what paper scraps might be on the desk and floor.

11. If students have not finished pasting their pieces, direct them to get an envelope, place their names on the envelope, and put their cut out pieces into the envelope so they won’t get lost before they can work on the marquetry again.

12. Poll the class to see about how much time is still needed to complete the design so you can adjust the next lesson.

13. Have students tell you how simple or difficult it is to cut out the necessary pieces. Ask them to relate this to what it would be like to be cutting these designs out of wood!

14. Tell students they will be completing their design tomorrow—then they will need to calculate the cost of their marquetry if they were actually using veneers instead of colored paper! Have them think about the information they will need to do those computations.

**Extensions/Connections**

For geography and science, students can visit the website www.harwoodspecies.org/index.msql

At this site, sample hardwoods are depicted, as well as a brief descriptions of the woods, their uses, where they are grown, and sometimes even some folklore and history associated with the species.

Invite a representative from a local lumber store to come in to speak to the class. S/he can show samples of veneers and talk about the uses of different kinds of woods.

If one is available, you might invite a local furniture designer in to speak to the students about his/her work.
Lesson Five

Teacher notes: Students should finish up their creations today. They will be given the costs of the “veneers” and asked to compute the cost of making their designs.

CIM Mathematics Content Standards/Benchmarks: Calculations and Estimations:
MA.03.CE.09, MA.03.CE.13, MA.03.CE.15, MA.04.CE.10, MA.04.CE.11, MA.04.CE.12, MA.04.CE.13, MA.04.CE.14

Goal: Students will cut out geometric shapes in different colors to build the design from their blueprint. Given costs/square foot and the areas of the different shapes, students will compute the costs of the materials for their marquetry.

Objectives:
The student will be able to:
1. Minimize total area of paper needed by strategically tracing pattern blocks on the paper;
2. See relationships and patterns among pattern block pieces as they place them in the design;
3. Calculate the costs of the “veneers” used in their marquetry design.

Materials:
Pattern blocks
Construction paper
Scissors
Rulers
Student blueprints and beginning creations from the previous lesson
Paste/glue stick
Envelopes students to used to store their cut and not yet pasted pattern pieces
Calculator
Students’ completed handout of pattern block shapes for naming and calculating area from Lesson Two
Handout for calculation of costs

Lesson
Motivation/Preassessment
1. Check to see that students remember what they need to do the first part of the period today (continue working on their design and, hopefully, complete their creation).

2. Tell students that after they complete their design, they will need to determine what the cost would be if we were to make a wall mural of their marquetry and use actual veneers instead of construction paper. (Check that students know what a mural is!) Tell them to assume their paper creation is a scale model and their square inch is equal to a square foot.

3. Ask them what a scale model is. (It’s a smaller or larger model of the actual item that’s proportional in size.)
4. Ask them how the areas of the pattern block pieces would change if an inch was going to be equal to a foot. (The only change would be in the units.)

5. Ask students what information they would need to calculate the cost of the mural. (Students should be able to figure out that they would need to know the costs of the wood and the area of the different wood pieces they used.)

6. Tell students that you have a sheet to help them in calculating the costs of their marquetry creation when they are finished with their construction. They should either let you know when they have completed their marquetry or you can place the sheets on the supply table.

**Body**

7. Relay your day’s expectations to the students. Do you expect them to complete their creations and the costs today or just finish the creations, or…(your timeline depends on the complexity of your students’ designs and their dexterity in cutting and pasting!)

8. Have students work on completing their creations.

9. When students are done, they should begin work on calculating the costs of a mural of their design.

**Closure**

10. Depending on where students are with the task, have them clean up the work areas, replace the supplies, etc.

11. Have willing students share their creations with the class.

12. Tell students that tomorrow they will be calculating or finishing their calculations of the costs of making their marquetry into a wall mural.

**Extensions/Connections**

Students can research the history of murals. They might also examine when tapestries were used and why.

In art, students can design their own tapestries or the class can collaborate on a tapestry for the classroom.

Students can search the web for pictures of wall murals and note these sites so others in the class can visit them.
Calculation Sheet

Listed below are the colors of paper, the wood they represent, and the cost/square foot for each of the “veneers.” Calculate the cost of making your marquetry. Don’t forget to include the base paper and the framing!

<table>
<thead>
<tr>
<th>Color</th>
<th>Tree Represented</th>
<th>Cost/square foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark brown</td>
<td>Walnut</td>
<td>$0.40</td>
</tr>
<tr>
<td>Black</td>
<td>Ebony</td>
<td>$0.35</td>
</tr>
<tr>
<td>Purple</td>
<td>Purpleheart</td>
<td>$0.35</td>
</tr>
<tr>
<td>White</td>
<td>Maple</td>
<td>$0.30</td>
</tr>
<tr>
<td>Yellow</td>
<td>Pine</td>
<td>$0.25</td>
</tr>
</tbody>
</table>

Total Area of Veneer Used (in square feet) | Total Cost/Veneer

Walnut

Ebony

Purpleheart

Maple

Pine

Total Cost_____________________________
Lesson Six

Teacher notes: Students should be done with their creations today. Some students will probably have started on their cost calculations. All should be able to finish these calculations today. Those that are done early can be challenged to redesign the use of their woods to create the least expensive and/or most expensive mural.

CIM Mathematics Content Standards/Benchmarks: Calculations and Estimations: MA.03.CE.13, MA.03.CE.15, MA.04.CE.11, MA.04.CE.12, MA.04.CE.14. For students doing step 7, the common curriculum goals for Mathematical Problem Solving will also be addressed.

Goal: Students will be able to calculate the costs of creating their murals, using cost/square foot and area of geometric wood pieces.

Objectives:
The student will be able to:
1. Perform calculations in addition and multiplication with fractions and/or decimals;
2. Determine the dollar cost of creating their creation as a mural with wood veneers.

Materials:
Student creations
Handout for calculation of costs
Calculators

Lesson:
Motivation/Preassessment:
1. Have students take out their creations.
2. Ask students what we were going to do with these creations (use them as scale models for a wall mural made of wood). Have a student remind the class how to compute the cost of making their design into a wood mural.
3. Pass out the calculation handout for those who didn’t pick one up during the previous lesson.
4. Review the sheet with the class (or have a student who started it do this for you).

Body
5. Have students work on their calculations.
6. When students are done, they can exchange their worksheet and creation with another student to double check their calculations.
7. Earlier finishers, or all students, can be challenged to recreate their design by substituting “wood veneers” to make the least expensive and/or most expensive version of their design. They would need to do another set(s) of calculations to see what the new cost(s) would be.

Closing
8. Have the class compare their costs. Of the original designs, which design was the most expensive? Which design was the least expensive? Did changing the veneers used make a substantial difference in the costs?

9. Ask students if the costs they calculated are accurate. Do they account for the “scraps” that weren’t used in the final product but would need to be “purchased” in order to complete the piece? (No)

10. Do students think actual pieces of marquetry would be expensive or inexpensive? Why? (Probably expensive because of the time element involved in designing, cutting, and creating the artwork.)

11. Summarize the unit, being sure to review wood as a medium for artwork, the real-world uses of math, especially geometric shapes and designs, areas, perimeters, and ability to work with decimals and fractions.

Extensions/Connections
For career education, have students brainstorm and then research careers that rely on mathematics and how math is a part of those careers.

As an art project, have students make a collage of magazine pictures showing wooden artwork.

As a language arts activity, have students make a hallway bulletin board display to show their creations. Along with their creations, they should compose a history and explanation of marquetry so other students can understand and appreciate their work.
Life Cycle

Annual Cycle

Deciduous Tree
Various seeds & seed bearing structures
Stem Cross Section

adapted from www.domtar.com/arbre/english
Trees

- Ecology
- Clues about the past
- Special Uses in Cities
- Forest Products
Intarsia
Marquetry
<table>
<thead>
<tr>
<th>Shape</th>
<th>Area (square inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Square]</td>
<td></td>
</tr>
<tr>
<td>[Triangle]</td>
<td></td>
</tr>
<tr>
<td>[Parallelogram]</td>
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<tr>
<td>[Trapezoid]</td>
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<td>[Hexagon]</td>
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<tr>
<td>[Rhombus]</td>
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</tbody>
</table>
Name__________________________

Calculate the area of the figure below. Use the area of known shapes to help you.
Challenge!

Name____________________

Calculate the area of the figure below. Use the area of known shapes to help you.