Activity No.	Activity ID	Unit introduction and motion examples video	Revision Date	Status
1	1.1		3-10-2005	Current

Student Pages	Procedures	Activity Materials
R2	Introduce the unit Use Student Page 2 (R2) to introduce the unit. Motion, is something that people have wondered about "since ancient times."	
R2	Introduce Felicia's Motion Investigation Journal R2 introduces Felicia as a third grader whose class is also learning about motion. Entries from Felicia's science journal will allow your class to find out about Felicia's class' motion investigations. (Although this will not be made explicit to the students, it will also model certain kinds of practices and reasoning.)	
	Read pages FJ1 (title page) & FJ2 of Felicia's Journal with the children. FJ2 introduces the video of example motions.	FJ1, FJ2
	Show Felicia's video Instruct the children to watch carefully and see what they notice about the motions in the video. (Show video)	Motion video VCR and TV monitor
N2	Briefly discuss what the children noticed Ask students to record what they noticed in their Science Notebook (N2). Ask the children about some of the things they noticed about the motions. Take note of the kinds of things the children report. However, this is a preliminary introduction rather than a record on which the investigations will build.	
	Transition to Activity 2 Tell the children that the video showed many examples of motion. In the next activity, the class will learn about what Felicia's class did with their video examples.	

How Do Objects Move?

Activity No.	Activity ID	Unit introduction and motion examples video	Revision Date	Status
1	1.1		3-10-2005	Current

Reader Page

Motion

Objects move everywhere in the world. Balls bounce, roll, and are tossed. Leaves fall to the ground. Cars move people.

Since ancient times people have wondered how objects move. During the next few weeks your class will investigate how things move.

Your class has Felicia's science journal. She is a third grader. She studied how objects move. She wrote about this in her science journal. It tells things she learned.

Felicia's class made a video of motions. We can find out about the videos in her journal.

R2

Inquiry Narrative

This journal is my study of motions. I will describe the motions. I hope other people can use my descriptions. Sharing my observations and descriptions with others may help me learn about motion.

My class made videos of moving things. We can watch the videos and observe the motions. This helps me describe each motion. Descriptions of the motions help me compare them.

FJ2

Notebook page

Felicia's Motion Study

What did you notice in Felicia's video?

N2

Activity No.	Activity ID	Introduce sketches for describing example motions	Revision Date	Status
2	1.2		3-10-2005	Current

Student Pages	Procedures	Activity Materials
	Introduce the use of sketches to record observations Use Felicia's journal to introduce the use of sketches to record observations of example motions for the purposes of remembering, comparing and sharing with others. Show an example sketch and discuss how the steps were used.	FJ3
	Discuss the path Ask them what the path was like. Have the children show what the path was like by tracing it with their hands in the air. Do their gestures agree with one another? Does the sketch agree with their hand gestures? If necessary, have them trace the path of one or two other motions (e.g., the child swinging and/or riding on the merry-go-round). When you think that the path tracing is pretty well established for most of the class, proceed to the next activity where the children will actually sketch an example motion.	FJ4 FJ4

Activity No.	Activity ID	Introduce sketches for describing example motions	Revision Date	Status
2	1.2		3-10-2005	Current

Reader Page

None for this activity

Inquiry Narrative

The video showed some motions I observed I wanted to remember the motions I observed. I also wanted to compare the motions One way to describe the motions is to make sketches. I started with one motion.

I made my description following these steps.

1. I drew a line to show the path from start to stop.
2. I drew an arrow to show the direction.
3. I labeled the important objects in the sketch

FJ3

(Additional Felicia's journal page)

Sketch goes here

I can share my sketches with others. I can compare sketches to learn about motion.

FJ4

Notebook page

Activity No.	Activity ID	Describe and explain motion of a tossed ball (preassess)	Revision Date	Status
3	1.3		3-10-2005	Current

Student Pages	Procedures	Activity Materials
R3	<u>Introduce the "what" and "why" questions</u> Use Reader page 3 to introduce the "what" and "why" questions that scientists frequently ask. <u>Pose questions about the motion of a tossed ball</u> Introduce a ball and continue with R3, posing the "what" and "why" questions about the ball you will toss to one of the children. Toss the ball underhand so that it makes a clear arch. Repeat the toss several times, encouraging the children to observe carefully. Try to make the tosses as similar as possible. Demonstrate one last time. this is the toss they will sketch. Emphasize that the example motion is from you to the child.	Ball (e.g., basketball or volley ball to toss)
N3	Instruct students to write their ideas about motion on page N4 of their notebook. The students should also sketch the motion of the ball on notebook page N3.	
N4	Direct students to notebook page N4 and ask them to write their idea of why the ball moved the way it did.	

Activity No.	Activity ID	Describe and explain motion of a tossed ball (preassess)	Revision Date	Status
3	1.3		3-10-2005	Current

Reader Page

Ask & Observe

Scientists ask a lot of questions. Having good questions is not easy. One science question is, "What happens?" Another question is, "Why does that happen?" We can ask those questions about motions.

Think about a tossed ball. This is an example motion. One person tosses a ball to another person. What happens to the ball? Why does that happen?

You will write ideas about that motion in your Notebook pages. After we investigate other motions, we will come back to the tossed ball. We can see how our ideas have changed.

R4

Inquiry Narrative

(none needed for this particular activity)

Ask & Observe

A Tossed Ball

Why did the ball move the way it did? Write an answer to this question.

N4

Notebook page

Ask & Observe

A Tossed Ball

What happened to the ball? Make and label a sketch of the ball's motion.

N3

Activity No.	Activity ID	Describe/sketch experienced motions	Revision Date	Status
4	1.4		3-10-2005	Current

Student Pages	Procedures	Activity Materials
R4	Introduce sharing of experienced motions Use R5 to introduce the idea of sharing example motions they have experienced. Remind the children of the question, “What happened?” They will answer that question using their sketches.	
N5	Sketching experienced motions in the Science Notebooks Briefly review Page N5 where they will record their ideas.	
	Show FJ3 on the overhead while they sketch to remind the students of the steps.	FJ3
	Circulate and note what the children are describing. If they are telling about a very complicated motion (e.g., a trip somewhere), ask if they could tell about just a part of the motion. Signal when time is half up and when there are two and one minutes left.	
	Transition to next Activity Wrap up the activity reviewing the following points: * They will be sharing their motions with the class. * Their sketches will help others learn about their example motion. * They can learn about others' example motions from their sketches. * Scientists often use drawings and writing to share their ideas with other scientists. * They have been doing science/being scientists.	

Activity No.	Activity ID	Describe/sketch experienced motions	Revision Date	Status
4	1.4		3-10-2005	Current

Reader Page

Sharing Example Motions

Your class observed motions on video.
You have seen many other examples of motion, too. You can share an example motion with your class.

A science question asks, “What happens?” What happens to the object? You can describe what happens in your example motion by making a sketch.

Think of a motion you have seen. Make a sketch of that motion on page N5 of your Science Notebook. Make a sketch like Felicia’s.

1. Draw a line to show the path of the motion from start to stop.

2. Use an arrow to show the direction of the motion.

3. Label the important objects in the sketch

R4

Inquiry Narrative

Notebook page

Experienced Motion

Make a labeled sketch of a motion you saw. Your sketch describes what happened.

N5

Activity No.	Activity ID	Investigating by grouping things	Revision Date	Status
5	1.5		3-10-2005	Current

Student Pages	Procedures	Activity Materials
	Introduce "grouping" as a way of investigating	
R5	Use R5 to introduce examples of grouping including living things and rocks. The children identify different kinds of living things scientists put into groups. (e.g., dogs, cats, rabbits and people are all mammals. They all have fur or hair.) You may want to include other examples that your class may have already studied.	
	Why is grouping useful?	
R6	Use R6 to discuss groupings of trees that have needles v. flat leaves. Putting together trees with needles instead of flat leaves turns out to be useful because they also are similar in other ways. They usually keep their leaves instead of loosing them every year. Their cones are different than the flowers and seeds of trees with flat leaves. Scientists often gives special names to the different groups. ('conifers' for tree with needles, 'deciduous' for those with flat leaves.) The key idea is that things that have been found to be similar in some ways may be then found to be similar in other ways. However, not all ways of grouping turn out to be useful. Useful groupings are those where other similarities are then found.	
	Introduce grouping of motions	
R7	R7 suggests that putting motions into groups might be useful. Perhaps motions with similar paths are similar in other ways. Can motions be grouped by having similar paths? Read Felicia's Journal page FJ5 with the class.	FJ5

How Do Objects Move?

Activity No.	Activity ID		Revision Date	Status
5	1.5	**Investigating by grouping things**	3-10-2005	Current

Reader Page

Investigating by Grouping

Scientists investigate different objects. They investigate plants, animals, magnets, weather, rocks and stars.

Scientists make groups of objects that are similar. Can you think of things that scientists have made into groups?

R5

Inquiry Narrative

I noticed that some of the motions were similar. I made groups of sketches that had things that were the same. I named the groups of sketches for the thing that was the same. My friends were helping me make groups.

Erica wanted to make a group that was balls. But balls can move in different ways. One ball went straight up and down. Another one rolled along the floor in a straight line. Another curved upward and then downward when it got kicked. The balls were similar, but the motions were different. So balls would not be a good motion group.

FJ5

Investigating by Grouping

Why is Grouping Useful?
Trees are put in groups. Trees have similar parts. One part is a leaf. Trees have leaves. Some kinds of trees have needles instead of flat leaves. In what other ways are trees similar?

Rocks are put in groups. Rocks can have similar pieces or grains. Rocks with the same pieces or grains make a group. You can examine rocks with a magnifying glass to see the pieces or grains. Rocks made of similar pieces often have formed in similar ways. Scientists make groups of rocks to compare how the rocks formed.

R6

Notebook page

Investigating by Grouping

Grouping Motions
Motions can be grouped. To group motions we can look at motion sketches your class made. Things that are similar in the sketches may make a group. For example, motions with similar paths may be similar other ways. What ways are they similar? What groups can you make?

R7

Activity No.	Activity ID	Sharing and grouping experienced motions	Revision Date	Status
6	1.6		3-10-2005	Current

Student Pages	Procedures	Activity Materials
N5 (Children's motion sketches)	<u>Have the children present and group their motion examples</u> Have children present their motion sketches one at a time, posting them where the class can see them. As they are presented, ask if the new one is similar to any that have been presented earlier. Encourage them to focus on the path initially. Post motions with similar paths together. (Save any speed descriptions for later.) The children should be able to distinguish straight and curved paths, and subdivide those groups further. Straight paths may be grouped by direction. You may want to introduce the formal direction labels if you use them in mathematics or other contexts. (up and down--vertical, side to side--horizontal, and "slanted" or "at an angle"--diagonal.) Assist the class in making up descriptive labels for the groups.	Tape or other means of posting motion sketches
	Felicia's Journal page Fj6 can be used to suggest or discuss ways of grouping motions.	FJ6
	<u>Record groupings on overhead or chart</u> When all of the motions have been presented and grouped, record the groupings in a chart on the overhead or chart paper similar to Science Notebook page N6.	Overhead transparency of N6
	You might use Felicia's journal (FJ6) here and then do a second grouping.	
N6	You may have the children work in small groups to form groups of motions or have them record the class groupings on Science Notebook page N6.	

Activity No.	Activity ID	Revision Date	Status
6	1.6	3-10-2005	Current

Sharing and grouping experienced motions

Reader Page

Inquiry Narrative

Here are the motion groups I think are good:

Straight up and down
Straight sideways
Straight at an angle
Curved in a circle
Curved but not in a circle
Back and forth

Add a page listing the motions from the video in each group? (to show after)

FJ6

Notebook page

Studying by Grouping

Try to make groups of your example motions. Look for similar motions, not just similar objects. Start by looking at the paths.

Motions	Similarities	Group Label

(This should be a table)

N6

Activity No.	Activity ID	How we are being scientists	Revision Date	Status
7	1.7		3-30-2005	Current

Student Pages	Procedures	Activity Materials
N7	Review progress on learning about motion Refer the to page N7 in thier Science Notebooks. Remind the children that they have been learning about motion. Review the first two questions, What have they done to learn about motion and what have they learned about motion? Give the children some time to write about these two questions. Have the children report their ideas. Record their ideas on two separate lists. You may need to help them decide on the best list for their ideas. *Possible ways children investigated motion:* Watch videos of motions Make sketches to record motion observations. Show the path and direction of motions Ask what happens Ask why objects move the way they do Share observations and ideas about motion with others Group similar motions *Possible ideas about motion*: There are different kinds of motions (straight up and down, curved, etc.) Motions have a path and direction. Relate their work to what scientits do Point out that they have been doing many things that scientists do. Ask what they have done that is like what scientists do. You may provide time for children to write or have them record the ideas on N7. You List these on a chart or overhead transparency. If the children do not mention the following suggest them: Make careful observations Ask questions about what happens and why Make records of observations Share observations and ideas with others Put things that are similar into groups Transition to the next activity sequence Point out that they now have several groups of motions. They can investigate some of these groups further. Tell them that they will start with straight up and down motions. They will investigate what happens and why. Straight up and down motions have similar paths and directions. There may be other ways that straight up and down motions are similar.	
N7		

Activity No.	Activity ID	Revision Date	Status
7	1.7	3-30-2005	Current

How we are being scientists

Reader Page

None

Inquiry Narrative

None

Notebook page

How we are being scientists

What have you done to learn about motion?

What have you learned about motion?

What have you done that is like what scientists do?

Activity No.	Activity ID	Revision Date	Status
8	2.1	3-27-2005	Current

Review progress and select a motion to investigate

Student Pages

Procedures

Activity Materials

Review making groups as a way of investigating in science

Remind the children that scientists make groups of things that are similar in some ways, just like the class made groups of motions.

Explain that scientists try to find out more by investigating one group. They may find new ways that the things in the group are similar.

Suggest that the class can find out more about motion by investigating one group.

Focus attention on the group including straight up and down motions

Use the overhead of N6 to show the groups of motion examples.

Overhead of N6

Have the children review the group labels.

Select (in advance) the group that would include tossing a ball straight up and then catching it.

Trace around that group with a bright colored marker.

Have the children review the examples included in the straight up and down group.

Introduce the tossed ball example for investigation

Suggest that the class might learn more about motion by investigating an example motion in this group.

If the ball toss is not on the list already, add it. Remind the children that tossing a ball straight up and cathcing it was one of the motions on the video.

You can say:
“One of video motions was a ball tossed straight up and then caught. Since this one went up and down, it might be a good one to investigate further.”

How Do Objects Move?

Activity No.	Activity ID		Revision Date	Status
8	2.1	**Review progress and select a motion to investigate**	3-27-2005	Current

Reader Page

no pages here

Inquiry Narrative

None

Notebook page

INone

Activity No.	Activity ID	Revision Date	Status
9	2.2	4-25-2005	Current

Observe a tossed ball and discuss its speed

Student Pages

Procedures

Activity Materials

Pose the "what happens" question about the tossed ball

Remind the children that they are going to observe an example motion from the straight up and down group, the ball toss.

Tell them that they will observe tossed balls and then prepare a class sketch to answer to the question, "What happens to the ball when it is tossed?" Show them the overhead or chart for the sketch with the question written on it.

Overhead or chart paper with the question, "What happens...?

Observe tennis balls being tossed

Form groups of three or four and provide each group with a ball. Each child should have a turn tossing while the others observe the ball carefully. Encourage the children to discuss in their groups what happens to the ball. They should discuss three characteristics of the motion: 1) path, 2) direction, and 3) speed. Children should trace the path with hand gestures. They could try to match the speed and the path of the ball with their hand. They should also discuss directions of motion on the path, when the ball starts and stops, and also how to describe the speed.

Chart or overhead with the sketching steps

Prepare a class sketch

Call the children back together. Explain that the class will now make a class sketch. Display the steps for making sketches of motion. Remind them that the first step is to sketch the path.

(example sketch for teacher)

Have them show the path with hand gestures. As they agree on parts of the path (During the push, upward after the push, downward, the catch), sketch the path line on the class sketch.

Ask about the direction of the motion. Add line arrows to the sketch showing the directions for the parts of the motion.

Label the start and stop and the location of the end of the push (where the ball is released). If the children suggest labeling the high point "stop" or "stop and start" as well, follow the suggestion.

Ask what happens to the object's speed

Ask the children, "What do you think happens to the ball's speed during the motion?" After the first response, ask if others agree. Also ask if others have a different idea.

If some children seem to agree that it simply went "fast" or "slow," ask if it went the at same speed all along the path or if the speed changed. Did it speed up? Did it slow down?

Activity No.	Activity ID	Activity	Revision Date	Status
9	2.2	**Observe a tossed ball and discuss its speed**	4-25-2005	Current

Reader Page

no pages here

Inquiry Narrative

None

Notebook page

None

Activity No.	Activity ID	Introduce and discuss alternative ways of showing speed	Revision Date	Status
10a	2.3		4-25-2005	Current

Student Pages

Procedures

Activity Materials

Introduce motor sounds and hand signals
To clarify these concepts, have the children make motor sounds (RRRRRR, as a truck or motorcycle) to represent changing speed. Have them increase the pitch for speeding up and decrease the pitch for slowing down. Maintain a constant pitch for a steady speed. Practice making sounds first without changing speeds. Then, give examples of sounds for speeding up, going a constant speed and then slowing down. Contrast speeding up and slowing down with steady speed.

Add (static) hand signals to represent changing speed. Hand with fingers angled upward for speeding up, angled downward for slowing down and level for steady speed. Have the children practice with hand signals for example motions presented as motor sounds. Practice coordinating sounds with hand gestures for single examples (e.g., just speeding up). Then practice with sequences (e.g., Speeding up, constant speed, then slowing down.)

Use hand gestures to discuss what happens to the ball's speed
Refer the children to the sketch of the path. Where along the path do they think the object was speeding up/slowing down/moving with constant speed. Ask what they think was happening to the speed for each part of the path. They can answer with hand signals. They are likely to have differing ideas.

How can these ideas be shown on the motion sketch?
Remind them that they used motor sounds and hand signals to tell what happened to the speed. But these go away after they make them. Ask how might they record their ideas about what happens to the speed of the ball on the class sketch. (So that they can remember and share their ideas with others like scientists do. It is important to use the same way of recording our ideas so that we understand each other.)

Continued on 10b

Activity No.	Activity ID		Revision Date	Status
10a	2.3	**Introduce and discuss alternative ways of showing speed**	4-25-2005	Current

Reader Page

no pages here

Inquiry Narrative

None

Notebook page

None

Activity No.	Activity ID	Introduce and discuss alternative ways of showing speed	Revision Date	Status
10b	2.3		3-30-2005	Current

Student Pages	Procedures	Activity Materials
FJ7 & FJ8	***Continued from 10a*** How can these ideas be shown on the motion sketch? Remind the students (if necessary) that they had different ideas about what happens to the speed. Remind them that they used motor sounds and hand signals to tell what happened to the speed. But these go away after they make them. Ask how might they record their ideas about what happens to the speed of the ball on sketches like the class sketch. (So that they can remember and share their ideas with others like scientists do. It is important to use the same way of recording our ideas so that we understand each other.) Introduce color coding and line width conventions Read Felicia's journal describing different methods for representing speed. Practice using sound and hand gestures to match what is written in Felicia's journal. *NOTE: The correct science ideas are **NOT** represented in Felicia's science journal. This helps establish a problem showing that there are different ideas about what happens to the motion.* Point out to the children that Felicia and James have different ideas about how to show speed **AND** what happens to the speed. Ask what they think of these ways of showing the speed. Discuss these and other ideas the children suggest. Tell the students to use both the color code and the line width. As the class discusses motions it is acceptable to add ideas children suggest for how to represent speed. However, for this unit when making class sketches and encouraging students to use common conventions, continue to use the line width to represent changes in speed. This means: 1) increasing line width for increasing speed 2) constant line width for constant speed 3) decreasing line width for decreasing speed 4) no line when an object is motionless Transition to the next activity Point out that they had different ideas about what happens to the speed during the motion. They will record their ideas about happens to the speed and then check to see if they agree with others.	Class sketch from the previous activity

Activity No.	Activity ID		Revision Date	Status
10b	2.3	**Introduce and discuss alternative ways of showing speed**	3-30-2005	Current

Reader Page

None

Inquiry Narrative

Showing the Speed on a sketch

I have an idea about how to represent the speed using colors. I can show with color hat happens to the speed.

Green stands for speeding up.
Black stands for constant speed.
Red stands for slowing down.

This sketch shows what I think happens to the speed on the going up side of the path:

color coded sketch of tossed ball
(shows green all the way to the stop)

FJ7

James had a different idea of how to show speed. His idea is to change the path line width.
Wide lines would mean faster
Thin lines would be slower.
This sketch represents what James thinks happens to the speed on the going up side of the path.

color coded sketch of tossed ball
(shows a widening line about one third of the way to the hand, then a constant width line with and very short narrowing near the "stop.")

FJ8

Notebook page

Activity No.	Activity ID	Revision Date	Status
11	2.4	4-25-1995	Current

Document ideas about the ball's speed

Student Pages	Procedures	Activity Materials
N8	<u>Review class conventions to represent speed</u> In the previous activity the class agreed on conventions that they can use to represent changes in speed of objects. Make sure that the students are familiar and comfortable using these conventions. You may want to write these as procedures that students should follow. This is an opportunity for shared writing. <u>Recalling the tossed ball</u> Remind the students about Felicia's journal about representing speed. Point out that Felicia only represented the upward path of the ball. Remind the students that they also observed a ball being tossed. They all should have tossed a ball and observed a peer tossing a ball. Point out that there are three distinct parts of the motion: 1) first the ball was tossed 2) next the ball was going up 3) finally the ball came down Ask the children to imagine the ball toss in their minds. When they are imagining the ball toss they should think about what is happening to the speed. <u>Representing ideas about the speed of the tossed ball</u> Tell the children to open page N8 of their science notebooks. Remind them about the procedures for representing speed. Ask the children to describe their ideas about what happens to the speed of the ball on page N8. <u>Transition to the next activity</u> Tell the children that they will use their records of the speed to compare their ideas with their friends. We will see if we agree about what happens to the speed.	Overhead or chart of the class conventions to represent changes in speed.

Activity No.	Activity ID	Revision Date	Status
11	2.4	4-25-1995	Current

Document ideas about the ball's speed

Reader Page

none

Inquiry Narrative

none

Notebook page

Ideas about Speed

Think about the motion of the ball in the ball toss.

What happens to the speed of the ball in this motion? Use the line width to show your ideas.

(put the path line for the sketch here)

How Do Objects Move?

Activity No.	Activity ID	Comparing sketches & discussing new procedures for determining speed	Revision Date	Status
12a	2.5		4-25-2005	Current

Student Pages	Procedures	Activity Materials
N8 & N9	*Preparation for this activity* Before beginning this activity the teacher should review students' work on page N8. The teacher should make groups of students that show the same ideas about what happens to the speed. Record these on a transparency for use later in this activity. *See example* Next jigsaw these groups, make groups of 4 or 5 students' so that each group contains students from each group. This is to prepare for small group work and create a problem that students aren't sure about the speed. Comparing records of motion Arranging the children in the groups of 4 or 5 children identified in the preparation . Read page N9 as a class. Then ask the children to share and compare their records (page N8) with one another. Tell the children to answer questions on N9 in their groups. Reporting on similarities and differences Ask each group to report on the things that they saw as similar and different in their sketches of motion. As children report, highlight the points that students disagreed about what happens to the speed of the ball. Use the prepared group transparency to highlight that there are different ideas in the class about what happens to the speed of the ball. Point out that each group has a different idea and that the class wants to be sure that they agree. *If the children seem to agree as a class. The teacher should introduce alternative descriptions of the speed to challenge the children's ideas. It may help to point out the in the beginning the ball was stopped, then it was moving, then it was stopped. So, it isn't possible for example that the ball was always going a constant speed.* Resolving disagreements The class should have arrived at the conclusion that there is a disagreement about what happens to the speed. Remind the class that there was a video of this same motion. Ask the children if they think they could use that video to help with their disagreement.	Transparency teacher prepared groups of students with the same ideas about changing speed.

How Do Objects Move?

Activity No.	Activity ID		Revision Date	Status
12a	2.5	**Comparing sketches & discussing new procedures for determining speed**	4-25-2005	Current

Reader Page

Inquiry Narrative

Example Teacher Transparency made by grouping student page N8:

Group 1: Johnny, Susan, and Jim
Showed the speed as constant except at the start and stop.

Group 2: Amanda, Sam, Aaron, Lacreesha, and Sally
Showed that the speed decreased on the way up and increased on the way down.
Note to teacher: this is almost correct, there is increasing speed in the tossing and decreasing in the catching.

Group 3: James, Austin, Fred, Kirsten, Mia, Keesha, and Shauna
Showed the ball moving a constant speed the whole path.

ETC...

Notebook page

How Do Objects Move?

Activity No.	Activity ID	Comparing sketches & discussing new procedures for determining speed (Alternate)	Revision Date	Status
12b	2.5		4-25-2005	Current

Student Pages	Procedures	Activity Materials
N8 & N9 (Children's sketches)	*Pass back their sketches and show them the overhead with the representations of their ideas.* (Explain that we weren't quite sure what the others meant and that they can explain their sketches to us individually later.) Have one of the children from the group explain their idea. (?) or do motor sounds for it. (If they want to change their mind, acknowledge that and add their name to the other list.) Have the class interpret the sketch with hand gestures for each part of the path. (If someone says they want to change their mind, acknowledge that and add their name accordingly, but don't do a general discussion of it unless they pursue it. They may argue against the second one (all green) especially. That seems to have been a different interpretation of what the colors meant.) Repeat with the other sketches. Ask if anyone has changed their mind (show of hands). If so, ask how many now agree with each of the sketches. Are there any other ideas about what happened to the speed? If so, have them describe what happened to the speed and, if it seems clear, make up a sketch for it on the blank path sketch(es). Limit this to two new ones(?) Explain that they have different ideas. Remind the class that there was a video of this same motion. Ask the children if they think they could use that video to help with their disagreement. *3) Proceed with Activity 13. (Probably won't be time for it in this lesson. I will come prepared, just in case. We might at least get to look at it and see the slow motion.)*	Transparency of groups of students with the same ideas about changing speed. Transparency with uncoded path sketches

How Do Objects Move?

Activity No.	Activity ID		Revision Date	Status
12b	2.5	Comparing sketches & discussing new procedures for determining speed (Alternate)	4-25-2005	Current

Reader Page

Inquiry Narrative

Example Teacher Transparency made by grouping student page N8:

Group 1: Johnny, Susan, and Jim
Showed the speed as constant except at the start and stop.

Group 2: Amanda, Sam, Aaron, Lacreesha, and Sally
Showed that the speed decreased on the way up and increased on the way down.
Note to teacher: this is almost correct, there is increasing speed in the tossing and decreasing in the catching.

Group 3: James, Austin, Fred, Kirsten, Mia, Keesha, and Shauna
Showed the ball moving a constant speed the whole path.

ETC...

Notebook page

Activity No.	Activity ID	Revision Date	Status
13	2.6	3-30-2005	Current

Investigating the ball's speed using stop action video

Student Pages

Procedures

(Note: A new video can be made by the class and used if time and equipment are available.)

Reviewing the video of motion

Show the video of the tossed ball to the class again. Ask the children to observe carefully to see if they can resolve their differences about changes in speed. It should become clear that they still can't agree.

Ask children for suggestions about how to use this video to understand more about the speed. If they suggest it, watch the video in slow motion.

Using video to make a record of speed

Arrange to show a video of a tossed ball that can be projected using a computer and Real Video. Project the video onto a wall where a large sheet of chart paper is prepared for use.

Explain to the children that you will advance the video frame by frame so that they can see what happens to the speed. Each time you advance the movie, you will record the location of the ball on the chart paper. This will make a record of the location of the ball at even increments of time in its motion.

Using the projected ball toss, follow these steps:
1) draw a circle around the ball
2) advance the video
3) draw a new circle
4) repeat
5) note when the ball is released
6) note when the ball reaches the peak
7) move the image slightly to the right
8) continue for the downward path
9) note when the ball stops

Transition to the next activity

Explain to the students that using this new record of the motion of the ball they can make a new class sketch including the class conventions for speed.

Activity Materials

Stop action video and projector

Chart paper

Activity No.	Activity ID	Revision Date	Status
13	2.6	3-30-2005	Current

Investigating the ball's speed using stop action video

Reader Page

Inquiry Narrative

Notebook page

Activity No.	Activity ID	Revision Date	Status
14	2.7	4-25-2005	Current

Interpreting the records of the ball's positions

Student Pages	Procedures	Activity Materials
	Discuss the record from stop action video Ask the children about things that they notice about this record of the motion. Be sure that the children notice that the space between the ball circles changes. Ask them what they think it means when the spaces or distance between the circles changes. Point out that the space between the balls increase during the push, decrease during the upward path, increase during the downward path. The class should agree that increasing space between the circles means speeding up and when the circles get closer together, that the ball slows down.	Chart paper with record of ball toss
N10	Students interpret the video results Have the children interpret the results on N10.	
	Draw a new class sketch Make a new class sketch on the overhead. (Include only the upward part of the path initially. The children will be asked to do the downward part later more independently.) 1) Sketch a path line 2) Identify starts and stops and the release 3) Reproduce the circles representation from the video on the sketch. 4) Add the speed using conventions *During the above steps, discuss with students their observations and interpretations. Ask them to make sound and hand gestures for the path and changing speed. Have them suggest what color and line width to use for the parts of the path.*	Overhead for class sketch with speed conventions
N11	Students revise their interpretations of the video results If necessary, the children can revise their interpretations using N11.	

Activity No.	Activity ID	Revision Date	Status
14	2.7	4-25-2005	Current

Interpreting the records of the ball's positions

Reader Page

Inquiry Narrative

Notebook page

Activity No.	Activity ID	Explaining the changes in speed: Initial Ideas	Revision Date	Status
15	2.8		4-15-2005	Current

Student Pages	Procedures	Activity Materials
N12	Introduce the "Why?" Question Show the Overhead transparency of N12. Remind the childsren that they have been answering the "What happened?" quesstion. Now they will work on the "Why?" question. When looking at page N12, the teacher should highlight for students that there are 2 places shown that the ball is changing speed: before the release and on the way up afer the release. The "Why?" question can be asled for both. There is also the part of the path where the class was unsure about what was happening to the speed. They can just ignore that part for now. Students explain why the ball changes speed Using student page N12, have the students give their ideas about why the ball changes speed on the way up. (They will be asked about the downward path later.) (This is an opportunity to find out about the children's ideas. An ideal answer is that there is a push up when the ball is tossed making it speed up. Then gravity pulls down, slowing the ball's speed until it stops going up.) Sharing ideas and explanations When students have written their responses, have them share with a person sitting near them. You might ask to show thumbs up if the agreed and thumbs down if they disagreed. Transition to the next activity The whole class will discuss their ideas in the next activity as the idea of force is developed from the idea of the push that speeds the ball up.	transparency of N12 (Explaining the upward motion)

Activity No.	Activity ID	Revision Date	Status
15	2.8	4-15-2005	Current

Explaining the changes in speed: Initial Ideas

Reader Page

Inquiry Narrative

Notebook page

N10

The record below shows the ball speeding up, slowing down and speeding up again.

Why does the speed change the way that it does?

Activity No.	Activity ID	Revision Date	Status
16a	2.9	4-25-2005	Current

Using 'force' and 'gravity' to explain the patterns

Student Pages	Procedures	Activity Materials
N12 Completed copies	<u>Explaining the speeding up using force arrows</u> Show the transparency of the page N12 (With conventions documenting the changes in speed. Pose the big question, Why did the speed change? Direct the children's attention to the first part of the path and the first change, the speeding up during the push. Why did the ball speed up? The children are likely to say, it sped up because of the push, or because the girl pushed it. As everyone agrees, introduce the idea that a push is a 'force.' Also, forces can be shown with block arrows. Draw an upward block arrow and label it "girl's push," (Or introduce the overhead transparency with the block arrows.) <u>Explaining the slowing down</u> Next focus on the upper part of the upward path where the ball slows down. Why does the ball slow down? The children will probably offer ideas including that the push stopped or that it ran out of push or force. Agree that the push has stopped, but ask if they can think of any other reason why the the ball might slow down instead of just keeping going up. Some of the children may suggest "gravity." This is hinted at by the faint block arrow on the overhead. Trace over the faint arrow and label the arrow "gravity." Gravity is a force resulting from the earth pulling down on every object near it. Have the children try to give the explanation. The force of gravity pulling on the ball slows it down as it moves upward. Finally gravity causes the ball to stop going up. (Try to avoid talking about the downward part of the motion as they will work on that later as an embedded assessment.) <u>What about the "unsure" part of the path?</u> Raise the question of what happens to the speed in the "unsure" part of the path. Gravity is acting on the ball all the time (even during the push). Does that give us an idea of what would happen to the speed right after the push ends? Hopefully some of the children will start arguing that the ball starts slowing down as soon as the push ends.	Transparency of N12 (The "Why?" questions for the upward path) Transparency with the block arrows for the upward motion Transparency with gravity modeled Transparency with the slowing down replacing the "unsure"

Activity No.	Activity ID		Revision Date	Status
16a	2.9	**Using ‘force’ and ‘gravity’ to explain the patterns**	4-25-2005	Current

Reader Page

What Happens to the Speed of the Tossed Ball?

(Upward Path)

Inquiry Narrative

Notebook page

Activity No.	Activity ID	Revising Ideas About the Upward Path	Revision Date	Status
16b	2.9		4-25-2005	Current

Student Pages	Procedures	Activity Materials
N12b	Use the overhead of N12b to review what has been agreed upon about what happens to the speed. The ball speeds up during the push. It slows down and stops going up after the push. They were unsure about what happens right after the release point. Now we have talked about gravity and how gravity acts all the time. They may have revised their ideas. They can record their revised ideas on N12b. Provide cut out block arrows for the children to use in showing the forces. When they have figured out their revised ideas, they can trace the arrows to show the forces. Encourage the chilren to use the block arrow cut outs to figure out their ideas, to show the forces on their page and to write their ideas for each question. This work serves as an embedded assessment of where the children are in their thinking.	Tansparency of N12b

Activity No.	Activity ID	Revising Ideas About the Upward Path	Revision Date	Status
16b	2.9		4-25-2005	Current

Reader Page

Inquiry Narrative

Notebook page

Activity No.	Activity ID	Revision Date	Status
17	2.10	4-18-2004	Current

The Scientist's Story About the Upward Path

Student Pages	Procedures	Activity Materials
R8	Reading about the Scientists' Ideas Show R8 as the "scientists' story" about what happens to the ball on the way up, and why that happens. Remind the children about the two big questions; the "what happens?" question and the "Why?" question. Have the children help read the first paragrah. The push part of the path Point to the push part of the path. Have the children show the hand sign for what is happening to the speed here. (They should show the hand up sign.) Ask what forces are acting during the push. (They should notice the two arrows, one for the push and one for gravity, and report those two forces.) Use a bowling ball or heavy gym ball as a demonstration. Gravity is really pulling with a large force just holding the ball. It would take a very big force to toss it. Then hold a tennis ball. Is gravity pulling on it when you are just holding it? (Yes, but it is much a smaller force of gravity than on the heavier ball.) Have the children help read the text in the bottom box (1) about why the ball speeds up. Right after the push Have the children help read the text in the middle box (2) about what happens right after the release and why. Point out the red arrow that shows the speed slowing down right after the release point. Have the children use hand gestures to show what they think happens to the speed right after the release point. (Some may still hold out for constant speed. Leave it that.) Continuing along the upward path Have the children use hand gestures to show what happens to the speed during the rest of the upward path. Have the children help read the text in the top box (3) .	Transparency of R8 Bowling ball or heavy gym ball Tennis ball

Activity No.	Activity ID	Revision Date	Status
17	2.10	4-18-2004	Current

The Scientist's Story About the Upward Path

Reader Page

Inquiry Narrative

Notebook page

Activity No.	Activity ID	Describing and Explaining the Downward Motion	Revision Date	Status
18	2.11		4-18-2005	Current

Student Pages	Procedures	Activity Materials
N13 For describing and explaining the downward part of the balls path	<u>Describing and explaining the changes in motion on the downward part of the ball's motion</u> Now is the time to raise the question what happened to the speed of the ball on the way down? Why did the ball move the way it did? This will serve as an embedded assessment of the children's ideas. Provide page N13 which shows the downward path and the positions from the stop frame video. The children are to try to describe what happened to the speed of the motion using the conventions. They should then try to explain why the speed changed the way it did. Encourage them to try to use block arrows in their answers. They can also use words. Provide cut out block arrows for the children to use in thinking about the forces. When they have made up their minds about their ideas using the cut outs, they can draw in or trace the arrows for their sketches.	Transparency with the block arrows for the upward motion

Activity No.	Activity ID	Describing and Explaining the Downward Motion	Revision Date	Status
18	2.11		4-18-2005	Current

Reader Page

What Happens to the Speed of the Tossed Ball?

(Upward Path)

Inquiry Narrative

Notebook page

Activity No.	Activity ID	Revision Date	Status
19	2.12	4-18-2005	Current

The scientists' story about the downward path and the whole motion

Student Pages

Procedures

Activity Materials

Inroduce the questions scientists ask and answer
Distribute and show the transparency of R9. Point out the downward direction arrow and the positions of the ball from the stop action video. Point out the "contact point" where the girl first touched the ball.

Remind the children of the two big questions scientists often ask, "What happens?" and "Why?" (Point to the underlined parts of the questions on the overhead.)

The "what happens?" question and answer
Have the children help read the "What happens?" question and the scientists' answer. (The ball speeds up until the girl contacts the ball. Then it slows down and stops.)

Have the children describe how this is shown in the diagram. (The green color and the arrow getting wider show that the ball is speeding up. The red arrow and the arrow getting narrower show that the ball is slowing down and stopping.)

The "Why?" question and answer
Havwe the children read the "Why?" question and the scientists' answer. (The force of gravity pulls down on the ball and makes it speed up. The girl's pushing force makes the ball slow down and stop.)

Have the children describe how this is shown in the diagram. (The Block arrow for gravity is by the speeding up part of the path. The arrow for the girl's push is by the slowing down part of the path.)

Ask why there is also a gravity force arrow by the slowing down part of the path. (To remind us that gravity is still acting on the ball.)

Gravity is always pulling on the ball. The girl's pushing force is bigger.

The whole story
Show the transparency of R10. This shows the whole path. The children can take turns telling the story of the tossed ball. They can tell it to other people and tell them how they are asking and answering questions like scientists.

Activity No.	Activity ID		Revision Date	Status
19	2.12	**The scientists' story about the downward path and the whole motion**	4-18-2005	Current

Reader Page

Inquiry Narrative

Notebook page