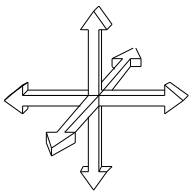
1 - Getting Started



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A Teacher's Guide to Developing Virtual Environments: VRRV Project Support

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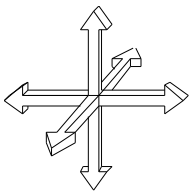


1 - Getting Started

INTRODUCTION

1.1 Welcome to the world of virtual environment design

Your virtual environment design project promises to be challenging, time consuming, and hopefully, ultimately rewarding. This Teacher's Guide provides one way that you can undertake this project. It is neither definitive nor complete, but is intended as a practical resource from which you can draw and expand, based on your own needs.

Your other resource is your Project Contact. In the space below, please fill in the name, phone number, and e-mail address of your Project Contact. We are all on voice-mail, and should be able to get back to your in short order should you have questions or concerns.

PROJECT CONTACT: _____

E-MAIL/PHONE:_____

1.1.1 Reviewing the Four-Step Process

Planning and developing a virtual environment is a four step process: Planning, Building, Programming and Experiencing. These four steps are predicated on the assumption that your students are already learning how to model objects in 3-D using the software provided by the VRRV team. This modeling knowledge will help you and your students when your great idea needs to move from conception to reality. I cannot stress this point enough--- turn the modeling software over to your students, and let them have at it. They may well be able to teach all of us a thing or two when this is over. To reiterate:

GIVE YOUR STUDENTS ACCESS TO THE MODELING SOFTWARE NOW!!!

And in terms of getting yourself ready, we have several suggestions:

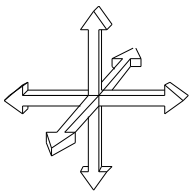
∑.....Practice using the modeling software as much as you can.

∑. .Give yourself plenty of planning time to adequately address all of the issues discussed in this guide.

∑Make sure that everyone in your near vicinity knows what you are up to, and what it is going to take to be successful. This can include peers, administrative individuals, school boards, partners and your own children. This is an exciting undertaking and is one to be widely shared.

∑.....Give yourself a break if things don't go exactly according to plan.

1 - Getting Started



∑.....Enjoy yourself and your students during this creative process!

1.1.2 Setting Project Goals

Another worthwhile activity is to set some project goals-- things that you would like to see come out of this virtual environment creation process. These goals can be as amorphous as "I want my students to be exposed to this new technology so that they build an awareness about the future", to setting specific outcomes having to do with anything from revamping the districts' perspective on the use of technology in the classroom, to expectations about changes in your own teaching style, or changes in the way that your students perceive and utilize information to create knowledge. Only you will know what these goals will be, but we encourage you to set them, and to evaluate whether those goals were met at the end of the process.

SUMMARY

In this chapter we covered:

∑.....Reviewing the Four-Step Process

∑.....Setting Project Goals

In the next chapter, **PROJECT MANAGEMENT ISSUES**, we will cover:

∑.....Developing a Project Management Plan and associated Timeline for your project

∑.....When, why and how to schedule meetings with your Project Contact

INTRODUCTION

Effective project management will form the cornerstone of a successful virtual environment design experience. You as the teacher are in much closer proximity to both your administration and to your students than we are, and the bulk of day-to-day project management will fall under your jurisdiction.

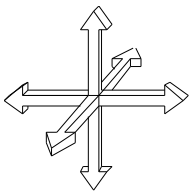
That being said, our job is to give you an effective set of tools that can be used to facilitate project activities. These tools include guidelines on what we have experienced during 'successful' projects in the past, 'Master' documents that can be copied and used during the process, and a great deal of encouragement and support.

In this chapter, PROJECT MANAGEMENT ISSUES, we will cover:

∑.....Developing a Project Management Plan and associated Timeline for your project

∑.....When, why and how to schedule meetings with your Project Contact

2.1 Developing a Project Management Plan & Timeline



1 - Getting Started

Developing a Project Management Plan and Timeline that is realistic and will serve as an adequate guide for the project is an important component to assuring the success of your project. This is a living, breathing, dynamic document that will expand and change over the duration of the project. Remember, it embodies a set of *guidelines*, NOT hard and fast *rules*.

2.1.1 Project Management Plan

The Project Management document will encompass, over time, all of the following:

∑.....Curriculum Plan

∑.....Assessment Plan

∑.....Process Plan

∑.....World Plan

It may also include additional plans, such as a Press Plan or Publication Plan, for further presentation of your students' work, such as at Parent-Teacher nights, at educational conferences, or in educational journals.

2.1.2 Project Timeline

During the Project Management Seminar, we talked about developing a timeline for your project. Most of you have an understanding of just how much time you can devote to this project. It varies from environment to environment, especially since schools have such diverse class schedules, internal structures, and a wide variety of resources from which to draw.

If you can, start with the maximum time that you might be able to allot, and work backwards from there. Some of the activities that need to be included in the Timeline are:

∑.....Training for students in 3-D Modeling software

∑.....Classtime for teaching and absorbing content

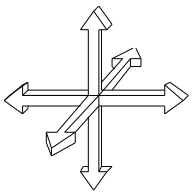
∑.....Classtime for each step in the world-building process, including assessment

∑.....Planning and execution time for you as the teacher and project lead

There are certain 'minimums' that we have discovered in working with students on projects of this nature. They are listed in Table 1, Timeline Minimums, below.

TABLE 1, TIMELINE MINIMUMS

PROJECT ACTIVITY	PERFORMED BY:	TIMELINE MINIMUM	FUDGE FACTOR	DESIRED OUTCOME
3-D Modeling Training	Teachers Students	6 hours 6 hours	± 4 hours ± 4 hours	Proficiency Proficiency
Planning - Process Planning - World	Teachers Students & Teachers	4 hours 6 hours	± 2 hours ± 4 hours	Overall Guide World Plan
Constructing	Students	4 hours	± 2 hours	Workable objects & environments
Programming	Students	3 hours	± 2 hours	Completed Behavior

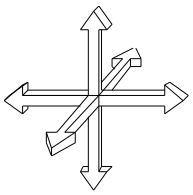


	HITL Staff	2 days	3 days	Matrix Completed World
Experiencing	Teachers Students	TBD	TBD	Solid understanding of the created environment

NOTE: An example of one version of a timeline is contained in Chapter 3, section 3.3.1, pages 11-12.

2.2 You and your Project Contact

It will also be important to develop a schedule of meeting times with your Project Contact. That way, both you and your Project Contact will know what is expected of each party for the duration of the project.



2.2.1 Meetings

During the course of the project, you and your Project Contact should schedule at least 4 progress meetings. These are in addition to the time spent in the classroom with students. These meetings are intended as an opportunity to check project progress, develop a better understanding of the needs and desires of each party, and to generally keep the air clear between you, your school, and the HIT Lab. We have found from previous experience that GOOD COMMUNICATION IS CRITICAL to the success of your venture.

2.2.2 Progress Meeting 1 - Planning the Project

The first of these meetings will be held just after you and your students have gone through the **Subject/Concept Selection** activity in Step 1 - Planning, but before actual **World Planning** begins. The dates for this Planning Meeting were selected at the Project Management Seminar. At the Planning Meeting, you will need to be prepared to discuss these aspects of your Project Management Plan:

∑ Curriculum Plan, including:
- Selected subject/concept area
- Educational goal and sub-goal statements

∑ Assessment Plan
- Content assessment tool information

∑ Process Plan, including:
- Project Timeline
- Logistical Description
- Student Teams/Student Schedules
- Responsibility Matrix for all involved staff
- Contingency Plan (what to do when everything imaginable goes wrong)

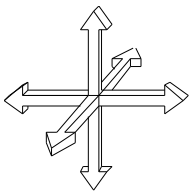
The goal for this meeting is to come to an understanding of what the curriculum will entail, what the educational goals and sub-goals are, and to select (if not already selected) an appropriate environment topic. It is also an opportunity to discuss and refine the research agenda associated with the project.

All of this planning is predicated on what the hardware that we are using for this project can and cannot do, especially given the changing nature of the technology. Currently, the VRRV team is using the Division platform. Division is a company out of Bristol, England. They have been in the virtual reality business for over 5 years. They make the computer that we will use in the classroom to represent the virtual world. They also wrote the software that we will use to make the world function as the students have specified.

Your Project Contact understands what the Division system can and cannot do, and can guide you to select an environment that makes maximum use of the presentation resource at your disposal, and will provide educational value above and beyond an attempt to convey information using any other format, such as a paper report, hypercard stack, or other presentation form. You can expect to discuss technological limitations, presentation issues, and logistical issues with your Project Contact. Please be prepared to be flexible!!

2.2.3 Additional Progress Meetings

Plan on establishing a schedule with your Project Contact that will detail their involvement in the project. This will include scheduling the other 3 progress meetings, (2 during the interim, and 1 wrap-up) and all other classroom-based interaction.



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You should also plan on discussing the amount of classroom time that you would like to have from your Project Contact, and what that classroom time will entail. The goal is to develop a plan of action that works for both of you.

We also understand that there are those of you who are running this project outside of the classroom, for example, perhaps after school. The time you will need to devote will still be the same-- it will just be taken under different circumstances. With regard to getting your students to 'commit' to certain activities, and to putting in the necessary time, we have found that under most circumstances students are more than willing to put in the time to create an environment. However, extenuating circumstances sometimes do get in the way, like soccer practice. Only you can make the call on what kind of commitment you can reasonably expect out of your students. Talk to your Project Contact if you have concerns.

Regardless of the mode (classroom or otherwise) that you choose to use for running this project, do maintain good contact with your Project Contact through these progress meetings.

SUMMARY

In Chapter 2, **PROJECT MANAGEMENT ISSUES** we covered:

∑.....Developing a Project Management Plan and associated Timeline for your project

∑.....When, why and how to schedule meetings with your Project Point-Person

In the next chapter, **STEP ONE: PLANNING**, we will cover:

∑ Developing various components of the Project Management Plan, including the:
- Curriculum Plan
- Assessment Plan
- Process Plan, including a timeline for your project
- World Plan

∑.....How to manage the process effectively

INTRODUCTION

Planning occurs at three levels; you yourself must plan the virtual environment development process just as you would plan any curriculum module. There is then a mutually agreed-upon plan that you develop in conjunction with your Project Contact. Lastly, there is level at which the planning activity includes your students in a very important manner, so that they too have a benchmark against which to measure their progress.

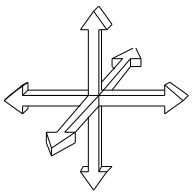
In this chapter we will cover the how-to's and associated documentation for developing your:

∑.....Curriculum Plan

∑.....Assessment Plan

∑.....Process Plan

∑.....World Plan



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3.1 Developing your Curriculum Plan

In developing your Curriculum Plan, consider the subject areas that will provide your students with an opportunity to maximize the use of the virtual environment as a presentation tool. There is no point in selecting subjects and environments that can best be represented in another way.

Remember from our discussion during the Project Management Seminar what we perceive to be the value of virtual reality-- it allows the student to 'move beyond' the real world in some fashion-- either by representing an environment that the student couldn't normally experience, or by clarifying some abstract concept by creating a visual representation that can then be shared with others.

In the back of this guide, you will find a copy of all of the forms you need to complete this virtual environment development project. The first form, ***Subject/Concept Assessment***, is the one that you will use in the next section. Please make a copy of it to use in your activity

ACTIVITY 1: Describe and evaluate potential subject/concept areas
Performed by: Teacher (and perhaps students)

Form Used: Subject/Concept Assessment

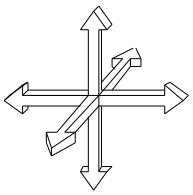
The first step is to select a subject area that fits within the constraints described above. You may find that you have more than one subject area that you would like to explore. Keep in mind that you will need to take the time to brainstorm each idea with your students, if you choose to include them in this process. Our suggestion: limit yourself to one or two subject areas, then explore more than one aspect of the subject area in a more in-depth fashion.

Fill in the first column, **General Subject Area**, on the form with the subject areas under consideration. Continue to further describe the concept that you would like to focus on in the next column, **Subject/ Concept Description**. Continue your evaluation of the subject/concept area by filling in the next column, **Concept/Presentation Advantages and Obstacles** with your perspective of the educational value and/or any obstacles that you might be able to identify regarding the subject/concept. Think about how the subject/concept will be visually represented. Try and come up with challenges that you might face, or advantages that might make the subject/concept particularly viable. The last column, **Technological Constraints** is the area in which you detail potential problems that might occur when attempting to build your virtual environment, such as 'too many polygons', or 'too many texture maps needed', etc.

An example of an exploration of subject/concept domains is illustrated below:

SUBJECT/CONCEPT ASSESSMENT

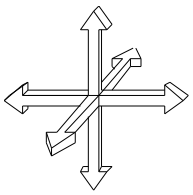
GENERAL SUBJECT AREA	SUBJECT/CONCEPT DESCRIPTION	CONCEPT/ PRESENTATION ADVANTAGES AND OBSTACLES	TECHNOLOGICAL CONSTRAINTS
Botany	Tree Structures and Life Processes	- Basic and pervasive plant that contributes most profoundly to the earth's ecosystem - Will build an understanding	- May be difficult to represent some of the movement associated with abstract concept representation



		of the life processes of plants - Can 'zoom' in on specific structures, such as leaves	- Must make simple leaves to keep the polygon count low

From your list of subject/concepts, you and your Project Contact should be able to select the environment that best fits within your curricular scheme, and provides an opportunity to make best use of the technology as a presentation tool.

After you have made your selection, use the subject/concept area to develop your Learning Goals, described in Activity 2, next.



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ACTIVITY 2: Identify Learning Goals

Performed by: Teacher

Form Used: Learning Goals

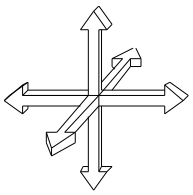
The second step is to identify the specific learning goals associated with the subject/concept you have selected. This is analogous to the activity that we undertook during the Project Management Seminar. The **Learning Goal** is a broad statement, generally headed by the phrase 'The student shall understand _____". The **Sub-Goal** statements are then performance-based activities that will illustrate whether the larger learning goal has been met. Sub-goal statements generally start with the statement "The student shall show that they know _____ by _____".

Using the tree example that we completed at the Project Management Seminar, Learning Goal and Sub-Goal statements might be:

LEARNING GOALS:

LEARNING GOAL 1: The student shall understand the basic structures and life processes of a tree.	**SUB-GOAL:** The student shall show that they know tree structures by naming each component part, and by building a virtual tree from the roots up while in the virtual environment.
	SUB-GOAL: The student shall show that they understand the *absorption* process by describing and tracing the path of nutrients and water from the root structure, through the bark layers and into the branch and leaf structure of the tree created above.
	SUB-GOAL: The student shall show that they understand *photosynthesis* by using metaphorical referents in the virtual world (such as energy from the sun) and physical tree components to describe and illustrate the process by which energy from the sun is incorporated into the tree structure.

After you have determined the Learning Goal(s), the next step is to select appropriate content knowledge assessment tools. This is performed in Activity 3, next.



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3.2 Developing your Assessment Plan

ACTIVITY 3: Developing an Assessment Plan
Performed by: Teacher
Form Used: Content-Based Assessment Tool Selection

When selecting appropriate assessment tools, consider for a moment what it is that you are trying to assess. It is content information, yes, but the virtual world is a performance-based environment. There is nothing passive about the type of activity that transpires there. We encourage you to consider performance-based assessment techniques, such as those described in the paper you received at the Project Management Seminar, Assessing Learning in VR: Towards Developing a Paradigm (Rose, 1995).

Of course, paper-and-pencil tests are also acceptable measures of content knowledge. It would be best, however, to have a variety of assessment tools that will helpfully corroborate your findings across the board.

When using the Content-Based Assessment Tool Selection form, fill it out in the following fashion:

CONTENT-BASED ASSESSMENT TOOL SELECTION:

ASSESSMENT TOOL NAME	ASSESSMENT TOOL DESCRIPTION	EXISTS/ CREATE?	VALUE DESCRIPTION
Assessment of Basic Tree Structures and Life Processes Knowledge.	Performance based assessment while in the virtual environment. Have student describe basic structures (root, trunk, branch, leaf) as they 'build' the tree from components in the virtual environment. Secondary performance tracing the path of both water and nutrients from the roots up to the leaves, and sugars created during photosynthesis from the leaves to the roots.	Will be **created** as part of the virtual environ-ment.	Doing/describing is a very accurate way to see whether the student understands the concepts at hand.

3.3 Developing your Process Plan

ACTIVITY 4: Developing a Process Plan
Performed by: Teacher
Forms Used: Responsibility Matrix

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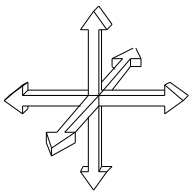


The Process Plan contains most of the day-to-day project management documents that you will use. Some of the items, such as the Timeline and the Responsibility Matrix will need to be agreed upon between you and your Project Contact. Other documents are there for you and your staffs' information only.

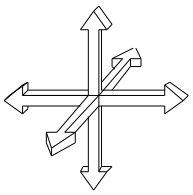
3.3.1 Project Timeline

The Project Timeline has already been discussed briefly in Chapter 2 - Project Management Issues. Your goal in developing a timeline is to give you and your students enough time to get through all of the virtual environment development activities, and still deliver a quality product at the end for all to experience.

It is best to calculate in a 'fudge factor', so that if you do get behind there is still time to recover. We tend to recommend about a 40-60% allowance, simply because different schools have different children, and the scenarios that we have experienced thus far have varied extensively in terms of the time needed to actually design and build a virtual environment. A 60% allowance, for example would allow plus or minus 6 hours for every 10 hours of scheduled time. This padding is there 'just in case'.

The place where additional time always seem to be needed is in the Building phase. Students always want to work and rework their objects. In the case of your project, they will also be doing some of the programming; a new activity that had been previously handled by HITL staff. We don't know what kind of actual time it will take to accomplish this task. The estimates provided in the Project Management Seminar and in Chapter 2 *should* be adequate, however.

Our suggestion is to get a big piece of butcher paper, and to detail out each activity from start date through completion. Note who exactly is *responsible* for that activity, and the *start date*, *end date*, and *drop dead date* associated with each activity. Also on the timeline, describe any *deliverables* that need to come out of the process. For example, one way to develop a project timeline is illustrated on the next page:



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PROJECT TIMELINE (in hours):

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15. . .

ACTIVITY: 3-D MODELING TRAINING
RESPONSIBILITY: TEACHER AND STUDENTS
START DATE: 3/1/95
END DATE: 3/14/95
DROP DEAD DATE: 3/16/95
DELIVERABLE: FULLY TRAINED STUDENTS

ACTIVITY: CURRICULUM PLANNING
RESPONSIBILITY: TEACHER
START DATE: 3/1/95
END DATE: 3/7/95
DROP DEAD DATE: 3/10/95
DELIVERABLE: CURRICULUM PLAN

ACTIVITY: PROCESS PLANNING
RESPONSIBILITY: TEACHER
START DATE: 3/7/95
END DATE: 3/14/95
DROP DEAD DATE: 3/16/95
DELIVERABLE: PROCESS PLAN

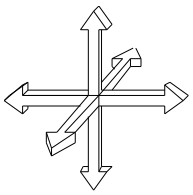
ACTIVITY: WORLD PLANNING
RESPONSIBILITY: TEACHER AND STUDENTS
START DATE: 3/14/95
END DATE: 3/21/95
DROP DEAD DATE: 3/24/95
DELIVERABLE: WORLD PLAN

ACTIVITY: ASSESSMENT PLANNING
RESPONSIBILITY: TEACHER
START DATE: 3/1/95
END DATE: 3/7/95
DROP DEAD DATE: 3/10/95
DELIVERABLE: ASSESSMENT PLAN

3.3.2 Logistics Description

The Logistics Description details what computers are available, where they are located, current versions of software that are running on them, scheduling and availability of other teaching aids, such as an overhead projector and liquid crystal display, or a full-scale projection system that can be connected to a computer for showing students on-screen activities.

It also involves scheduling rooms, making sure that space will be available when you need it. There is nothing worse than arriving in an environment where everything is constrained time-wise, only to discover that a class is being held in the only space that you can use. This makes absolutely no one happy, so it is best to plan these kinds of 'oh-oh's' right out of existence.



3.3.3 Student Teams/Student Schedules/Roles and Responsibilities

As a complement to the Logistics Plan, the Student Teams document details who will be working with whom, and how the teams are arranged in terms of scheduling, instructional variations, precedence variations, and the like.

First and foremost, it is a list of student groups. From there, the document can become infinitely more complex as the research agenda may dictate that certain students receive a particular type or quantity of instruction, or in a particular order. Again, this will be dictated by the research agenda. There are many other salient bits of information that might be contained in a document of this nature. It will all depend on what you and your Project Contact have worked out.

It is also appropriate to mention here that it is possible that not all of your students will take part in all aspects of the world building activity. In previous projects, we have assigned roles within teams. Some of the roles that we have assigned are listed below:

∑ **Project Facilitator** - Is in charge of making sure that their group project comes together in the time that we have available. More than one individual per team can be a facilitator, as long as they work together.

∑...**Group Cybrarian** - Is in charge of taking notes (and keeping them so that they can be turned in later as part of the world documentation) drafting a description of the world (which is also a part of the documentation process) and collecting all drawings (or other models) made during the course of the project.

∑. **Art Director** - Is in charge of helping other students create their objects in the modeling program, and to use the Behavior Matrix during the Programming phase of the project. They essentially act as technology mentors for other students.

∑...**Behavior Designer** - Is in charge of thinking about special behaviors that will be a part of the virtual environment. This individual or individuals will also be in charge of filling in the paper version of the Behavior Matrix during the Planning phase of the project.

∑. .**Base Modeler** - Is in charge of developing the base world, and building the combined world at the end of the project, just prior to when the information is handed off to HIT Lab staff. These individuals are critical to the success of the project, because the combined world is the key component that we need to effectively render the environment back at the Lab.

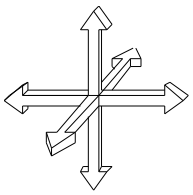
There are other roles and responsibilities that could be assigned to your students; project historian, project model builder or storyboard creator, etc. It all depends on how many students you have, what kind of access they will have to the technology, what you want them to do, and what you want them to get out of the process.

The bottom line is that we will need to have an understanding of whom you have assigned to what role, and to what group. This should be available to us fairly soon after the start of the project.

3.3.4 Responsibility Matrix

The Responsibility Matrix describes all of the individuals (or groups, such as students) and their responsibilities for the duration of the project. This becomes your master deliverables list. It is also a great way to keep track of who is responsible for what, and is a cross-reference to your Project Timeline. An example of the Responsibility Matrix is illustrated below.

RESPONSIBILITY MATRIX



INDIVIDUAL/ROLE: ---------- RESPONSIBILITIES	HITL PROJECT MANAGER	PRIMARY TEACHER	STUDENTS
MANAGE OVERALL PROJECT	X		
TEACH STUDENTS 3-D MODELING		X	X
DEVELOP CURRICULUM PLAN		X	
DEVELOP CONTENT BASED ASSESSMENT PLAN		X	
DEVELOP RESEARCH AGENDA	X	X	
AND SO ON...			

3.3.5 Contingency Plan

The Contingency Plan details what you will do in the event that everything that could go wrong, does. In fact the plan should address even the picky little things that could go wrong, and what you would do to rectify the situation. The good news is that most of you contingency plan on a regular basis, and you probably have already thought about these kinds of issues.

However, the one thing for which you cannot control is equipment failure. Unfortunately, neither can we. We have an arrangement for repair and replacement with our hardware manufacturer, but it is not an instantaneous event. We will endeavor to provide you with the best in service and delivery, but again, we ask you to be flexible should the need arise.

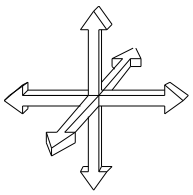
This completes the document set for the Process Plan. The next set of activities have to do with developing your World Plan. This is where the fun begins, because we are building the basis for the actual environment, instead of the how-to's and where-for's for its development and construction.

3.4 Developing your World Plan

The World Plan is the activity that you undertake with your students, wholeheartedly and without reservation. World Plan development is a dynamic process, and will extend beyond this first step, through Step 2: Building, and into Step 3: Programming.

The World Plan is the primary documentation about the virtual environment that you and your students choose to create. It will describe the environment as a whole (similar to developing a stage setting for a play), each individual object within that environment, who will be making it, how they will fit together, and the behaviors in the environment, both object-to-object, and participant-to-object.

1 - Getting Started



There are many activities associated with developing a World Plan. These include, but are not limited to: brainstorming, developing thumbnail sketches, clay or other sculptural models, and storyboards. We like to encourage our students to get as deep an understanding about the environment as possible before we break them into their individual groups to create their individual objects. We find that having a picture of the environment as a whole, and understanding its' educational purpose enhances the experience portion of the project substantially.

The first activity associated with creating a World Plan is to brainstorm ideas with your students. This is described in Activity 5, next.

ACTIVITY 5	*Brainstorming on Selected Subject/Concept*
Performed by:	*Teacher/Student/Project Contact*
Forms/Mat'ls Used:	Object Matrix Scratch paper for sketching

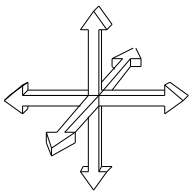
In the first part of this planning process, you, or you and your students selected a certain subject/concept on which you wanted to concentrate. In this activity, you and your students will expand upon the selected subject/concept by brainstorming about the kind of objects that might be included in the selected environment, how the environment itself may look and feel, and how the students perceive that the educational goals can be met through developing a presentation in this perceptual medium.

Give yourself at least half an hour to discuss the functionality of the environment, its educational purpose, and the contents of the environment. Allow at least an hour for the students to begin generating suggestions on how to create the environment that will satisfy the intended functionality. Use a blackboard, whiteboard, or overhead to keep track of the students' suggestions. AT THIS STAGE, DISCOUNT NOTHING!!! There will be plenty of time to begin selecting specific objects and representational metaphors a little later.

A BIG HINT: What we have found is that with guidance, they students themselves will begin to select the 'best' objects that need to go into the final environment. They will also begin to see how objects can be prioritized, based on the 'fit' of the object in the environment.

We encourage you to open the discussion as widely as possible, to focus on the environment as a whole, and to discuss part-to-whole relationships with your students. Also allow them the time and opportunity to sketch their ideas in their groups. Let them talk with each other about visual representations, metaphorical concept representation, and stage setting.

After they have a rich offering of visual representations, and an idea of how to use those representations in the virtual environment, bring all of the students back together to select the final object 'list', prioritize the objects on it, and to assign responsibility for each objects' creation. To do this, go back to your original list that you generated on the board or overhead and look at each object closely. Ask the students to describe why that particular object should be included or discarded; why it would have value in the virtual environment. Again, focus on the part-to-whole relationships. As you either assign students to a particular object, or they self-select an object or objects, make note on the Object Matrix form. Using the Tree example again, a sample Object Matrix form has been included on the next page.



1 - Getting Started

OBJECT MATRIX

INDIVIDUAL: ---------- OBJECT:	OBJECT RATING (H, M, L)	JOHN	MEGAN	JOSE'	JANICIA	BRUCE
TREE ROOT	H					X
TREE TRUNK	H			X		
TREE BRANCH 1	H					
TREE BRANCH 2	H					
TREE BRANCH 3	M	X				
10 LEAVES	H		X			
10 LEAVES	H					X
10 LEAVES	M			X		
SUN'S ENERGY	M	X				
WATER/NUTRIENTS	H		X			
SUN	H					
RAIN	L				X	

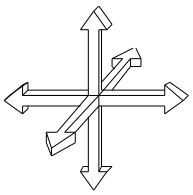
When all of the objects have been assigned to (or selected by) different students, you will want to consider the behaviors associated with those objects. In our estimation, it is never to soon to consider the environment as a whole, and how the participant and the environment will interact with one and other.

'Behaviors' are events that can be assigned to an object in an individual fashion (i.e. are inherent to the object, and are not 'caused' by the participant or another object), and those to which a clear cause-and- effect relationship can be established.

Table 2, on the next page, is a list of behavioral characteristics that can be assigned to an object, or to an object-interaction.

TABLE 2, BEHAVIORAL CHARACTERISTICS

INHERENT CHARACTERISTICS	CHANGE-IN-STATE CHARACTERISTICS
BASICS: POSITION, ORIENTATION, ORIGINAL COLOR, SCALE	CHANGE IN BASICS: POSITION, ORIENTATION, COLOR/APPEARANCE, SCALE CHANGE IN BACKGROUND COLOR
VISIBILITY	CHANGE IN VISIBILITY (VISIBLE//NOT VISIBLE)
COLLIDABILITY	CHANGE IN COLLIDABILITY



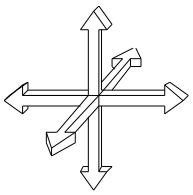
(COLLIDABLE/NOT COLLIDABLE)	(COLLIDABLE/NOT COLLIDABLE)
ORIGINAL SOUND STATE	CHANGE IN SOUND STATE
ORIGINAL MOVEMENT STATES (SPINNING/NOT SPINNING, PATHED/STATIONARY)	CHANGE IN MOVEMENT STATE: SPIN, MOVE BETWEEN OBJECTS
ORIGINAL PARTICIPANT PERSPECTIVE	CHANGE IN PARTICIPANT PERSPECTIVE (RIDE/UNRIDE)

Using these behaviors, you and your students can begin to develop the Behavior Matrix guide, which will be used as a programming aid when working in the actual Behavior Matrix Supercard stack during the Programming phase of the project.

Please note that just because you CAN have an interaction doesn't mean that you should. Interactions should add value to the experience, and should be used judiciously. On paper, by all means detail out each object and its' potential interactions for evaluation purposes. However, you will only have a ten object by ten object matrix in the Supercard stack, so you will need to select your most meaningful interactions for inclusion in the stack.

LIMITATIONS: You may only select 3 textures for your environment, so again, please be judicious. A list of the currently available textures will be provided to you by your Project Contact. Alternatively, you can provide your own textures as well, but talk to your Project Contact about format, size, etc.

An example of the Behavior Matrix guide is illustrated on the next page.

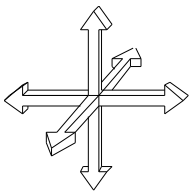


1 - Getting Started

BEHAVIOR MATRIX

PRIMARY OBJECT: **----------** **SECONDARY OBJECT:**	**Tree Root**	**Tree Trunk**	**Tree Branch 1**	**Tree Branch 2**	**Tree Branch 3**	**Leaves**
Tree Root		ATTACH & ALIGN ASSIGN SOUND 'PING'	ASSIGN SOUND 'BONG'	ASSIGN SOUND 'BONG'	ASSIGN SOUND 'BONG'	ASSIGN SOUND 'BONG'
Tree Trunk	ATTACH & ALIGN ASSIGN SOUND 'PING'					
Tree Branch 1		ATTACH & ALIGN ASSIGN SOUND 'PING'		ASSIGN SOUND 'BONG'	ASSIGN SOUND 'BONG'	ATTACH & ALIGN ASSIGN SOUND 'PING'
Tree Branch 2		ATTACH & ALIGN ASSIGN SOUND 'PING'	ASSIGN SOUND 'BONG'		ASSIGN SOUND 'BONG'	ATTACH & ALIGN ASSIGN SOUND 'PING'
Tree Branch 3		ATTACH & ALIGN ASSIGN SOUND 'PING'	ASSIGN SOUND 'BONG'	ASSIGN SOUND 'BONG'		ATTACH & ALIGN ASSIGN SOUND 'PING'
Leaves			ATTACH & ALIGN ASSIGN SOUND 'PING'	ATTACH & ALIGN ASSIGN SOUND 'PING'	ATTACH & ALIGN ASSIGN SOUND 'PING'	
User	'FLASH' AT TOUCH	'FLASH' AT TOUCH	'FLASH' AT TOUCH	'FLASH' AT TOUCH	'FLASH' AT TOUCH	'FLASH' AT TOUCH

As can be seen from this last example, the user or participant and his or her actions also need to be taken into account. Though the Behavior Matrix above does not represent all of the components of the Tree due to space constraints, we feel you could expand it accordingly. For example, during the absorption process that will be described, a behavioral interaction might be that when the tree has been 'fed' certain nutrients, it will bear fruit, eventually resulting in the appearance (a visibility toggle between visible/not visible of the fruit) of the fruit on the tree.



3.4.1 Additions to the World Plan

As you move further along the development path, other items will get added to your World Plan, such as the students' sketches, 3-D model examples from Step 2: Building, code snippets from Step 3: Programming, a full-blown world description detailing the functionality of the world, and perhaps even video clips of students in action. Please do not feel limited to include only those items referenced here-- it is your environment, so document it as you wish!!

3.5 Managing the Process

The key feature to managing this project is to have a clear understanding of your goals, know your limitations (such as time constraints), and try to achieve a balance between the two. If you get behind, know what it is that you can cut. If you are ahead of schedule, know what it is that you would like to explore in a more in-depth fashion.

SUMMARY

In Chapter 3, **STEP ONE: PLANNING** we covered:

Σ Developing various components of the Project Management Plan, including the:
- Curriculum Plan
- Assessment Plan
- Process Plan, including a timeline for your project
- World Plan

Σ.....How to manage the process effectively

In the next chapter, **STEP TWO: BUILDING**, we will cover:

Σ Object construction
- Simple object construction
- Complex object construction
  * Deconstructing objects into component parts

Σ.....Creating a base world

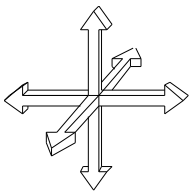
Σ Stage-setting for composition and functionality
- Pathed or free-form functionality analysis

INTRODUCTION

The Building component of creating a virtual environment is where the 'rubber hits the road', so to speak. As we discussed in the Project Management Seminar, you can imagine almost anything, but whether you can build it or not determines its real value.

In this chapter we will cover:

Σ Object construction
- Simple object construction
- Complex object construction



- Deconstructing objects into component parts
- How to 'set-up' objects for later recombination in virtual space

Σ.....Creating a base world

Σ Stage-setting for composition and functionality
- Pathed or free-form functionality analysis

4.1 Object Construction

In assisting your students to construct their objects, we cannot understate the value of drawing objects first using paper-and-pencil. The first activity in the Building process is to have your students consider their individual objects from three perspectives; top, side, and cross section views. This type of analysis is *helpful* for simple objects. However, it is *critical* for complex, multi-component objects.

The other point that we cannot emphasize enough is that the Tutorial that is described in your 3-D Modeling Manual is actually pretty complete. It will give both you and your students an idea of how Macromodel perceives 3-D modeling, and will give you a number of examples that can be used again when creating your 'real' objects. The examples provided on the diskette entitled 'Macromodel Examples' is also a good source of model construction information, especially for those of you that worked your way through the examples during the Macromodel training session.

In the next sections, we will discuss both simple and complex object types, and how to best assist your students in creating them. As in the case of forms used in Chapter 3, all forms for these activities will also be found in Appendix A - Forms, in the back of the manual.

4.1.1 Simple Objects and Complex Objects

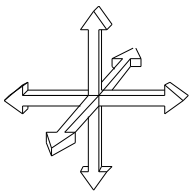
Simple objects are those objects that can be created in one piece, either through the extrusion or the lathe function. This is not to say that the resulting object may have a simple appearance, however. Macromodel allows the designer a great deal of latitude and power to create visually complex objects by using the control points to deform simple shapes. Let's start with how to assist your students in designing and constructing truly simple objects.

ACTIVITY 6: Designing and drawing simple objects
Performed by: Students (plus Teacher's assistance)
Form Used: Simple Object Design Guide (multiple copies)

Designing simple objects in three dimensions can be easy and fun. It can also be quite frustrating until you get a good handle on how the software package works. By using the Simple Object Design Guide, your students will begin to visualize objects from more than one perspective, and be able to 'recombine' them both in their mind, and in the modeling package.

This activity (and the next) are essentially an opportunity to practice building objects from scratch. Our suggestion is to work with your students through Activity 6 and 7 together, then turn them loose on designing and building their own objects.

To get started, make sure your students have enough copies of the form for both this activity and the next (multiple copies, copied both front and back is most efficient, because they may well draw a lot of objects before they come up with a design with which they are happy) and still have one to three forms for their own object designs (which is described in Activity 8).



Use props to illustrate how a simple object can be viewed from the top, side and cross-section perspectives. Use items such as a book, pencil, pop can, Ping-Pong ball, and a pyramid if you can find one. There is a wonderful selection of basic shapes at Learning World, and at the Educational Aids store at Northgate. You probably have your own sources, but many of these simple objects are found in the 'real world' too. Come up with as many as you can, and allow the students practice time to create these objects on their forms.

When you feel that your students understand the concept of multiple perspectives relatively well, start the next activity, which will increase the need for active visualization and the complexity level substantially.

ACTIVITY 7: Designing and drawing complex objects
Performed by: Students (plus Teacher's assistance)

Form Used: Simple Object Design Guide (multiple copies)
Scratch paper for drawing complex wholes

The good news is that designing complex objects is just deconstructing objects into their simpler subcomponents, creating each of those simple subcomponents, then bringing them together as a cohesive whole.

Make sure your students have enough copies of the form. Answer any residual questions from the previous activity, then dive right into how to 'deconstruct' an object into its' component parts.

We again suggest that you use props to illustrate how a complex object can be viewed from the top, side and cross-section perspectives, and what each component part looks like from each of those angles. Use items such as a coffee cup, telephone, or wristwatch. Some of the objects included in Ari's Macromodel Examples diskette might also be good, especially since these models have already been created for the student's viewing (and construction) pleasure.

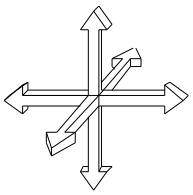
Ask for examples from the students, too. you may be surprised at how their world view will change based on this activity--this is one of the most powerful aspects of virtual world design that we have encountered. By seeing objects in both the real and the virtual environment in their mind's eye, and on paper, students begin to realize that part-to-whole relationship and its relevance to modeling, and on a grander scale as well. Be cognizant of how students begin to speak during this activity--they will begin to use language in a different way that is a reflection of their 'new' perspective on life.

When you feel that your students understand the concept of multiple objects and multiple perspectives relatively well, start Activity 8, where they will begin to design their own objects on paper.

ACTIVITY 8: Designing and drawing students' objects
Performed by: Students (plus Teacher's assistance)

Form Used: Simple Object Design Guide (multiple copies)
Scratch paper for drawing complex wholes

The students will have by now gotten a great deal of practice thinking about both simple and complex objects. Let them now design their individual objects on paper. These designs will then be used as a template for their creation time on the computer.



The reason behind doing things this way is that most of the schools with which we are working have limited computer resources. When students DO have computer time, it would be a good idea to let them maximize their time on this limited resource. Therefore, good design is an important component to making the most of your resources.

Make sure that each student can describe to you the component parts of the object, and other characteristics as well, such as color, articulation, constrained and free motion, and the relationship of the object to the environment as a whole. Do not let them model on the computer until you are satisfied that they understand these concepts!

4.1.2 Object Construction Hints

Helpful hints about object construction vary with regard to the software package that is used to create those objects. In the case of Macromodel, encourage your students to practice making simple objects first, then combining those simple objects. Another area that will be confusing to students is use of the working plane; as the working plane is moved from one quadrant to another, it is easy to get confused about positive and negative coordinate systems, sometimes in all 3 planes. You might consider using a rudimentary tool to illustrate the X, Y, and Z planes (tinker toys work). Using this representation in conjunction with a piece of screen really can help students 'lock in' the quadrant in which they are working. This will help them visualize their creations a little more easily.

Obviously, encouraging your students to do extensive drawing of actual objects is one way to get those creative juices flowing. Another is to reference the importance of different perspectives completely out of context of the environment creation process; perhaps from the social sciences, or from the hard sciences.

For the most part, object creation just takes time and effort. Try and encourage your students to really think about what they are trying to create, to assist them in effectively using the time available to them.

4.1.3 Deconstructing/Reconstructing Complex Objects

When making a complex object that you want to have complex behavior (such as a bird flapping its wings), at minimum the body of the bird and each wing will need to be created separately. This is because you will need to be able to assign 'behaviors' to each wing independent of the body, and to the body as well.

Make sure to make this point with your students as they make their objects.

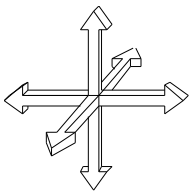
4.2 Creating a Base World

The base world is the environment upon which all other objects will be 'based', or perhaps even attached. This might be anything from a space station to a wetland meadow, or any imaginable form in between. If a base world is desired, it becomes the central reference point from which all other objects are oriented, and from which all activities transpire.

You and your students will need to talk about what the base world will provide, and who will be making it. Scale is not a problem-- all objects can be scaled within the virtual environment to 'fit' together in a form that is workable. However, just for your information, the standard scale that we use is 1" = 1'. What this means is that the base world may need to be quite large.

The base world model will also be the environment into which all of the other student objects will be transferred. We suggest that the base world center point be located at (0.00, 0.00, 0.00), and that it be created so that it is locked in place, and is not collidable. This will help when in comes time to put the rest of the environment together.

The bottom line: if you want a base world, some of your students should be in charge of creating it. Otherwise it might not get done.



4.3 Composition and Functionality

The composition of the world plays a major role in the aesthetic and functional appeal of the environment. When designing a learning environment it is best to take the learning goals established in Step One into account.

Think about the following with your students-- there are many ways to present, and to access information. In the form of a report, the writer is presenting a sequentially organized information set. It may or may not be organized in a manner that would allow an individual to turn to a chapter at random and still make sense of it. And, due to its form, this presentation technique is primarily passive in terms of reader-writer interaction.

In the case of a pictorial presentation, the creator may be presenting information with a particular focal point, or specific area or areas of interest. The creator has the opportunity to make use of 'image' which is directly translated by the brain into information, rather than 'text' (which requires symbol translation from text into meaning in the brain), but the pictorial presentation is again primarily passive.

When an individual designs a learning environment in which the viewer is an active participant, the creator can no longer afford to work strictly in terms of the 'climax' of the story, or the focal point of the pictorial representation. Instead, the entire environment is designed around the learning goals one hopes will become inherent to the environment.

4.3.1 Scenes

One way to design the environment as a whole is to consider different 'scenes', similar to the scenes used in a play. These activities might tie to a particular region of the environment, or they may play out in what might be considered a common or multipurpose portion of the environment.

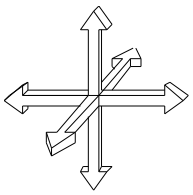
Consider setting the scene from both the perspective of the participant, and from a holistic view. Because you have limited control over what the participant will actually do, you must consider how to keep the participant engaged in the environment, even if they follow a different route than what you have anticipated.

In addition to setting the scene, you and your students must decide whether the experiences to be had the environment follow the script sequentially, or whether there is some flexibility in how a participant might experience the environment. For example, you might consider a 'pathed' experience, where activities build upon one and other, step by step. You might have an environment where the participant can move and interact with the information contained therein in an entirely random fashion. These kinds of decisions are up to you and your students to make, based on what it is that you want to accomplish in the world.

4.3.2 Environmental Complexity, External Guides, and Environment Type

We have found that the type of composition and functionality that must be presented in the environment is dependent upon another factor as well; environment complexity. The more complex the environment, the more likely it is that you will need to have an external guide available, to assist participants through the environment. Unfortunately, the technology that we are using currently precludes us from having an 'internal' guide in the virtual environment. This too shall also pass, but it is currently not an available option.

If you need to have an external guide, it is best to have a 'pathed' environment that can be easily negotiated by both the participant and the guide. The more random the activity set, the harder it is for the guide to be exceedingly useful as the participant bounces from one activity to another.



4.3.3 Environment Size

Also consider the size of the environment. Because of the nature of the technology as it stands today, we have a difficult time controlling such things as 'flying speed' when an object is in a participants' hand. Therefore, it is a more pleasant experience if the world itself is large enough so that all forms of movement can be accommodated (even turbo-fly).

Environment size is dictated by object scale. A good rule of thumb is 1" = 1'. These measurements can be clearly seen in Macromodel when creating objects. This is not to say that individual objects cannot be sized while creating the final world--they can. But if everyone is building objects based on the same scale, it is going to make life a whole lot easier in the long run.

4.3.4 Functionality

If you have a set of activities that require a number of component parts, it is best to have those component parts relatively close to one and other in the environment. This eases navigational burden on the participant, and also allows you as the programmer kind of a visual check on the items required for the learning that you are attempting to facilitate. Of course, there are always those environments that are *intended* to be difficult, such as a treasure hunt world, or a puzzle world, or even some of the adventure games (where tools in the environment are intended to be misleading, or to be used at another point in the adventure) but for the most part, we perceive that it is best to put things a) where participants can find them, and b) where net resultant 'behaviors' can also be viewed effectively.

For example, in Tree World, the participant might need to build the tree from component parts, then figure out what the tree needs to live and grow. If we as designers have ascertained that water is one of those components, the water should be made available in the area in which it will need to be used, i.e. next to the tree. Furthermore, the water should be placed in a manner so that when the participant 'feeds' the tree the water, he or she can see the effect that the water had on the tree. This means that the participant needs to be viewing the tree from a point far enough away from it to see if there is an improvement in the relative health of the tree, based on what she or he has done to the tree. This kind of feedback is very important for students; otherwise it is sometimes difficult to get the point!

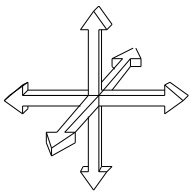
4.4 Creating the Total Environment

One of the deliverables that the HIT Lab will require is a 3-D model of the completed environment. This means that some of your students will need to 'combine' all of the objects into the world as a whole. This will give us an idea of what you desire as a final product, and is also a useful communication tool in and of itself, since it will be available permanently on-site at your school.

As we discussed in Section 4.2, Creating a Base World, the easiest way to get the entire environment in one place is to start with the base world if you have one, and add in each individual's objects one at a time. Composing the space will be difficult; no doubt about it. Expect to get frustrated. This may be one of the times that you will want to have your Project Contact available to assist you.

The easiest way to get everything in position is to keep rotating the view of the environment Keep in mind that you will be trying to place objects in 3 planes. What may look correctly placed when viewed from the front may be incorrect when viewed from the top. This is the type of spatial reasoning that we were trying to enhance in teaching students how to consider objects from the side, top and cross section view. Encourage your students who are taking part in creating this total environment to use the same kind of reasoning, but on a much grander scale.

HINT: SAVE YOUR TOTAL ENVIRONMENT AFTER EACH OBJECT HAS BEEN PROPERLY PLACED! THIS WILL SAVE YOU MUCH GRIEF IF THE SOFTWARE DECIDES TO FREEZE, OR SOME OTHER DISASTER STRIKES WHILE YOU ARE CREATING THE TOTAL ENVIRONMENT!



1 - Getting Started

Once you have the combined world, the next step will be to save each object individually, in .DXF format. What we are trying to get is a copy of each object in position and orientation, so that the final creation will go much more smoothly than if the composition needed to be created from scratch. Directions on how to go about completing this task are included in Chapter 5, Step Three: Programming.

SUMMARY

In this chapter, Chapter 4, **STEP TWO: BUILDING** we covered:

∑ Object construction
- Simple object construction
- Complex object construction
  - Deconstructing objects into component parts
  - How to 'set-up' objects for later recombination in virtual space

∑.....Creating a base world

∑ Stage-setting for composition and functionality

∑ Creating the total environment

In the next chapter, **STEP THREE: PROGRAMMING**, we will cover:

∑.....How to use the Behavior Matrix software

∑.....The deliverables that the HIT Lab needs from you and your students to create the final world

INTRODUCTION

As we discussed in the last chapter, the Building component of creating a virtual environment is where the 'rubber hits the road', so to speak. To continue the metaphor, the Programming component is what determines whether the road you are on will actually take you to your destination. It is here that all of the objects that have been created are melded into a cohesive whole that the virtual environment computer can then represent.

In this chapter we will cover:

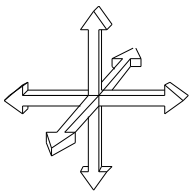
∑.....How to use the Behavior Matrix software

∑.....The deliverables that the HIT Lab needs from you and your students to create the final world

5.1 Using the Behavior Matrix Software

In the Chapter 3, we discussed assigning behaviors to objects and interactions in the virtual environment. These behaviors were described in the Behavior Matrix form you filled out during the Planning phase, as an illustration of the behaviors that your students have selected. This document will be used as the input document while using the Behavior Matrix software.

The Behavior Matrix program is designed to allow students to select and specify on-screen certain cause and effect relationships between the participant and an object, and between objects. The software will actually come with its' own



manual, so we suggest that you turn to this document for specific information on how to use the application. However, a general description of the program's capabilities is included below.

5.1.1 Object List

The first screen that appears in the Behavior Matrix is the Object List. On this screen, you will provide the name of the world to be created, and all of the geometry (.DXF) file names that are required for interaction specification.

NOTE: ONLY INCLUDE THOSE GEOMETRY FILES THAT REFERENCE OBJECTS THAT HAVE AN INTERACTION ASSOCIATED WITH THEM! GEOMETRY FILES THAT ARE 'JUST FOR SHOW' (PART OF THE AESTHETIC OF THE ENVIRONMENT BUT ***DO NOT INTERACT WITH EITHER THE PARTICIPANT OR WITH OTHER OBJECTS IN THE ENVIRONMENT***) SHOULD NOT BE INCLUDED!

In addition to the geometry (.DXF) file names, the user will need to provide a 5-character 'nickname' for the object specified in the geometry file, and will have the option of changing the objects' initial visibility, collidability, sound state, position, orientation, scale, and whether the object's movement is constrained in any of the 3 planes; x, y, and/or z. These changes can be made by clicking on the 'Object Specs' box associated with that object.

When the user is finished describing each object that has an interaction attached to it, they may proceed to the second screen; the Interaction Matrix by clicking on the box 'Go To Matrix'.

5.1.2 Interaction Matrix

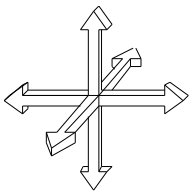
The second screen that appears in the program is the Interaction Matrix. On this screen, all of the nicknames that were specified in the Object List will appear both along the top of the screen (from last to first), and down the left-hand side of the screen (from first to last). This ordering pattern allows the user to specify COLLIDE functions (pink interaction zones) and UNCOLLIDE functions (blue interaction zones) for each object pair.

There are three other participant-based actions that are listed on the left-hand side of the screen; TOUCH, GRAB and DROP. These participant-based behaviors can take place with regard to any of the objects listed across the top of the screen, and are conveniently placed at the top of the list of objects on the left-hand side. Their interaction zones are yellow.

To select interaction options, the user would double-click on an interaction zone between the two objects in question. A third Behavior Specification screen will appear that will allow the user to choose the behaviors associated with that particular interaction. After the behaviors have been described for each interaction required, the user would click on the 'Done' button to quit the program and return to the MacIntosh environment.

NOTE: The user should consider what behaviors need to be associated with each interaction state; in this case COLLIDE and UNCOLLIDE (plus TOUCH, GRAB, and DROP). For example, if I have a tree root that I have placed in the ground, and I want to attach a tree trunk to the tree root, there may well be certain behaviors associated with 1) when I GRAB the tree trunk (perhaps I will hear a sound), 2) the COLLISION of the tree trunk with the tree root (perhaps another sound, and the trunk and root will become 'brighter' in color), 3) the UNCOLLIDE of the root and trunk (the separate parts become visually 'duller'), and 4) when I DROP the tree trunk (if it is still COLLIDING with the root, the trunk and root might 'snap' into the appropriate position, and if the root and trunk are no longer COLLIDING, the trunk might return to the original position from which I originally GRABBED it). In this example, behaviors would be assigned in four different interaction zones: GRAB-TRUNK (yellow zone), ROOT-TRUNK (COLLIDE (pink) zone), ROOT-TRUNK (UNCOLLIDE (blue) zone), and DROP-TRUNK (yellow zone).

As you can see, assigning behaviors can in fact be tricky business. Sometimes scripting different scenes is also of assistance, as described in Chapter 4, section 4.3.1 - Scenes. This script can then serve as a checklist against the behaviors that have been assigned in each instance.



To return to the first screen, the Object List, the user can click on a button entitled 'Go To List'. To quit the program, the user can click on the button entitled 'Done' on this screen.

5.1.3 Behavior Specification

On this third screen, the user is reminded of the interaction that is being scripted by looking at the upper right-hand portion of the screen; for example, 'nitro with cloud'.

In this screen, the user can select from the Effect Type list, to change parameters such as visibility, sound, changing the background color of the world (the void), changing an objects position, orientation, scale or color, moving an object (making it spin, or 'fly to' another object or location), or to move the participant (ride or unride an object, or fly to an object or location).

Also available on this screen is the capability to write the file (i.e. save it) and to print it. The user can review the printed version to make certain that all of the behaviors associated with a particular interaction have been specified. It will also give the user a chance to see what the 'guts' of the software program that will be used to render their world really looks like.

From this screen, the user can return to the Object List by clicking on the button "Go To List'. To return to the Interaction Matrix, the user can click on a button entitled 'Go To Matrix'. To quit the program, the user must return to the Interaction Matrix and click on the button entitled 'Done'.

5.1.4 The Final Behavior Matrix Product

At the end of all of this on-screen Behavior specification, the resulting file should actually work with the geometry files to perform the behaviors the students have selected in the virtual environment. The file itself is called a .MAZ file, and is specific to the Division system. The .MAZ file is one of the deliverables that the HIT Lab will need to create your world in its entirety. Please see the section on Deliverables, next.

5.2 Deliverables for the HIT Lab

5.2.1 Object Files

As mentioned in Chapter 4, all of the students' objects will need to be placed in a 'combined' environment, in position, and at the proper scale. From this combined world, each object (and object element, for complex objects) will need to be saved individually. This step is a pain in the proverbial backside, but is a necessary one for creating the final product. To save each object individually, follow the steps below:

1.....First, MAKE A BACKUP COPY OF THE WORLD JUST IN CASE.!!!

2.....Bring up the Total World.

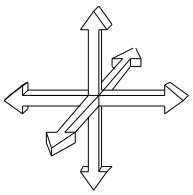
3.....Highlight the object (or the element of the complex object that will have an interaction associated with it).

4.....Select the Copy function from the EDIT Menu.

5.....From the FILE Menu, select New.

6.....When the New file opens, select Paste from the EDIT Menu.

7.....Under the FILE Menu, choose the Export option.



8.....From the Export option, choose the .DXF file format.

9.....Name the file, with the extension .DXF. For example, TREETRNK.DXF.

10.....Close the .DXF file.

11.....The Total World should still be available for the next object that needs to copied and saved.

12.....Repeat for each object in the environment by going back through Steps 2 - 12.

We will need each individual .DXF file to re-create the Total environment as your students have specified it, so this process should be undertaken with care.

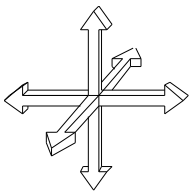
HINT: Document EVERYTHING, SO THAT YOU CAN RE-TRACE YOUR STEPS IF NEED BE.

The best 'Master Lists' are the Object Matrix and the Behavior Matrix created in Chapter 3 during the Planning phase. By using these two matrices, you can tell which objects need to be individually saved, and you can also tell if there are complex objects that have behaviors associated with them that will need to be saved at the element level.

REPEAT: The only objects that will need to be saved at the element level are those that have behaviors associated with SEPARATE ASPECTS of them; for example, if I bring food to a bird, I might want him to fly away. Each of his wings need to operate independently, so the bird would need to be stored in 3 separate files, for example: WING1.DXF, WING2.DXF, AND BIRDBODY.DXF. If you have no objects that have this level of complexity associated with them, even complex objects can be saved in one .DXF file.

5.2.2 Total World Description

We will also need a physical description of the world that references the Object Matrix, and the Behavior Matrix. What we are looking for is any information that we can use to create the world back at the Lab. This will include a line that describes each object or object element if there is a behavior associated with it, the objects position and scale, its' .DXF file name, and a list of the objects with which it interacts. By using a document of this nature, we should be able to construct the environment fairly completely. And example of the form used to provide this information is illustrated on the next page.



FINAL OBJECT/INTERACTION MASTER

NAME & DESCRIPTION	POSITION	SCALE	FILENAME	INTERACTS WITH:
FREE NITROGEN	X: 0.0 Y: 90.0 Z: 0.0 Pitch: .354 Roll: .000 Yaw: .765	1" = 1'	FREENIT.DXF	PARTICIPANT PICK: CLOUD.DXF RAIN.DXF FIXEDNIT.DXF

5.2.3 Object and Behavior Matrices

Please also forward copies of the paper versions of the Object and Behavior Matrices. We will need these master documents to ensure that everything has been fully documented.

5.2.4 Functionality Script

Include a full-blown description of the desired functionality in the environment. This will include learning goals, and how those learning goals are to be met. Set the scene, and describe how each learning scenario is to unfold. This is needed because even though the students will have completed some, if not most of the programming using the Behavior Matrix Supercard stack, there may still be additional functionality that will need to be included.

This script will also assist you and your students in developing the role of an external guide, should you choose to have one.

5.2.5 Behavior Matrix Program Results

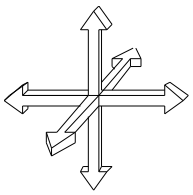
The .MAZ file that is generated by the Behavior Matrix Supercard stack is as important as the object files. We will take this .MAZ file and make any adjustments needed, based on the above documentation. It is the .MAZ file that the computer uses to render the environment in its' entirety, and contains references to all of the object geometry contained in the .DXF files, as well as all of the behaviors as described on the Behavior Matrix and programmed into the Supercard stack.

5.2.6 Any Additional Documentation. . .

Please include any additional documentation that you feel will help facilitate the process of creating the program files associated with you and your students' virtual environment. You and your Project Contact should have been in pretty close touch, so we should all have an understanding of what the environment is supposed to be like.

Depending on the complexity of the environment, the assembly process could take one to several days. This final process will also be dependent upon the schedule you have chosen and how many other schools are also attempting to get their worlds programmed at the same time. You and your Project Contact will be able to develop a clear understanding about when the environment will be available for experiencing based on these two parameters; complexity and scheduling constraints.

5.2 Deliverables FROM the HIT Lab



If you give us all of the information above, what you will get back is a fully functional environment. We look forward to providing this environment, and hope that you and your students will be pleased with the results.

SUMMARY

In Chapter 5, **STEP THREE: PROGRAMMING** we covered:

∑.....How to use the Behavior Matrix software

∑.....The deliverables that the HIT Lab needs from you and your students to create the final world

∑.....The deliverable FROM the Hit Lab, i.e. the final world, ready to be experienced

In the next chapter, **STEP FOUR: EXPERIENCING**, we will cover:

∑.....Selecting a good Experiencing environment

∑.....Assessment issues

INTRODUCTION

Congratulations! You have finally reached the stage that all of us have been waiting for--- the point at which you and your students get to experience your collaborative creation.

In this chapter we will cover:

∑.....Selecting a good Experiencing environment

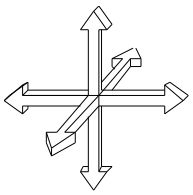
∑.....Assessment issues

6.1 Selecting the environment

The environment in which you choose to have your students go through the Experiencing portion of this project can take many forms. Most of your decisions will be based on the process you have selected for this portion-- is there post-testing involved? interviews? survey information to be collected? Are the students allowed to view each other going through their environment or are there constraints placed on the amount of interpersonal interaction that will take place? Go over how you want the process to unfold based on these kinds of questions, then select an appropriate environment. In addition, consider how many tables and chairs might be needed, or where an interview space might be appropriately located.

Another issue is whether you want to capture the students' experience in some way, for example, on video tape, or with a camera. Lighting becomes a concern in this case. This might also be an issue if the press has been invited to view students in their environment. Trying to film against glass during daylight hours is difficult at best; try and select an environment where this can be avoided.

Another example might be a scenario where the students will be experiencing their environment in a public forum, where many students (and other individuals) might be watching their experience. Perhaps the post-testing or other data collection process might be less stringent. In this case, the environment selected for the Experiencing portion would be considerable different.



Another point that needs to be considered has to do with power-- the Division system needs a power source of at least 10 amps. This usually means finding an environment with a dedicated circuit. For every school in the virtual environment world building process, we have been in your school before so there is at least one space that can accommodate the needs of the Division system. Hopefully, it will also accommodate any additional needs that might be defined for this portion of the project.

6.2 Assessment Issues

There are many forms of post-assessment that might take place. At minimum, there is the content-based post-test designed by you. In addition, there may be an opportunity to collect substantial information in addition to the content-based measures. Most of these post-measures will have already been discussed between you and your Project Contact.

For example, if you have chosen a form of performance-based assessment in the virtual environment, the entire sequence will either need to be videotaped, or will need to be 'tracked' by someone familiar enough with the subject matter and the procedure to keep accurate track of a students' progress through the virtual environment.

Post assessment on spatial intelligence and general ability may also be administered as part of the VRRV data collection process. All of this will unfold based on what you and your Project Contact have agreed to, so play it by ear.

There may also be an opportunity to use a hypercard stack to track student perceptions of the project, or other survey techniques. The bottom line-- we perceive that this is an incredibly rich opportunity to find out how students learn, and about their level of motivation. Our other stance is that it is always better to collect more information than you ever possibly can conceive of needing. That way, you are not left 'holding the bag' at a later date.

If you have questions, talk about them with your Project Contact. He or she should be able to help get things sorted out.

SUMMARY

In Chapter 6, **STEP FOUR: EXPERIENCING** we covered:

∑.....Selecting a good Experiencing environment

∑.....Assessment issues

In the next chapter, **EVALUATION**, we will cover:

∑.....How to evaluate your VRRV Project

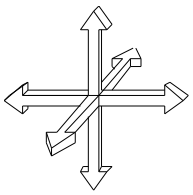
INTRODUCTION

Any project of this magnitude should be evaluated at its' completion, simply so that you know whether your expectations were met, whether you would undertake such a project again, what could have been done to improve the process, and so on.

In this chapter we will cover one option on how you might evaluate the project at its completion.

7.1 Evaluating your VRRV Project

Pull out the goals that you defined for the project during the Planning phase. Take a good look at what you had expected. Compare it to what you actually experienced, and note any differences.



1 - Getting Started

We as a team are very interested in your opinions regarding the project. Our goal is to make this process as complete and as enjoyable as possible, for all parties. We need to know what went well, and what did not. We need to know where and when you needed additional information or assistance. And we, like all other humans, are perfectly willing to accept a pat on the back if one is deserved.

The last form in the Appendix is designed to allow you to describe your experience with us at each stage of the process. We would also appreciate student input regarding their experience. Please open up this opportunity for critical review to them as well. And example of the form, and some of the types of comments that might be made is included below.

PROJECT EVALUATION SHEET

PROJECT PHASE	WHAT WENT WELL:	WHAT COULD BE IMPROVED:
3-D MODELING TRAINING	Students were engaged immediately and worked hard on their own	Not enough time to fully absorb the capabilities of the software
PLANNING	The process really made sense after I had taken the time to consider all aspects of the project	Too much documentation!!
BUILDING	Students were very creative in their designs	Snapping and aligning objects was VERY difficult.

This type of form can be expanded or contracted based on how much information you would like to provide to us. Obviously, more is better. But we also understand that you have one or two other things that might take your attention away from such an activity. Please provide us with as much as you can.

7.2 In Appreciation...

We would like to thank you in advance for undertaking this project. We realize that it will be extremely valuable, but will also be extremely time and effort intensive. It takes a special teacher to try something this new and novel, even if the concepts imbued in the technology are as old as the hills. Hopefully, we will all be able to see information assimilation and presentation in a new light, based on what the project teaches us.

With this goal in mind, ENJOY!!

The VRRV Team